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I. Introductory Materials

I.A. Preface

In light of the ongoing development of Reston, Reston Association’s Environmental Advisory Committee saw a need to assess the current environmental conditions of our community to establish a baseline against which future changes can be measured. This first Reston Annual State of the Environment Report (RASER) is the result. It has been designed as a living document that will evolve as Reston’s environment changes and as its residents pose questions about our environment.

Assessing the environmental health of a landscape as diverse as Reston’s is a complex task. RASER reflects research by a volunteer nine-member working group of scientists and citizen scientists who have endeavored to represent both data and current scientific consensus on environmental issues. The working group spent many months and hundreds of hours searching for and reviewing fact sheets, newsletters, brochures, plans, policies, white papers, formal reports, archived and live databases, and spreadsheets. Data available from RA were supplemented with data academic institutions, not-for-profit organizations, and county, state, regional, and federal agencies.

Reston is a special place, in part because fostering its natural beauty was part of its founder’s vision. Today, as Reston accommodates ever higher population densities, it strives to maintain elements of its natural areas, water features, woodlands, and open spaces that give its residents a sense of well-being, benefit the economy, and provide a host of critically important ecological services. These services include cleansing the air and water, recycling nutrients, detoxifying and decomposing wastes, and supporting varied animal and plant populations.

As urbanization expands rapidly, not only in Northern Virginia but also worldwide, there is a growing disconnect between people and nature. When people are isolated from nature, they perceive it as less relevant and more threatening, and its physical, emotional, and spiritual benefits are devalued. Consequently, interest in conserving and protecting the natural environment is weakened, and society comes to accept a lowered environmental quality as the new norm. Fortunately, we have the ability to circumvent such a negative outcome. By ensuring people remain in contact with the natural world, promoting educational programs and projects that raise environmental awareness, and taking action to improve or restore our community’s natural resources when they are degraded, we can help keep Reston environmentally healthy for its citizens and visitors today and for generations to come.

We hope this report’s readers will gain a better understanding of the current environmental conditions within our community. We also hope to inspire residents to add to our collective knowledge by participating in future RASER working groups. It is our intention that this report and future annual updates identify environmental concerns and trends so that RA can make pertinent adjustments in policies, programs, and projects. This will ensure Reston continues to be a vibrant, diverse, and healthy place to live, retaining its culture of caring and appreciation for our many natural resources.

– The 2017 RASER Working Group
I.B. Acknowledgements

The Reston Annual State of the Environment Report (RASER) Working Group of the Reston Association (RA) Environmental Advisory Committee (EAC) produced this first edition of RASER. The Working Group is composed of both environmental professionals and citizen scientists. All but its two RA staff liaisons are uncompensated volunteers. Doug Britt served as the RASER project leader and co-edited the report with Robin Duska.

Some RASER Working Group members are also EAC members, and many are certified as Virginia Master Naturalists (VMN) or have graduated from the program:

**Sue Beffel:** EAC Chairperson, reviewer

**Doug Britt:** EAC, certified VMN, RASER project leader, co-editor, lead author (Introductory sections, General Environmental Setting, Air Quality, Streams, Lakes and Ponds, Drinking Water, Wetlands), contributing author (Land Use, Birds, Reptiles and Amphibians, Invertebrates)

**Don Coram:** Certified VMN, lead author (Invertebrates), contributing author (Birds)

**Robin Duska:** EAC, certified VMN, co-editor, lead author (Birds, Mammals, Light Pollution)

**Linda Fuller:** VMN, co-lead author (Environmental Education and Outreach), contributing author (Birds)

**Carl Mitchell:** EAC, lead author (Stormwater Management, Hazardous and Toxic Materials), contributing author (Land Use)

**Lois Phemister:** VMN, reviewer

**Claudia Thompson-Deahl:** RA staff liaison to EAC, VMN, lead author (Tree Cover, Meadows, Reptiles and Amphibians, Wildlife Management Issues), contributing author (Birds)

**Katie Shaw:** RA staff liaison to EAC, co-lead author (Environmental Education and Outreach), contributing author (Mammals)

Former EAC member Melissa Gildea also contributed to the Stormwater Management and the Light Pollution chapters. In addition to the Working Group liaisons, several other RA staff members provided considerable assistance in locating critical data sources, providing historical context and technical reviews, and helping with IT issues, including data storage, data sharing, GIS mapping, graphics, and publication services. The Working Group especially appreciates the assistance of Nicki Bellezza, Rebecca Gates, Patricia Greenberg, Ali Khatibi, Will Peterson, Abby Stocking, and Sabrina Tadele.

The 2017 RASER was completed nine months from its inception. It could not have been completed within that timeframe without the helpful assistance of many individuals associated with Fairfax County, Virginia State and Federal governmental agencies, and representatives affiliated with academic institutions and not-for-profit organizations, including:

**Land Use and Population:** Faheem Darab, Senior Planner, Fairfax County Department of Planning & Zoning
**Stormwater Management:**  Michael Rolband, President, Wetland Studies and Solutions, Inc. and Charles Smith, Branch Chief, Fairfax County Department of Public Works and Environmental Services, Stormwater Planning Division, Watershed Projects Implementation Branch - Central

**Tree Cover:**  Hugh Whitehead, Fairfax County Urban Forester

**Birds:**  Greg Butcher, Migratory Species Coordinator for U.S. Forest Service International Programs

**Hazardous and Toxic Materials:**  Randy Chapman, Environmental Manager, Remediation Program, Northern Regional Office, Virginia Department of Environmental Quality; Saiful Islam Ph.D., Code Specialist II, Industrial Waste Section, Wastewater Planning & Monitoring Division, Noman M. Cole, Jr. Pollution Control Plant; Peter Van Metre, Research Hydrologist, U.S. Geological Survey; and W. Trice Burgess Jr., Assistant Fire Marshal/Code Specialist II Fairfax County Fire & Rescue, Fire Prevention Division, Fire & Hazardous Materials Investigative Services

**Reptiles and Amphibians:**  Kelly Geer, Reston resident, and Kevin Munroe, chief, Laguna de Santa Rosa Foundation. Former RA naturalist and author of *Dragonflies of Northern Virginia* (http://www.dragonfliesnva.com), Kevin also provided assistance on the *Invertebrates* chapter.

Finally, EAC’s members deserve recognition for their unwavering support for this challenging project, for their constructive criticism of early drafts, and for helping the Working Group come to a consensus on RASER’s recommendations.
I.C. Purpose and Organization

The Reston Annual Environmental Status Report (RASER) has five objectives:

- Summarize existing quantitative environmental data for the Reston community in one publicly accessible document.
- Establish an environmental baseline that can be re-assessed annually to facilitate the identification of environmental trends and to evaluate the efficacy of environmental improvement and conservation programs and initiatives.
- Provide relevant and timely environmental information that can help RA and its Board of Directors in shaping future policy and programs.
- Help educate and inform Reston residents and other interested parties about Reston’s environmental health.
- Create a living document that can be revised and expanded as deemed appropriate to meet future environmental challenges and information needs.

The information summarized in this report provides a broad overview of Reston’s most important environmental characteristics. The primary sources of summarized data are provided wherever appropriate as a guide to readers interested in more detailed analyses. The information presented in the following chapters represents the most recently available data, except when historical trends are described.

Following a general description of Reston’s environmental setting in Chapter II, RASER is organized around six topics with chapters devoted to a specific environmental resource or topic, followed by a chapter summarizing RA environmental programs/outreach activities, a Postscript, and an Appendix listing environmental awards and certifications. In each chapter, Background information on the subject is followed by a description of Existing Conditions in Reston. Following Conclusions drawn about the subject, Recommendations are made. As colored traffic light icons indicate, each environmental issue is evaluated as good (green), fair (yellow), poor (red), or undetermined (black).

Photographs not otherwise credited are from Reston Association staff. Reston Association is abbreviated throughout the report as RA.
II. General Environmental Setting

The following chapters briefly describe some of the important physical, chemical, and biological factors that help define the environmental setting of the place called Reston.

II.A. Climate and Weather

Reston’s climate is classified as *humid subtropical* based on the Koppen Climate Classification System.\(^1\) It is characterized by humid summers and mild to cool winters. Based on a 48-year weather record from Weatherbase,\(^2\) the average temperature for Reston is 54.4 degrees Fahrenheit (F), with an average January minimum of 22.8 degrees F and an average July maximum of 87.2 degrees F. On average, Reston experiences about 30 days above 90 degrees F and 111 days below 32 degrees F. Reston averages 197 sunny days per year and 117 days of precipitation. Average annual precipitation is approximately 41 inches per year, generally well distributed throughout the year with low-pressure fronts creating rainfall in the cooler winter months and brief thunderstorms during the warmer summer months. Average snowfall is 22.9 inches, with February typically receiving the highest totals.

Based on temperature recordings at Dulles International Airport (IAD), 2016 was nearly 2 degrees warmer than normal and the second warmest year in the past 25 years. According to The Weather Channel, Reston had 50 days of temperatures reaching 90 degrees F or higher and 170 sunny days in 2016, a year with the third consecutive December without significant snowfall – the longest such streak since records have been kept. Exhibit II.A-1 illustrates average monthly temperatures in 2016 compared to long-term average maximum and average minimum temperatures for each month. Although 2016 began with a wet spring, the second half of the year was exceptionally dry. Precipitation for the year was 35.33 inches as measured at IAD, which makes 2016 the second driest year in the past 10 years.\(^3\)

Exhibit II.A-1: 2016 Monthly Average Temperatures (Degrees F) as Measured at IAD

Yellow areas represent the range between average monthly maximum temperatures and average monthly minimum temperatures based on 35 years of monitoring (1981 -2010).\(^4\)
The average UV Index for Reston is 4.0, which is slightly less than the nationwide average value of 4.3. The UV Index is a forecast of the amount of skin-damaging ultraviolet solar radiation expected to reach Earth’s surface when the sun is at its highest point in the sky around noon. Exhibit II.A-2 shows the UV Index scale and appropriate precautions to be taken for various ranges. Historic UV Index values were not found for Reston, but Washington DC recorded 47 days when the UV Index was High, 94 days when it was Very High, but no days when it was Extreme during 2016.5

Exhibit II.A-2: Interpretation of the UV Index6

<table>
<thead>
<tr>
<th>Sun Exposure Risk</th>
<th>UV Index</th>
<th>Recommended Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0-2</td>
<td>Safe to be outdoors - no protection required</td>
</tr>
<tr>
<td>Moderate</td>
<td>3-5</td>
<td>Take precautions, such as covering up during midday hours, wearing a hat and sunglasses and using sunscreen. Stay in the shade near midday when the sun is strongest.</td>
</tr>
<tr>
<td>High</td>
<td>6-7</td>
<td>Wear sunglasses and use SPF 30+ sunscreen, cover the body with sun-protective clothing and a wide-brimmed hat, and reduce time in the sun from three hours before to three hours after solar noon.</td>
</tr>
<tr>
<td>Very High</td>
<td>8-10</td>
<td>Wear SPF 30+ sunscreen, a shirt, sunglasses, and a hat. Do not stay out in the sun for too long.</td>
</tr>
<tr>
<td>Extreme</td>
<td>11+</td>
<td>Take all precautions, including: wear sunglasses and use SPF 30+ sunscreen, cover the body with a long-sleeved shirt and trousers, wear a very broad hat, and avoid the sun from three hours before until three hours after solar noon.</td>
</tr>
</tbody>
</table>
II.B. Soil, Geology, and Physiography

Reston is situated in the Piedmont, the largest of the five physiographic provinces of Virginia (Exhibit II.B-1). The Piedmont is the remnant of several very ancient mountain chains that have been eroded away and is characterized by low rolling hills with a complex geology that includes igneous, metamorphic, and sedimentary rocks.\(^7\) Within Fairfax County, the Piedmont is underlain by highly weathered metamorphic crystalline rock that has been chemically weathered at the surface to form a soft, thoroughly decomposed and porous rock called saprolite, which is often rich in clay. The thickness and permeability of saprolite varies substantially throughout Fairfax County; it can be quite deep and well drained. The western portion of Fairfax County and parts of Reston adjacent to the town of Herndon are situated in the Triassic basin of the Piedmont province. Bedrock of the Triassic basin consists of sedimentary rocks such as shale and siltstone with local intrusions of igneous diabase.\(^8\)

Exhibit II.B- 1: Physiographic Provinces of Virginia

Ecologically, the Piedmont is a transitional area between the mostly mountainous ecoregions of the Appalachians to the west and the more level coastal plain to the east. Its typical clay-rich acidic soils and the humid, warm climate originally supported forests of oak, hickory, and pine. Following settlement, much of the Piedmont in Northern Virginia was cultivated, causing significant soil loss. After cultivation, lands often reverted to pine and hardwood woodlands.\(^9\)

Stream systems can differ greatly in their physical and biotic components from one physiographic province to another. Piedmont streams are characterized by medium to high gradient valleys and channels with gravel and cobble substrates and riffle and pool dominated flow regimes.\(^10\) To the east, Great Falls is part of the Fall Line that forms the boundary between the Piedmont and the more poorly drained Coastal Plain physiographic province. Great Falls is the largest natural physical river barrier in Virginia and presents an insurmountable obstacle to anadromous fishes that migrate upstream to spawn and many lowland, calm-water fish species.\(^11\)
Asbestos, a human carcinogen, is a natural mineral fiber found within certain geologic formations. Fairfax County has several square miles of land with the potential for these mineral deposits, which are interspersed in underlying green stone formations of the bedrock. The Northern Virginia Soil and Water Conservation District recently performed soil survey work to more precisely define the borders of soil types used to identify areas with a potential for these mineral deposits in Fairfax County. Areas of potential naturally occurring asbestos include parts of Reston, as illustrated in Exhibit II.B-2. Maps showing these areas in the County, along with additional information sources, can also be accessed on the Fairfax County Health Department’s Naturally Occurring Asbestos Web page at www.fairfaxcounty.gov/hd/chs/natural-asb.htm.

The asbestos fibers are typically locked up within the green stone rock or are potentially found within the very deep subsoil. Living on such soils is not considered a hazard because any asbestos fibers are sequestered deep underground. During major construction, however, excavations may be deep enough to disturb the deep subsoil or the bedrock itself, so Fairfax County has placed special restrictions on construction activities at sites with a high potential for asbestos deposits. The Fairfax County Health Department, the Northern Virginia Soil and Water Conservation District, and the Department of Public Works and Environmental Services have jointly created a guidance document called Construction Safety in Areas of Naturally Occurring Asbestos that describes safe construction practices in areas of green stone bedrock, which can be accessed at: http://www.fairfaxcounty.gov/nvswcd/asbestos-safety.htm.

Fairfax County also has certain geologic formations with mineral deposits that release radon gas. Radon is a natural byproduct of the radioactive decay of uranium, thorium, or radium in rocks, soil, or groundwater. It can find its way into buildings through porous materials and cracks in foundations. The U.S. Surgeon General has identified radon as a leading cause of lung cancer, and the U.S. Environmental Protection Agency (EPA) has recommended homeowners take action to reduce radon gas levels when indoor concentrations exceed 4 picoCuries/liter (pCi/L).
The EPA map of radon risk broadly indicates all of Fairfax County at high risk for the accumulation of radon gas inside homes. Studies conducted by the Fairfax County Health Department resulted in a more detailed map identifying radon risk rankings from low to high in the different geographic regions of the county, including Reston (see Exhibit II.B-3). Radon levels greater than 4 pCi/L can occur anywhere in the county, but a large part of Reston falls into the high-potential area. Studies in the late 1980s indicated that 14 percent of homes that were tested in the “low-potential” areas of the county had radon levels that were a problem. On the other end of the spectrum, 56 percent of homes tested in the “high-potential” areas did not have a problem. This natural environmental health risk can be significantly reduced by installing radon mitigation systems in homes. The county map, along with links to information and radon mitigation techniques, can be found on the Fairfax County Health Department’s Radon Information Web page at www.fairfaxcounty.gov/hd/air radon.htm.

Owing to its diverse geology, there are more than 100 soil types in Fairfax County. The soil composition of Reston also is complex and reflects the physical and chemical weathering of its underlying rocks and minerals, further modified by biological processes and transport by wind and water. Glenelg soil is the
predominant soil type in Reston. It has a high mica content, which makes it highly erodible. Manor soils are also abundant in Reston. They are quite silty and sandy and also are subject to erosion. Soils derived from the Triassic basin on the western edge of Reston near Herndon tend to be clayey, sticky, chemically basic, and iron rich. They also are typically shallow and poorly drained. More detailed information regarding local soil types may be obtained from the ‘Soils – Official 2011’ maps on the Fairfax County GIS and Mapping Digital Map Viewer at www.fairfaxcounty.gov/gisapps/DMV/Default.aspx.htm.

Apart from the physical characteristics of soils, healthy soil communities help filter and purify storm water, recycle biologically essential minerals and nutrients, sequester carbon, and support food and fiber production, among other ecological services provided. These services are lost or diminished as soil is sealed over with impervious surfaces such as roads, parking lots, and buildings. Currently Reston has approximately 35 percent of its land area covered by impervious surfaces. In spite of the density of development in Reston, there are many intact and semi-intact natural soil profiles that support diverse plant communities.

Exhibit II.B-3: Reston Radon Gas Risk
II.C. Land Use and Population

Reston was planned as one of the nation’s mid-20th century landmark new towns: A community in which its residents can live, work and play. Reston was envisioned as a complete community where residents can fulfill day-to-day needs within a relatively compact area near concentrated employment opportunities along the Dulles Corridor between Washington, DC and Washington Dulles International Airport. Today Reston occupies approximately 7,040 acres of land, of which 18 percent (1,300 acres) is open space. RA manages 800 of these acres (11.4 percent) as natural areas. Buildings, parking areas, and roadways contribute to an estimated 35 percent total impervious surface area. Reston has 55 miles of paved and natural surface pathways (with 95 bridges) winding throughout its open spaces. All trails are multi-use, so users can expect to encounter walkers, joggers, bicycles, wheelchairs, and pathway maintenance vehicles. No motor vehicles are allowed on the pathway system. Not only do these paths provide a place for residents to exercise and connect with nature, but they also connect neighborhoods, recreation areas, and shopping centers.

Exhibit II.C-1 illustrates current land uses in Reston. Perhaps the most striking features are the significant amount of open space, the relatively few areas with commercial and office use concentrations, and the broad distribution of lower- and higher-density residential areas. This last feature means that lower-density residential areas are not segregated from somewhat higher densities. Thus, townhouses and condominium apartments are not concentrated into a few areas with single family uses elsewhere—instead, these are interspersed.

Exhibit II.C-2 is a table summarizing data on Reston assembled by the Fairfax Department of Planning and Zoning. This table compares values from several points of time between 1990 and 2015 for the number of dwelling units in residential areas and the gross floor area of various non-residential uses (e.g., office, retail, or hotel). Also, included in the right column of this table are population estimates from the U.S. Bureau of the Census for the same points in time. A couple of interesting trends can be seen in these data. First, while Reston’s population increased roughly 25 percent from 1990 to 2015, the number of dwelling units increased by 43 percent. This trend reflects an occupancy decline per unit from nearly 2.4 persons per dwelling unit in 1990 to nearly 2.0 by 2015. Second, even though total dwelling units increased over these 25 years from about 20,000 to just over 29,000, most of that increase is in multi-family units, and most of that is found in the Transit Station Areas (TSAs).

The population of Reston in July 2016 was estimated to be 60,238, which represents about a six percent increase from the 2010 U.S. census estimate and more than 60 percent growth since the 1980 census. The 2016 median age of Reston residents was approximately 38 years old.
In 2016 there were an estimated 753 homeless people living in Reston. This number is based on the number of people that the nonprofit organization, Cornerstones, served during their last fiscal year (July 1, 2015-June 30, 2016), which is the most complete data they have available. If not all homeless individuals in Reston interacted with Cornerstones, then their population could be higher. Cornerstones aims to promote self-sufficiency by providing support and advocacy for those in need of food, shelter, affordable housing.
Reston’s population is expected to increase substantially because of redevelopment of older residential and commercial properties and development generated by Metro Silver Line stations. In fact, the entire region is expected to see significant population growth. According to the Fairfax County Board of Supervisors, Fairfax County is projected to grow seven to eight percent between 2010 and 2020 and yet another eight to nine percent between 2020 and 2030. Between 2015 and 2045, the Washington-Maryland-Virginia region is expected to add more than 1.5 million people and 1.1 million jobs. Such development and redevelopment may have both direct and indirect effects on the environmental quality of the Reston community. The remainder of this report attempts to summarize the current environmental conditions for some of the most important environmental attributes of Reston, based on the latest available and reliable information.
III. Air Quality

Air pollutants are emitted by four types of sources: Stationary (e.g., power plants and industrial), area (e.g., gasoline service stations and dry cleaners), non-road (e.g., airplanes, tractors, boats), and mobile (e.g., automobiles and trucks). The U.S. Environmental Protection Agency (EPA) tracks the emission of air pollutants from stationary sources, including sources in Fairfax County. The Virginia Department of Environmental Quality (VDEQ) operates an air compliance program that inspects facilities within Fairfax County and records information on violations in the state’s database, the Comprehensive Environmental Data System. Reston does not have an air quality program nor does it routinely monitor air quality. Fairfax County, as part of a federal-state-regional-local partnership, has the responsibility to protect and improve air quality across the county, including the Reston community.

Background

In 2010, the VDEQ assumed responsibility for a robust air quality monitoring network in Fairfax County. Under Section 174 of the Clean Air Act Amendments, the governors of Maryland and Virginia and the mayor of the District of Columbia certified the Metropolitan Washington Air Quality Committee (MWAQC) to develop specific recommendations for a regional air quality plan. Fairfax County participates in the air quality planning activities in cooperation with the MWAQC. Emissions from all sources are modeled by a number of modeling centers, including the University of Maryland/Maryland Department of the Environment, VDEQ, and the Ozone Transport Commission, to determine if the National Capital Region complies with Clean Air Act requirements. The region and the Commonwealth of Virginia have had to develop air quality plans to improve air quality when the region is not in compliance.

The EPA establishes National Ambient Air Quality Standards (NAAQS) for six major air pollutants (criteria pollutants): Atmospheric (ground-level) ozone, fine particulate matter, carbon monoxide, sulphur dioxide, nitrogen dioxide, and lead (Exhibit III-1). Criteria pollutants are the only air pollutants with national air quality standards that define allowable concentrations of these substances in ambient air (https://www.epa.gov/criteria-air-pollutants/naaqs).

For all criteria pollutants except lead, Air Quality Index (AQI) values also are calculated on a daily basis. The AQI scale is established by the EPA, and daily values are calculated for the region including Reston by the Washington Metropolitan Council of Governments. The AQI indicates how clean or polluted the air is and what associated health concerns may be applicable to exposed individuals. The AQI focuses on health effects that can occur within a few hours or days after breathing polluted air. The AQI codes and their associated precautions for Fairfax County are presented in Exhibit III-2 and can be found at http://www.fairfaxcounty.gov/living/environment/airquality.
Exhibit III-1: EPA Criteria Pollutant Descriptions

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ozone</td>
<td>O3</td>
<td>Ozone is a form of oxygen with three atoms instead of the usual two atoms. It is a photochemical oxidant and, at ground level, is the main component of smog. Unlike other gaseous pollutants, ozone is not emitted directly into the atmosphere. Instead, it is created in the atmosphere by the action of sunlight on volatile organic compounds and nitrogen oxides. Higher levels of ozone usually occur on sunny days with light winds, primarily from March through October. An ozone exceedance day is counted if the measured eight-hour average ozone concentration exceeds the standards.</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>CO</td>
<td>Carbon Monoxide (CO) is a colorless, odorless, very toxic gas produced by the incomplete combustion of carbon-containing fuels, most notably by gasoline powered engines, power plants, and wood fires. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.</td>
</tr>
<tr>
<td>Sulfur Dioxide</td>
<td>SO2</td>
<td>Sulfur dioxide (SO\textsubscript{2}) is one of a group of highly reactive gasses known as &quot;oxides of sulfur.&quot; The largest sources of SO\textsubscript{2} emissions are from fossil fuel combustion at power plants (73%) and other industrial facilities (20%). Smaller sources of SO\textsubscript{2} emissions include industrial processes such as extracting metal from ore, and the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. SO\textsubscript{2} is linked with a number of adverse effects on the respiratory system.</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>NO2</td>
<td>Nitrogen dioxide (NO\textsubscript{2}) is one of a group of highly reactive gasses known as &quot;oxides of nitrogen&quot;, or &quot;nitrogen oxides (NO\textsubscript{x})&quot;. Other nitrogen oxides include nitrous acid and nitric acid. While EPA's National Ambient Air Quality Standard covers this entire group of NO\textsubscript{x}, NO\textsubscript{2} is the component of greatest interest and the indicator for the larger group of nitrogen oxides. NO\textsubscript{2} forms quickly from emissions from cars, trucks and buses, power plants, and off-road equipment. In addition to contributing to the formation of ground-level ozone and fine particle pollution, NO\textsubscript{2} is linked with a number of adverse effects on the respiratory system.</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>PM-2.5 PM-10</td>
<td>Particle pollution (also called particulate matter or PM) is the term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope. Particle pollution includes inhalable coarse particles, with diameters larger than 2.5 micrometers and smaller than 10 micrometers and fine particles, with diameters that are 2.5 micrometers and smaller. The average human hair is about 70 micrometers in diameter -- making it 30 times larger than the largest fine particle. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, known as primary particles, are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Others form in complicated reactions in the atmosphere of chemicals such as sulfur dioxides and nitrogen oxides that are emitted from power plants, industries and automobiles. These particles, known as secondary particles, make up most of the fine particle pollution in the country.</td>
</tr>
</tbody>
</table>
### Exhibit III-2: Air Quality Index Codes and Precautions for Fairfax County

<table>
<thead>
<tr>
<th>AQI Value</th>
<th>Color</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 50</td>
<td>Good - Green</td>
<td>Enjoy outdoor activities ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ carpool, use public transit, bike or walk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ keep engines tuned</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ use environmentally friendly products</td>
</tr>
<tr>
<td>51 - 100</td>
<td>Moderate - Yellow</td>
<td>Some pollution in the air ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ limit driving, consolidate trips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ reduce car idling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ conserve electricity, set A/C to 78 degrees</td>
</tr>
<tr>
<td>101 - 150</td>
<td>Unhealthy for Sensitive Groups - Orange</td>
<td>Children and adults with respiratory and heart sensitivity should limit outdoor activity ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ refuel after dusk, use fuel-efficient vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ avoid driving, use transit, telework</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ avoid using aerosol products</td>
</tr>
<tr>
<td>151 - 300</td>
<td>Unhealthy - Red</td>
<td>Unhealthy for everyone ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ avoid lawn mowing or use electric mowers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ put off painting until air quality improves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ limit strenuous outdoor activities</td>
</tr>
<tr>
<td>301 - 500</td>
<td>Very Unhealthy - Purple</td>
<td>Very unhealthy for everyone ...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ avoid outdoor physical activities, especially sensitive groups</td>
</tr>
</tbody>
</table>
**Existing Conditions**

By all standards, Fairfax County enjoys significantly better air quality today than even 10 years ago (see Exhibits III-3 and III-4). Although the area has not been notified that it is in violation of any current air quality standard, atmospheric ozone concentrations are a concern since the EPA, in October 2015, strengthened the 2008 primary and secondary eight-hour (8-hr) ground-level ozone standard from 0.75 parts per billion (ppb) to 0.70 ppb. If our region fails to meet the new standard based on data collected for the three-year period from 2014 to 2016, then EPA will likely designate the region as a non-attainment area for the new ground-level ozone standard. Official notification is expected in late summer of 2017. Preliminary monitoring data indicate the National Capital Region exceeded the 0.70 ppb standard on 14 days during the 2015 ozone season. Therefore, the VDEQ expects that the region will be classified as a “Marginal Non-Attainment” region for ground-level ozone (the lowest and least restrictive of five classes of non-attainment).

**Exhibit III-3: Air Quality Trends for 2008 and 2015 8-hr. Ozone Standards**

![Exhibit III-3: Air Quality Trends for 2008 and 2015 8-hr. Ozone Standards](image)

*Source: Metropolitan Washington Council of Governments. 2015 data are preliminary and may change.*
The American Lung Association (ALA) has developed an Air Quality Report Card for each county in the United States. Exhibit III-5 presents their grading system. For the year ending 2016, they gave Fairfax County an “F” for ozone pollution (based on having 19 Orange days, two Red days, and one Purple day). The County received a “B” for Fine Particulate Matter (based on one Orange day and no Red or Purple days).

Exhibit III-5: American Lung Association Air Quality Grading System

<table>
<thead>
<tr>
<th>Grade</th>
<th>Weighted Average</th>
<th>Approximate Number of Allowable Orange / Red / Purple / Maroon days</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.0</td>
<td>None</td>
</tr>
<tr>
<td>B</td>
<td>0.3 to 0.9</td>
<td>1 to 2 orange days with no red</td>
</tr>
<tr>
<td>C</td>
<td>1.0 to 2.0</td>
<td>3 to 6 days over the standard: 3 to 5 orange with no more than 1 red OR 6 orange with no red</td>
</tr>
<tr>
<td>D</td>
<td>2.1 to 3.2</td>
<td>7 to 9 days over the standard: 7 total (including up to 2 red) to 9 orange with no red</td>
</tr>
</tbody>
</table>

For ozone, an "F" grade was set to generally correlate with the number of unhealthy air days that would place a county in nonattainment for the ozone standard.

Should the region be classified as Marginal Non-Attainment for ozone as expected, it would have three years to come into compliance. Several factors suggest that air quality will continue improving and
compliance will be met in this timeframe. One major factor is the replacement of older cars and trucks with newer, post-2010 models meeting more stringent emission standards: 2017 models will have even lower emissions. Another major factor is the changing mix of the region’s electric generating facilities. Several regional coal-fired power plants are scheduled to come off line in the next few years, and others are converting to natural gas. In addition, Virginia expects to add 1000 megawatts of electricity generation from renewable energy sources over the next two years.29

The operation of the Metro Silver Line along with expansion of bike lanes and access to Bike Share in Reston also should help to reduce automotive sources of criteria pollutants. It remains uncertain, however, as to what degree these beneficial changes will offset increased traffic congestion associated with higher density redevelopment in Reston and the overall population growth for the region.

Although air quality for Reston is based on regional information, the extent of tree canopy coverage in Reston suggests that air quality within Reston may benefit relative to other urban parts of the region. In the process of photosynthesis, trees not only let in carbon dioxide but also take in and denature sulfur dioxide, nitrogen oxides, and ozone. In the process of doing so, trees clean the air we breathe. Tree canopies and leaf surfaces also create drag on moving air, reducing the air’s energy and causing deposition of airborne particles. Thus, by interacting with the air, trees in Reston directly reduce four of the six NAAQS criteria pollutants.30 Trees also can improve air quality indirectly by shading houses and protecting them from winter winds. Summer and winter energy use may be reduced by up to ten percent and three percent, respectively, thereby reducing pollution from energy generation. Similarly, trees reduce ambient air temperatures through transpiration, further decreasing summertime energy use and pollutant production.

Conclusions

Except for ozone concentrations, the current air quality in Reston appears to be reasonably good for such a densely populated area. Concentrations of all regulated atmospheric pollutants, including ozone, are trending toward lower concentrations, and this trend has been continuing for the past decade. Future replacement of the region’s automotive fleet with vehicles that have better emission controls, reductions in regional coal-fired power plants, access to alternative modes of transportation, and a healthy urban forest collectively should help mitigate increased emissions that may emanate from the energy demands associated with the population expansion projected for our region in the coming decades.

Meeting the new and more stringent 8-hr ground-level ozone standard, however, represents a near-term challenge for the region. After the EPA reviews the 2016 ground-level ozone data, it is probable that our region will be defined as a Marginal Non-attainment area for this pollutant, and that designation may require the implementation of new and more restrictive measures if attainment cannot be met within three years.
**Recommendations**

RA should:

- Continue to manage and to preserve Reston’s urban forests and tree canopy, and when practicable, to plant more trees.
- Continue to promote multi-modal transportation throughout the Reston community to reduce air pollution from automobiles and trucks.
- Encourage the placement of more electric car charging stations.
- Promote energy conservation practices and develop a sustainability framework through education and outreach initiatives as well as through official Reston policies and procedures.
- Encourage residents and commuters to avoid idling of gasoline and diesel-powered automobiles when stopped in traffic, waiting in pick-up lines, and at Metro Line Kiss & Ride sites.
IV. Water Resources – Introduction

Reston has 66 miles of perennial (year-round permanent) streams, four major man-made lakes occupying a total of 132 acres, and several wet and dry ponds mostly built for stormwater management occupying a total of 43 acres. These surface water features are important community assets, collectively providing ecological services such as flood control, sediment deposition, groundwater recharging, pollution filtering, and fish and wildlife habitat creation. They also provide passive and active recreation and generally enhance property values.

In addition, Lake Anne serves as a source of cooling water, providing chilled central air-conditioning to many of the properties surrounding the lake as well as irrigation water for Hidden Creek Country Club. Reston’s potable water is sourced from the Potomac River and supplied by Fairfax Water. The quality of these water resources is described in the following sub-chapter. Ecologically important wetlands are separately described in Chapter V.C. Wetlands.

IV.A. Streams

Background

Although all Reston streams eventually drain to the Potomac River, their headwaters begin in Reston as three separate sub-watersheds: Difficult Run, Sugarland Run, and Horsepen Creek (see Exhibit IV.A-1). Difficult Run is the largest Reston watershed, encompassing an area of 5,600 acres and draining approximately 71 percent of Reston (roughly all of Reston east of Reston Parkway). Sugarland Run drains approximately 28 percent of Reston, and Horsepen Creek drains less than two percent of Reston.31

Reston, because of its elevation, forms the headwaters of these three sub-watersheds. Reston land use and the behavior of its residents primarily determine the water quality of its streams as a consequence of the runoff within the community’s boundary. Each of the sub-watersheds contains several tributaries that drain smaller basins in and around Reston including The Glade, Snakeden Branch, Colvin Run, and many unnamed smaller tributaries. Reston’s watersheds are now almost fully developed with the bulk of the undeveloped property preserved as wooded open space in areas alongside streams and as athletic fields and buffers.

During Reston’s early development in the 1960s and 1970s, it was a common practice to direct stormwater flow from impervious surfaces such as parking lots, roads, and buildings directly to receiving waters such as streams and wetlands as quickly as possible. Although this practice often reduced local flooding, it ultimately disrupted the natural equilibrium of the receiving waters. The surge in storm flows created problems related to their volume and velocity, releasing more energy than the streams could accommodate. The result was erosion of stream banks, downstream transport of bottom substrate, widening of the stream channels with accompanying loss of streamside vegetation, and downstream deposition of sediment loads, among other adverse impacts. These physical changes reduce the quality and quantity of stream habitat. Consequently, Reston’s streams were destabilized, and water quality and aquatic life deteriorated. See Chapter IV.C Stormwater Management for more background.
Stream degradation is a widespread and common problem associated with urban development in Northern Virginia. Fairfax County has conducted several studies to assess the health of its streams. It has been estimated that more than half of the county's streams are in “poor” to “very poor” condition. In 2001 Fairfax County published the Stream Protection Strategy (SPS) Baseline Study, which provided a holistic ecological baseline assessment of county streams. The SPS Study sampled 114 stream sites throughout the county, including nine sites in Reston. The Reston sites included three in Snakeden Branch, one in Colvin Run, two in tributaries of Colvin Run, one in The Glade, and two in Sugarland Run. The study provides information on fish taxa, benthic (bottom dwelling) macroinvertebrates (animals lacking backbones but large enough to see with the naked eye), general evaluation of watershed and stream features, and calculations of the percentage of impervious cover within each watershed. The SPS Baseline Study is available at www.fairfaxcounty.gov/dpwes/environmental/sps_main.htm.

Exhibit IV.A-1: The Three Major Watersheds of Reston

The County also conducted a comprehensive assessment of the physical conditions of its streams in the autumn of 2002 and winter of 2003. The assessment included the three stream systems draining Reston: Difficult Run, Sugarland Run, and Horsepen Creek. The study documented habitat conditions, infrastructure impacts and stream problem areas, and stream morphology (the physical state of the stream channels). Most of the streams in both Sugarland Run and Horsepen Creek were classified as
Stage 3 for stream morphology. Stage 3 streams are the most unstable and typically exhibit steep banks, bank failures, and deleterious channel widening and deepening.

In response to recommendations presented in the County’s SPS Baseline Study, the information obtained in the Physical Stream Assessment, and the multi-state Chesapeake Bay 2000 Agreement,35 the Fairfax County Department of Public Works and Environmental Services (DPWES) initiated watershed management plans for all the county’s watersheds, including Difficult Run,36 and Sugarland Run and Horsepen Creek.37 These watershed plans synthesized information from stream assessments, monitoring studies, and watershed modelling to locate and evaluate stream impairments and to assess potential mitigation measures.

Fairfax County initiated a countywide Biological Stream Monitoring Program in 2004. The Program involves annual monitoring and is conducted using a probabilistic design approach, which allows statistically valid inferences to be made about the condition of the county’s streams. Each year the county collects data from a few reference sites as well as 40 sites that are selected randomly within the county for monitoring. Sometimes these sites include stream reaches in Reston. At these sites, samples are collected for benthic macroinvertebrates, fishes, and E. coli bacteria. Water quality and stream habitat characteristics are also evaluated. The previous year’s annual stream reports are available online at www.fairfaxcounty.gov/dpwes/stormwater/stormwater_status.htm and www.fairfaxcounty.gov/dpwes/stormwater/streams/streamsreports.htm.

The biological health of the benthic macroinvertebrate and fish communities is quantified using a multi-metric Index of Biological Integrity (IBI), which numerically rates various functions of the biological assemblage such as pollution tolerance, community diversity, active ecological functions, and other characteristics and compares them to reference conditions. The county’s benthic macroinvertebrate and fish data are then used to categorize a site as Excellent, Good, Fair, Poor, or Very Poor.

The benthic macroinvertebrate data also can be used to calculate a Stream Quality Index (SQI) for an entire stream, watershed, or the entire county. SQI values range from 1 (Very Poor Condition) to 5 (Excellent Condition). Exhibit IV.A-2 illustrates that the overall condition of county streams is somewhere between Poor and Fair (between 2 and 3, respectively) based on 11 years of data. The data also suggest that over the past nine years there has been a small increase in overall stream quality in Fairfax County. To determine an emerging trend with greater certainty, however, a longer period of data reporting will be required.38
Since 2004 the County has sampled 111 sites in Difficult Run, eight sites in Sugarland Run, and four sites in Horsepen Creek. Although many of these sites are downstream from Reston, collectively the data for benthic macroinvertebrates and fish assemblages confirm that the conditions of these streams are less than good (see Exhibit IV.A-3).

In parallel with the County’s efforts, RA began to evaluate Reston’s watershed issues in more detail in the early 2000s. The first RA aquatic biomonitoring program was established by RA staff in 2000 at six
stream sites in the Difficult Run and Sugarland Run watersheds. This program was expanded to 12 sites with the help of a trained volunteer workforce the following year. Samples are collected quarterly at each site. Subsequently one site was dropped as it was deemed to be beyond Reston’s border, so the current program consists of 11 sites (see Exhibit IV.A-4). It is noteworthy that nine of the RA biological monitoring sites correspond to nine of the previously described Fairfax County SPS Baseline Study sites where benthic macroinvertebrate communities were evaluated. In general, the 2000–2001 SPS data indicated the Reston streams were in only marginally better condition than the corresponding RA data suggested. The largest discrepancies (improvements) in rankings occurred at three sites: The lower Snakeden Branch site (DR3), a tributary site in Snakeden Branch (DR16), and the Colvin Run site (DR20).

Exhibit IV.A-4: RA Stream Monitoring Sites
The discrepancy between RA and County SPS findings may reflect the different monitoring protocols used. The County SPS method involved identifying the benthic organisms in more detail (lower taxonomic levels). Another explanation may be the fact that the reference conditions the County used to develop the metrics for the SPS were based on results from spring-season sampling. The types and numbers of benthic organisms can change substantially from season to season in headwater streams where leaf fall and leaf decomposition can alter the food source for macroinvertebrates. Also, the discrepancies were most noticeable in the fall RA sample analyses.

In 2001, a committee of RA’s Department of Parks, Recreation, and Events issued a report that described the condition of Reston’s watersheds and the effects they were having on Reston assets. The report was presented to the RA Board of Directors in December 2001. It stressed the importance of developing a Watershed Management Plan for Reston. As a result, a Reston Watershed Master Plan was developed in 2002. The Plan was designed to interpret changes to Reston’s landscape that produced the existing conditions, identify the most active geomorphic processes, inventory watershed areas most affected by geomorphic changes, and recommend improvement actions that could begin a process of watershed restoration. The technical approach involved performing bank erodibility hazard ratings, habitat assessments, hydraulic and hydrologic modeling, biological assessments, water quality analyses, and integration of findings into a geographic information system (GIS). The Plan indicated stream impairments and promoted a framework for stream restoration and volunteer stream monitoring still being followed today.

The Plan documented the fact that the majority of Reston’s streams were unstable and degraded, that uncontrolled stormwater flow was the primary agent of change, and that sections of Snakeden Branch and The Glade had the worst habitat and most unhealthy biological communities while Colvin Run main stem and Sugarland Run were in the best conditions of the streams evaluated. The water quality data collected were limited to nitrates, nitrites, and suspended sediments. The results suggested these parameters were within the normal range for Piedmont streams, but exceptions did occur where nitrite levels were unusually high at some sites. Because elevated nitrite concentrations did not persist throughout the year at these sites, it is possible the high levels recorded were sampling errors or perhaps reflected temporary sources such as animal droppings that were washed into the stream.

To help ameliorate the poor conditions found in many of Reston’s streams, RA began exploring ways of financing the restoration of some of its most degraded stream reaches. Ultimately, in collaboration with Northern Virginia Stream Restoration Bank, LLC, RA initiated the first stream restoration project in 2008. These restoration efforts continue today and are described in more detail below.

**Existing Conditions**

The previously described Reston stream biomonitoring program has been collecting information on the health of Reston streams on a quarterly basis since 2001. The monitoring program currently involves sampling the benthic macroinvertebrate communities of the 11 Reston sampling sites located in stream reaches of The Glade, Snakeden Branch, and Difficult Run shown in Exhibit IV.A-4 above. The monitoring method employed is the Izaak Walton League’s Modified Virginia Save Our Streams (SOS) Rocky Bottom Method, which is locally championed by the Northern Virginia Soil and Water Conservation District. The macroinvertebrates collected are counted and sorted into groups of
related organisms (e.g., mayflies, dragonflies, flat worms, and crayfish). A mathematical formula that gives higher values when pollution-sensitive organisms compose substantial percentages of the total number of specimens collected is used to calculate a stream score. Scores from 9 to 12 indicate acceptable ecological conditions, scores below 7 indicate unacceptable conditions, and a score of 8 constitutes a gray area. Basic physical measurements and a stream habitat assessment are also recorded during sampling events.

Exhibit IV.A-5 illustrates the average sampling site scores for the 11 Reston sites from 2001 through 2016. Although there is substantial seasonal and year to year variability in the scores (not illustrated, but based on a review of the raw data provided by RA\[^42\]), it is evident from Exhibit IV.A-5 that the streams and stream reaches sampled are in unacceptable ecological condition (index values below 7), with one Colvin Run site (DR28) in the “gray area.” This situation is not entirely unexpected, as other studies using slightly different monitoring protocols have found a direct correlation between the health of aquatic biological communities and the percentage of the watershed area classified as impervious surface. As little as 10 percent of impervious surface in an urbanizing watershed can greatly degrade aquatic invertebrate communities in comparison to such communities in primarily forested watersheds.\[^43\] The percentage of impervious surface area for the sub-watersheds of the Colvin Run, Snakeden Branch, The Glade, and Sugarland Run are 15 percent, 38 percent, 15 percent, and 43 percent, respectively; these percentages reflect highly developed watersheds.

Exhibit IV.A-5 also illustrates that the RA sampling sites where stream restoration has occurred still reflect unacceptable Index Values. Although not displayed in the Exhibit, comparisons of pre-restoration biological data with post-restoration data from sampling sites in restored streams do not indicate the biology is now improving. Similar results are reported from the restoration contractor, as described later in this report.

**Exhibit IV.A-5: Benthic Macroinvertebrate Monitoring Index Values (Average Values for Each Site From 2001 to 2016)**

![Average Stream Quality Ranking](image-url)
Based on the majority of the data collected thus far, it is apparent that the biological communities within Reston’s streams are experiencing the adverse, long-term effects of watershed development and uncontrolled storm flows. Habitat has been substantially degraded, creating conditions poorly suited to support a healthy and diverse macroinvertebrate community. The biological data support earlier analyses that concluded runoff from headwater streams is no longer connected with the mature riparian steam buffer that would otherwise help filter flows and slow velocities in an undeveloped watershed. These uncontrolled flows in the upper watersheds cause degradation of the stream bed and promote sedimentation and streambank instability in the lower reaches, creating a very mobile substrate and leaving very little stable habitat for colonization by benthic macroinvertebrates. The County SPS data suggest that the biological community may be more resilient than indicated by the RA SOS data; however, further evaluation using the SPS protocol will be needed to confirm this finding.

Although RA has not conducted any fish surveys in Reston streams, Exhibit IV.A-6 lists fish species collected by Fairfax County biologists from the three watersheds that drain Reston. The fish assemblages in these streams lack diversity, and those fish that are most frequently collected represent a few species tolerant of degraded stream conditions.

The short stretch of Snakeden Branch between Soapstone Drive and Lake Audubon is used to support a limited “put and take” fishing event annually for children each spring since 2011. The event is sponsored by RA, the Northern Virginia Chapter of Trout Unlimited, the VA Department of Game and Inland Fisheries, and Wetland Studies and Solutions, Inc. (WSSI). Approximately 550 rainbow trout (Oncorhynchus mykiss), from Cast-a-Line hatchery near Goshen, VA are stocked into Snakeden Branch, typically in late March. Children ages 2-12 are invited to fish with adult supervision. The trout are able to survive water conditions temporarily in the spring, but they do not permanently inhabit the stream because they cannot tolerate elevated water temperatures throughout the summer.

Owing to the degraded conditions of stream reaches and tributaries within the Difficult Run watershed, RA partnered with WSSI, managing member of Northern Virginia Stream Restoration Bank, LLC., to restore approximately 29 miles of degraded streams in Reston (14 stream miles in Phase I). Approximately eight miles of stream have been restored since the Phase I restoration efforts first began in February 2008. Snakeden Branch and The Glade stream valleys were targeted first for restoration, with construction completed in Snakeden Branch in 2009 and The Glade in 2010 (with a repair to the latter completed in 2012). Forest Edge North and South sections of the stream in the Colvin Run watershed were constructed next and completed in 2011. Restoration design plans for the remaining tributaries in the Colvin Run watershed were developed and are pending construction waiting for mitigation bank funding.

Exhibit IV.A-7 illustrates the locations of the completed Reston projects, on-going restoration efforts, and future sites where restoration plans have already been approved but not yet started. Exhibit IV.A-8 illustrates those stream reaches where restoration plans are needed but have not yet been requested or approved. As this exhibit demonstrates, many smaller stream segments still require attention to reduce their vulnerability to continued erosion and habitat damage.

Stream restoration efforts involve the use of Natural Channel Design (NCD) techniques that include raising the stream bed to reconnect higher storm flows with the floodplain, thus reducing erosive velocities and facilitating infiltration to groundwater; placement of reinforced beds composed of
crushed stone, sand, gravel, and top soil; and placement of logs and rock structures to direct flow away from channel banks and to create a more natural riffle/pool structure within the stream bed. Riffle/pool is a term used to refer to the natural tendency of streams to develop alternating areas of level pools and shallow, rocky rapids. Both riffles and pools are important to biological diversity because each type of area provides critical habitat for different species of aquatic organisms.

These NCD techniques help stream beds and banks to withstand the higher flow rates of an urbanized watershed. Design flow rates are developed through assessment of various design protocols, including hydrologic modeling using the U.S. Army Corps of Engineers (USACE) Hydrologic Modelling System (HEC-HMS), a computer model designed to simulate the precipitation-runoff processes of drainage basins for studies of water availability, urban drainage, flow forecasting, floodplain regulation, and systems operation. Hydraulic performance of the restoration designs was confirmed using the USACE River Assessment System Model (HEC-RAS), a related system that models the hydraulics of water flow through natural rivers and other channels, including cross-section shape changes, bends, and other two- and three-dimensional aspects of water flow and sediment transport.

Following the completion of stream restoration projects, WSSI implemented a 10-year monitoring and maintenance program. The monitoring included stream physical dimensions (to be monitored in post-construction Years 1, 3, 5, and 10), streamside vegetation (to be monitored in post-construction Years 1, 3, 5, 7, and 10), and habitat assessments and biological surveys (to be conducted pre-construction and again in post-construction Years 1, 5, and 10 in selected stream reaches). Monitoring of stream physical dimensions and streamside vegetation indicates that all stream restoration design criteria have been met to date in the Colvin Run, Snakeden Branch, and The Glade project sites.
### Exhibit IV.A-6: Fish Species Inhabiting Difficult Run (DR) & Sugarland Run or Horsepen Creek (SR/HC)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Watershed Where Collected (Total # Collected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creek Chub</td>
<td><em>Semotilus atromaculatus</em></td>
<td>DR, SR/HC (26)</td>
</tr>
<tr>
<td>Blacknose Dace</td>
<td><em>Rhinichthys atratulus</em></td>
<td>DR, SR/HC (25)</td>
</tr>
<tr>
<td>White Sucker</td>
<td><em>Catastoma commersoni</em></td>
<td>DR, SR/HC (25)</td>
</tr>
<tr>
<td>Tessellated Darter</td>
<td><em>Etheostoma olmstedi</em></td>
<td>DR, SR/HC (20)</td>
</tr>
<tr>
<td>Rosyside Dace</td>
<td><em>Clinostomus funduloides</em></td>
<td>DR, SR/HC (19)</td>
</tr>
<tr>
<td>Longnose Dace</td>
<td><em>Rhinichthys cataractae</em></td>
<td>DR, SR/HC (18)</td>
</tr>
<tr>
<td>American Eel Central</td>
<td><em>Anguilla rostrata</em></td>
<td>DR (17)</td>
</tr>
<tr>
<td>Stoneroller</td>
<td><em>Campostoma anomalum</em></td>
<td>DR, SR/HC (17)</td>
</tr>
<tr>
<td>Satinfin Shiner</td>
<td><em>Cyprinella analostana</em></td>
<td>DR, SR/HC (14)</td>
</tr>
<tr>
<td>Bluntnose minnow</td>
<td><em>Pimephales notatus</em></td>
<td>DR, SR/HC (14)</td>
</tr>
<tr>
<td>Green Sunfish</td>
<td><em>Lepomis cyanellus</em></td>
<td>DR, SR/HC (13)</td>
</tr>
<tr>
<td>Common Shiner</td>
<td><em>Luxilus cornutus</em></td>
<td>DR (13)</td>
</tr>
<tr>
<td>Yellow Bullhead</td>
<td><em>Ameiurus natalis</em></td>
<td>DR, SR/HC (13)</td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td><em>Micropterus salmoides</em></td>
<td>DR, SR/HC (12)</td>
</tr>
<tr>
<td>Bluegill Cutlip Minnow</td>
<td><em>Lepomis macrochirus</em></td>
<td>DR, SR/HC (12)</td>
</tr>
<tr>
<td>Swallowtail Shiner</td>
<td><em>Notropis procone</em></td>
<td>DR (10)</td>
</tr>
<tr>
<td>Northern Hogsucker</td>
<td><em>Hypentelium nigricans</em></td>
<td>DR (9)</td>
</tr>
<tr>
<td>Margined Madtom</td>
<td><em>Noturus insignis</em></td>
<td>DR (8)</td>
</tr>
<tr>
<td>Redbreast Sunfish</td>
<td><em>Lepomis auritus</em></td>
<td>DR, SR/HC (8)</td>
</tr>
<tr>
<td>Pumpkinseed Fantail Darter</td>
<td><em>Lepomis gibbosus</em></td>
<td>DR, SR/HC (6)</td>
</tr>
<tr>
<td>Spottail Shiner Greenside darter</td>
<td><em>Notropis hudsonius</em></td>
<td>DR, SR/HC (5)</td>
</tr>
<tr>
<td>Greenside darter</td>
<td><em>Etheostoma biennioides</em></td>
<td>SR/HC (2)</td>
</tr>
<tr>
<td>Banded Killifish</td>
<td><em>Fundulus diaphanus</em></td>
<td>SR/HC (2)</td>
</tr>
<tr>
<td>Golden Shiner</td>
<td><em>Notemigonus crysoleucas</em></td>
<td>SR/HC (2)</td>
</tr>
<tr>
<td>Brown Bullhead Creek Chubsucker</td>
<td><em>Ameiurus nebulosis</em></td>
<td>DR (1)</td>
</tr>
<tr>
<td>Creek Chubsucker</td>
<td><em>Erinnyzon oblongus</em></td>
<td>SR/HC (1)</td>
</tr>
<tr>
<td>Eastern Mudminnow</td>
<td><em>Umbra pygmaea</em></td>
<td>DR (1)</td>
</tr>
<tr>
<td>Fallfish</td>
<td><em>Semotilus corporalis</em></td>
<td>DR (1)</td>
</tr>
<tr>
<td>Fathead Minnow</td>
<td><em>Pimephales promelas</em></td>
<td>DR (1)</td>
</tr>
<tr>
<td>Eastern SIlvery Minnow</td>
<td><em>Hybognanthus regius</em></td>
<td>SR/HC (1)</td>
</tr>
<tr>
<td>Longear Sunfish</td>
<td><em>Lepomis megalotis</em></td>
<td>DR (1)</td>
</tr>
<tr>
<td>Warmouth</td>
<td><em>Lepomis gulosis</em></td>
<td>DR (1)</td>
</tr>
</tbody>
</table>
Exhibit IV.A-7: Status of Reston Stream Restoration Sites

Northern Virginia Stream Restoration Bank
RESTON, VIRGINIA

Restoration Status
- Construction Completed
- Under Construction
- Plans Approved
Stream habitat analyses and biological surveys are also being conducted by WSSI for informational purposes, although they are not explicit design criteria. The results indicate substantial improvements.
in stream habitat quality in all three sub-watersheds based on the U.S. Environmental Protection Agency (EPA) Rapid Bioassessment Protocol. No biological recovery has been observed, however, as all stream reaches were assessed to be “severely stressed” based on their Virginia Non-coastal Streams – Stream Condition Index (VA-SCI) scores developed for the Virginia Department of Environmental Quality (VDEQ) to assess Streams of the Commonwealth. The VA-SCI is another multi-metric Index of Biotic Integrity somewhat analogous to the modified SOS monitoring protocol used by RA staff and volunteers, but it is more rigorous because the collected macroinvertebrates are preserved, sorted in a laboratory, and identified with the aid of microscopes to lower taxonomic levels than the field identifications of RA monitoring program. Consequently, the scores derived are not directly comparable.

The WSSI team has concluded that the stream habitats for the restored sections of Snakeden Branch and The Glade are now in the “Optimal” range and appear to have stabilized due to maturation of riparian vegetation which functions to stabilize banks, with little evidence of erosion or depositional zones throughout the restored sections. They surmise that the apparent inability of a healthy benthic macroinvertebrate community to colonize the now stable stream substrates suggests that other water quality measures not addressed by the restoration effort (e.g., excess nutrients, impervious watershed surfaces, oil spills, etc.) are affecting the biological recovery.

In addition to the WSSI stream monitoring activities, volunteer scientists with the U.S. Geological Survey (USGS) have been working with RA and students in the International Baccalaureate Program at South Lakes High School (SLHS) to monitor ecological changes in Snakeden Branch beginning in 2009, following its restoration. Monitoring is conducted twice a year in the autumn, complementing the spring sampling conducted by WSSI and using the same VDEQ recommended protocols. Samples are collected from two sites within walking distance of SLHS. In addition, a reference stream reach in Little Difficult Run has been sampled, representing a relatively less-disturbed (lower percentage urban land use) watershed, with no stream restoration activity. Students from Advanced Biology classes conduct the sampling after a brief training session and are guided throughout the sampling by professional scientists and the RA watershed manager. Stream habitat is also assessed using the EPA’s Rapid Bioassessment Protocol. Stream chemistry samples are collected and analyzed. Analyses of these data are currently in progress and will examine changes in the VA-SCI index and temporal patterns in benthic invertebrates as well as stream chemistry and physical habitat characteristics in the two restored reaches of Snakeden Branch, with comparisons made to Little Difficult Run. Results were not available as of this report’s publication.

Fairfax County reports some indications that stream restoration and the more-frequent inundation of floodplains may be beginning to restore groundwater levels in Reston’s floodplain aquifers. Generally, lifting stream channels as part of restoration does restore groundwater elevation and proximity to the floodplain surface. One federal floodplain scientist advised that restorations of Reston’s streams were elevating ground water tables. Additionally, it was reported that a similar stream restoration in Mount Vernon District resulted in groundwater seepage flow in wetlands in the floodplains of the restored stream almost immediately.
Conclusions

Reston currently has many physically degraded streams and stream reaches that suffer from poor water quality. The biological communities of these streams are severely stressed, lack diversity, and are populated primarily by pollution-tolerant organisms. These problems originate largely from stormwater discharges. Reston has retained and protected many natural areas that can potentially intercept precipitation, slow overland flow, and facilitate infiltration of stormwater into the soil and groundwater. Their ability to perform these functions is diminished, however, because stormwater is often directly diverted into drains and culverts, thus creating high-energy discharges into Reston streams. These high-energy events erode stream banks, increase sediment deposition and transport, wash fertilizers and lawn chemicals into tributaries, and degrade the physical habitat important to many benthic macroinvertebrates.

RA has taken important steps toward understanding the conditions within its streams. Its monitoring programs collect data that are valuable for identifying problem areas, establishing baseline conditions to measure future impacts or improvements from watershed restoration projects, and creating public outreach, participation, and support for future watershed solutions.

RA’s efforts since 2008 to restore some of its highly degraded streams have begun to improve physical conditions in The Glade, Snakeden Branch, and Colvin Run, but recovery of the aquatic biological communities following restoration is not yet evident. It is possible that the biological communities will show improvement in future, but additional water quality enhancements further upstream in the watershed also may be required. It is also possible that these poor biological conditions reflect the fact that restoration methods employed in the early 2000s were primarily focused on improving the stream hydraulics and channel stability, not on biological recovery. New guidelines for stream restoration have been issued for mitigation banks, such as the one used to finance Reston’s projects, that make biological recovery part of the design criteria. The Reston projects, however, are grandfathered (exempted) from such changes.

To the extent stream restoration measures are successfully implemented and maintained, stream banks should become more stable, and sediment transport should be reduced. Moreover, reduced sediment transport in the streams entering the Reston lakes should improve lake water quality and extend the time interval between repeated dredging of the Reston lakes. It should also result in fewer repairs to bridges and paths owing to less erosion. The biggest benefit to restoring and protecting Reston’s watersheds, however, may be the environmental and aesthetic qualities that have become landmarks of the Reston community.
**Recommendations**

RA should:

- Task staff to identify the remaining stream reaches (contiguous segments of stream channel) most vulnerable to channel modifications from high-energy flows and contract to create monumented benchmarks (inexpensive permanent concrete or metal markers) that can be used to measure future changes in channel depths and widths. Reston staff or volunteers could then record changes in channel depth and width periodically. This information would be useful in helping set future stream management and restoration priorities.

- Explore whether Fairfax County’s interest in assessing the efficacy of county stream restoration projects can be focused on supporting more follow-up studies of restored Reston streams, to include a survey of fishes in its major streams, including restored and unrestored reaches. This effort would provide missing information about the resident fish species of Reston watersheds and data to determine whether improved physical habitats of restored reaches are actually benefitting the fish communities.

- Ensure that before any stream restoration is done, surveys are conducted on any wildlife potentially affected.
IV.B. Lakes and Ponds

Background

Although no natural lakes exist within Fairfax County, four lakes were created in Reston for the practical purpose of catching stormwater runoff, while also serving as aesthetic and recreational amenities: Lake Anne, Lake Audubon, Lake Thoreau, and Lake Newport. They are all situated in the Difficult Run watershed and owned and maintained by RA.

Lake Anne was created in 1962 by impounding a Colvin Run tributary and is the oldest lake in Reston. Reston’s founder, Bob Simon, named the lake after his second wife. Lake Thoreau was impounded in 1971. Initially it was known as Lake Elsa, but its name was changed after the larger Lake Elsa was bisected by the South Lakes dam in 1979 to create it and its sister lake, now known as Lake Audubon. Lake Newport is the smallest and newest of the four major Reston lakes. It was created in 1981 by the impoundment of an unnamed tributary of Colvin Run. The physical attributes of these lakes are presented in Exhibit IV.B-1.

Exhibit IV.B-1: Physical Attributes of the Four Reston Lakes

<table>
<thead>
<tr>
<th>Lake Name</th>
<th>ANNE</th>
<th>AUDUBON</th>
<th>NEWPORT</th>
<th>THOREAU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year Impounded</td>
<td>1962</td>
<td>1979</td>
<td>1981</td>
<td>1971</td>
</tr>
<tr>
<td>Normal Pool Surface Area</td>
<td>24.8 acres</td>
<td>43.5 acres</td>
<td>12.3 acres</td>
<td>40 acres</td>
</tr>
<tr>
<td>Volume</td>
<td>118.3 million gal.</td>
<td>133.6 million gal.</td>
<td>33 million gal.</td>
<td>26.5 million gal.</td>
</tr>
<tr>
<td>Normal Pool Maximum Depth</td>
<td>24 ft</td>
<td>32 ft</td>
<td>23 ft</td>
<td>45 ft</td>
</tr>
<tr>
<td>Watershed Size</td>
<td>582.4 acres</td>
<td>1,548.8 acres</td>
<td>134.4 acres</td>
<td>390 acres</td>
</tr>
</tbody>
</table>

The Reston Lake Anne Air-Conditioning Corporation (RELAAC), a subsidiary of Aqua Virginia, is a unique privately-owned utility that pulls water from Lake Anne to provide chilled central air-conditioning to 343 residential properties surrounding the lake. The RELAAC system was installed in 1963. In addition to RELAAC, the Hidden Creek Country Club has the right to pull water from Lake Anne to help maintain its golf course. In addition to the four major lakes, a variety of ponds are located throughout Reston, mostly serving as stormwater catchment basins. RA owns and maintains some as part of its natural areas (Butler and Bright Ponds are the two largest), and others are privately owned as part of office parks or golf courses (see Exhibit IV.B-2).
Exhibit IV.B-2: Major Lakes and Ponds of Reston

Owing to increased runoff from development and in-stream bank erosion, Reston’s lakes and some of its ponds are subject to heavy sedimentation requiring periodic dredging to maintain desired water depth. This situation is a common problem for many of the urban lakes and ponds in highly developed Fairfax County. The schedule for dredging Reston lakes and ponds is shown in Exhibit IV.B-3. Since the Reston lakes were impounded, approximately 20,900 cubic yards (cu.yds.) of sediment were removed from Lake Anne, 31,000 cu. yds. were removed from Lake Audubon, and 9,250 cu.yds. were removed from Lake Thoreau. About 5,900 cu. yds. of sediment were removed from Lake Newport prior to the start of the latest dredging operations in February 2017 (see Exhibit IV.B-4).
**Exhibit IV.B-3: Reston Dredging History/Projection**

<table>
<thead>
<tr>
<th>LAKE</th>
<th>DATE</th>
<th>SEDIMENT VOLUME REMOVED (Cu. Yds.)</th>
<th>PROJECTED DREDGE CYCLE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anne</td>
<td>1985</td>
<td>5,000</td>
<td>15</td>
</tr>
<tr>
<td>Audubon</td>
<td>1987</td>
<td>9,000</td>
<td>7</td>
</tr>
<tr>
<td>Anne (Canal)</td>
<td>1991</td>
<td>1,000</td>
<td>5</td>
</tr>
<tr>
<td>Thoreau</td>
<td>1987</td>
<td>4,000</td>
<td>15</td>
</tr>
<tr>
<td>Newport (Developer)</td>
<td>1993</td>
<td>2,500</td>
<td>15</td>
</tr>
<tr>
<td>Audubon</td>
<td>1994</td>
<td>10,000</td>
<td>7</td>
</tr>
<tr>
<td>Anne (Canal)</td>
<td>1996</td>
<td>800</td>
<td>5</td>
</tr>
<tr>
<td>Anne</td>
<td>2000</td>
<td>6,600</td>
<td>15</td>
</tr>
<tr>
<td>Audubon</td>
<td>2002</td>
<td>10,000</td>
<td>7</td>
</tr>
<tr>
<td>Thoreau</td>
<td>2002</td>
<td>4,600</td>
<td>15</td>
</tr>
<tr>
<td>Newport</td>
<td>2002</td>
<td>3,400</td>
<td>15</td>
</tr>
<tr>
<td>Anne (Canal)</td>
<td>2005</td>
<td>800</td>
<td>5</td>
</tr>
<tr>
<td>Audubon</td>
<td>2010</td>
<td>12,000</td>
<td>8</td>
</tr>
<tr>
<td>Anne (Canal)</td>
<td>2011</td>
<td>800</td>
<td>5</td>
</tr>
<tr>
<td>Thoreau (West Cove)</td>
<td>2011</td>
<td>650</td>
<td>5</td>
</tr>
<tr>
<td>Butler Pond</td>
<td>2014</td>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td>Bright Pond</td>
<td>2014</td>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td>Anne (Canal)</td>
<td>2015</td>
<td>300</td>
<td>5</td>
</tr>
<tr>
<td>Anne</td>
<td>2015</td>
<td>5,643</td>
<td>15</td>
</tr>
<tr>
<td>Hickory Cluster Pond</td>
<td>2015</td>
<td>500</td>
<td>5</td>
</tr>
<tr>
<td>Lake Newport</td>
<td>2016</td>
<td>~5000</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>78,793</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Hickory Cluster Pond has been done concurrently with Lake Anne Canal

*Dredge cycles may be altered due to budget constraints, need, or other factors*

Through 2016 the Reston dredge spoils were transported to the Chantilly Quarry, where they were used to fill in a mined area. The quarry, however, was scheduled to close in March 2017 for at least a year. The current back up spoil disposal site is in Hamilton, Virginia, if dredging operations continue after the Chantilly Quarry closes. Historically, finding adequate dredged spoil disposal sites has been a significant problem for Reston. Because Reston does not own much, if any, property around the lakes that can be used to dewater the sediment, RA has had to find farms or construction sites that can take the material. Such sites were typically in Loudoun County, but RA was the responsible party for getting the Erosion and Sediment Control Permits and doing the grading at sites.\(^{56}\)
RA has been monitoring the water quality in Lakes Anne, Audubon, and Thoreau since 1981 and in Lake Newport since 1992. Monitoring water quality in Butler and Bright Ponds began in 2003. The monitoring of water quality includes measurements of dissolved oxygen, dissolved oxygen saturation, temperature, pH, conductivity, total phosphorus, Secchi disk transparency (a measure of water clarity), chlorophyll a (an indicator of algal productivity), phytoplankton, and zooplankton. These parameters are good indicators of the health of a water body and its ability to support aquatic life. Additionally, bacterial monitoring for *E.coli* has been conducted occasionally in Lake Audubon to support swimming events.

Fish surveys have been conducted periodically in all four lakes. Data from the first survey performed in the late 1980’s are no longer available, nor are original fish stocking records. Exhibit IV.B-5 lists predatory fish species observed during the last two RA fishery studies. In 2007, some *Tilapia* also were captured and removed from Lake Anne. *Tilapia* is a genus of cichlid fishes endemic to southern Africa, so the Lake Anne fish probably were released aquarium pets. In 2016, a member of the RA staff identified a photograph submitted of a fish captured from Lake Thoreau as a non-native *Tilapia* species. *Tilapia* are not expected to survive winter temperatures in Northern Virginia.
## Exhibit IV.B-5: Predatory Fishes of Reston Lakes

* + indicates fish species present

### LAKE ANNE

<table>
<thead>
<tr>
<th>Common Name (Scientific Name)</th>
<th>2007*</th>
<th>1990**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largemouth Bass (<em>Micropterus salmoides</em>)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Smallmouth Bass (<em>Micropterus dolomieui</em>)</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Bluegill (<em>Lepomis macrochirus</em>)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Redear Sunfish (<em>Lepomis microlophus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Pumpkinseed Sunfish (<em>Lepomis gibbosus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Black Crappie (<em>Pomoxis nigromaculatus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Warmouth (<em>Chaenobryttus gulosus</em>)</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

### LAKE AUDUBON

<table>
<thead>
<tr>
<th>Common Name (Scientific Name)</th>
<th>2007*</th>
<th>1990**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largemouth Bass (<em>Micropterus salmoides</em>)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Bluegill (<em>Lepomis macrochirus</em>)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Redear Sunfish (<em>Lepomis microlophus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Black Crappie (<em>Pomoxis nigromaculatus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Brown Bullhead (<em>Ictalurus nebulosus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Channel Catfish (<em>Ictalurus punctatus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>American Eel (<em>Anguilla rostrata</em>)</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

### LAKE NEWPORT

<table>
<thead>
<tr>
<th>Common Name (Scientific Name)</th>
<th>2007*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largemouth Bass (<em>Micropterus salmoides</em>)</td>
<td>+</td>
</tr>
<tr>
<td>Bluegill (<em>Lepomis macrochirus</em>)</td>
<td>+</td>
</tr>
<tr>
<td>Yellow Perch (<em>Perca flavescens</em>)</td>
<td>+</td>
</tr>
<tr>
<td>Black Crappie (<em>Pomoxis nigromaculatus</em>)</td>
<td>***</td>
</tr>
</tbody>
</table>

### LAKE THOREAU

<table>
<thead>
<tr>
<th>Common Name (Scientific Name)</th>
<th>2007*</th>
<th>1990**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largemouth Bass (<em>Micropterus salmoides</em>)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Smallmouth Bass (<em>Micropterus dolomieui</em>)</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Bluegill (<em>Lepomis macrochirus</em>)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Redear Sunfish (<em>Lepomis microlophus</em>)</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Channel Catfish (<em>Ictalurus punctatus</em>)</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

*Collected by electro-fishing techniques in 2007, **Undocumented sampling techniques, *** Not reported from studies cited above, but commonly caught by sport fishermen.
More recently the U.S. Geological Survey (USGS) has conducted at least three special studies of contaminants in Lake Anne. The earliest one recorded trace elements (arsenic, barium, cadmium, chromium, copper, lead, manganese, nickel, strontium, vanadium, and zinc) and major ions (aluminum, bicarbonate, calcium, chloride, hydrogen ion, iron, magnesium, potassium, nitrate, sodium, and sulfate) in precipitation, lake water, and inlet and outlet streams to Lake Anne from 1997 through 1999 to collect baseline information from an urban lake watershed, but no interpretation of the data was presented. Another USGS study found that amounts of arsenic and copper in Lake Anne sediment exceeded what would be expected to occur naturally in this setting. The authors concluded that up to half of the arsenic could be attributed to nearby chromated copper arsenate (CCA)-treated wood, commonly referred to as “pressure-treated wood,” from decks, docks, bulkheading, and fences located immediately adjacent to the lake. Most of the remaining arsenic in the lake sediments came from streams feeding the lake that most likely carried that arsenic from other upstream sources of CCA-treated wood. It is noteworthy that Reston began reducing its use of wooden bulkheads in the late 1990s and instead has promoted the use of plantings and stone to stabilize shorelines and to improve shoreline habitat and water quality. In December 2003, chromated arsenicals manufacturers voluntarily discontinued manufacturing CCA-treated wood products for homeowner uses, but older pressure-treated structures may continue leaching arsenic into the environment for a long time. The U.S. Environmental Protection Agency (EPA) has not banned the use of CCA-treated wood but is currently re-evaluating all chromated arsenicals, including CCA, as part of its Registration Review program (see Docket Number EPA-HQ-OPP-2015-0349 at https://www.regulations.gov).

The USGS report cited above also suggested most of the elevated copper concentrations reported for Lake Anne came from road runoff--dust from wear of automotive brake linings is a significant source of copper. During storms, runoff flows along roads near the lake and then directly into the lake. Likewise, runoff from roads farther away flows into streams that eventually drain into the lake.

In 2008 the USGS conducted a study of a coal-tar-based pavement sealer (sealcoat) in sediment cores taken from Lake Anne. Sealcoat is a black, viscous liquid sprayed or painted on many asphalt parking lots, driveways, and playgrounds to protect and enhance the appearance of the underlying asphalt. Studies by USGS, academic institutions, and State and local agencies have identified coal-tar-based pavement sealcoat as a major source of polycyclic aromatic hydrocarbon (PAH) contaminations in urban and suburban areas. Because PAHs are known toxicants, carcinogens, mutagens, and teratogens (causing birth defects) in aquatic organisms and are potential human carcinogens, they are of potential concern for human health and aquatic life (see also Chapter VII Hazardous and Toxic Materials). The results of the USGS investigation found PAH concentrations in the most recently deposited sediment in Lake Anne were about 18 milligrams per kilogram (mg/kg). Concentrations above 22.8 mg/kg are expected to be toxic to benthic biota. As of 2015, three local governments in the Chesapeake Bay drainage basin have banned coal-tar pavement products: Prince George’s County, Montgomery County, and the District of Columbia.

Because the Reston lakes are nutrient enriched, they support algal blooms that can and do reach nuisance levels from time to time. The primary nutrient that stimulates these blooms is phosphorus. In addition to nuisance algal blooms, rooted and floating aquatic plants have also been problematic in the Reston lakes. A summary of these problems can be found on the RA website.
When overly abundant, floating aquatic plants can become unsightly, affect fishing and boat navigation, and be costly to manage. RA staff surveys the aquatic plant populations each year to determine the extent of coverage and whether the plants are detrimental to boating. Chemical treatments with aquatic herbicides are sometimes needed to control nuisance outbreaks. A biological control involving the periodic stocking of triploid sterile grass carp (Ctenopharygodon idella), sometimes called the white amur, also is employed in all of the lakes to control submerged aquatic plants such as hydrilla (Hydrilla verticillata). These fish are considered experimental by the State of Virginia, and a permit from the Department of Game and Inland Fisheries is required prior to any stocking. Exhibit IV.B-6 summarizes the stocking history of grass carp in Reston waters.

In addition to submerged nuisance plants, a shoreline invasive plant, purple loosestrife (Lythrum salicaria), has become established along all four Reston lakes. It is currently being manually removed. RA generally focuses first on managing non-native invasive plants and then takes direction from residents and the RA Board of Directors regarding other aquatic plant infestations.64

Resident Canada geese (Branta canadensis) populations have also become a nuisance for the Reston lakes (see Chapter VI.E—Wildlife Management Issues). Research indicates that goose excrement contains a wide variety of pathogens including bacteria, viruses, parasites, protists, and fungi that are potentially capable of infecting humans.65 In addition, goose fecal material contains organic matter and relatively high concentrations of nitrogen and phosphorus. It has been reported that a goose can defecate between 28 and 92 times each day and excrete 1.15 – 3.11 pounds of nitrogen and 0.36 – 1.41 pounds of phosphorus per year. Although Canada geese normally do not defecate directly into surface waters, runoff transports their fecal material and nutrients from the shorelines to adjacent lakes and ponds. Resident populations of Canada geese tend to feed and defecate in the same watersheds. Large numbers of geese, therefore, can quickly load fecal material and nutrients into a waterbody and detrimentally affect water quality.66
Exhibit IV.B-6: Grass Carp Stocking History in Reston Waters

<table>
<thead>
<tr>
<th>LAKE/ POND</th>
<th>STOCKING HISTORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANNE</td>
<td>Stocked in 1984 at 8 fish/acre; 8-11 in. length and 0.5 lb.weight.</td>
</tr>
<tr>
<td>THOREAU</td>
<td>Stocked in 1984 at 8 fish/acre; 8-11 in. length and 0.5 lb. weight. Stocked 20 fish in 2011, stocked 80 fish 2013</td>
</tr>
<tr>
<td>AUDUBON</td>
<td>Stocked in 1986, 1988, 1989 and 1990 at rates of 6, 0.5, 2 and 2.5 fish/acre respectively; 8-11 in. length and 0.5 lb. weight.</td>
</tr>
<tr>
<td>NEWPORT</td>
<td>Stocked in 1986, 1989, and 1990 at rates of 6, 2, and 3 fish/acre respectively; 8-11 in. length and 0.5 lb. weight. Stocked 130 in 2015 (10 per acre)</td>
</tr>
<tr>
<td>BUTLER and BRIGHT PONDS</td>
<td>Stocked 20 each pond Nov. 2015</td>
</tr>
</tbody>
</table>

Existing Conditions

Water quality monitoring of the four major lakes is performed by a contractor (currently Aquatic Ecology Consultants, Inc.). Lake monitoring is conducted monthly each year from April through September. Butler and Bright Ponds are currently monitored once per year, usually in July.

The results of the monitoring activities are compiled and analyzed in an annual environmental program report prepared by the contractor.

This information suggests that three of the four Reston lakes are now moderately eutrophic (an indication of nutrient enrichment and high biological productivity), while Lake Thoreau remains in a transition state between mesotrophic and eutrophic based on Carlson’s Trophic Status Index (TSI) values. TSI measurements can range from 1 to 100, with values from 50 to 69 being classified as eutrophic conditions. Values between 40 and 49 are indicative of mesotrophic systems. Mesotrophic lakes have more desirable water quality and usually support well balance aquatic ecosystems. Values of 70 and greater are indicative of hypereutrophic conditions. Hypereutrophic lakes are often seriously impaired from algal blooms, low dissolved oxygen concentrations, and poor light penetration. Three different water quality parameters (total phosphorus, Secchi disk transparency, and chlorophyll a) can be used to calculate a TSI value, and all three are measured in the Reston lakes. Based on data collected for 2016, most TSI values for the Reston lakes are fairly close to their historical averages (see Exhibit IV.B-7). Lake Thoreau had the most desirable water quality, as it typically does.

The current water quality of the Reston lakes indicates that none is in danger of becoming hypereutrophic in the near term. Phytoplankton assemblages in some of the lakes are, however, becoming increasingly dominated by blue-green algae (cyanophytes), which are more likely to create
noxious algae blooms. Moreover, there is increasing concern that global climate change is causing a shift in aquatic ecosystems toward more blue-green algae.\(^6\)

Conductivity values also have been usually high and generally increasing in all four lakes since 2012, for unknown reasons. Conductivity (sometimes referred to as “specific conductance”) is a measure of the electrical conductance of water and is influenced by the total dissolved ionic matter and water temperature. With the exception of Lake Anne, water temperatures in 2016 were substantially warmer than normal from May through the end of the sampling season in September.

### Exhibit IV.B-7: Trophic Status Index (TSI) Values for Reston Lakes

<table>
<thead>
<tr>
<th>Calculated TSI Values for:</th>
<th>Lake Anne</th>
<th>Lake Thoreau</th>
<th>Lake Audubon</th>
<th>Lake Newport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus</td>
<td>51.2</td>
<td>53.4</td>
<td>45.0</td>
<td>47.9</td>
</tr>
<tr>
<td>Secchi Disk Transparency</td>
<td>54.2</td>
<td>53.2</td>
<td>46.8</td>
<td>46.9</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>51.4</td>
<td>56.2</td>
<td>46.9</td>
<td>50.7</td>
</tr>
</tbody>
</table>

More information pertaining to physical, chemical, and biological conditions of the individual lakes and ponds is provided below:

**Lake Anne**

Lake Anne (Exhibit IV.B-8) is the second smallest of the four lakes (24.8 acres). It has a watershed area of 582.4 acres, giving it a watershed-to-lakesurface area ratio of about 23.5:1. It has a mean depth of 13.7 feet. Surface waters enter Lake Anne through two unnamed tributaries of Colvin Run and through immediate drainage from the land surrounding the lake. The northern tributary includes the overflow from Lake Newport, which is located about 1,200 feet upstream from Lake Anne. Lake Anne discharges into Anne’s Run, which empties into Lake Fairfax, 0.6 miles downstream.
Lake Anne has had a long history of nuisance algae blooms. Consequently, two management strategies have been employed in attempts to control these events. First, a diffused forced-air aeration system was installed in 1997 to raise dissolved oxygen concentrations in the water column. When dissolved oxygen concentrations fall too low, phosphorus bound to bottom sediments is released back into the water column where it is again available to nourish algal productivity. Although the installed aeration system did increase dissolved oxygen concentrations in the hypolimnion (deep bottom waters), it failed to trap enough phosphorus in the sediments to lower total phosphorus concentrations in the lake. Thus, nuisance algae blooms continued to be a problem. Consequently, aeration was discontinued. (Note the water fountain near the lake entrance to Lake Anne Plaza is not the aeration system.)

The second strategy involved the application of an algaecide (copper sulfate), beginning in 2005. It has been applied to Lake Anne three to five times each summer since then and as a result, concentrations of chlorophyll $a$ (an indicator of algal productivity) have fallen below levels in untreated years, while phosphorus concentrations have remained elevated above levels that are often associated with nuisance algal blooms.

The 2016 monitoring data indicate that algaecide treatments continue to be effective and to have profound effects on algal densities in Lake Anne. The seasonal density of phytoplankton since treatments began is three times less than it was for the previous 12 years without treatments. Moreover, there has been a shift in the phytoplankton populations of the lake in the last few years to more green algae and less blue-green algae. In 2016, green algae again dominated. The green algae in general are preferable to the blue-greens because they typically do not form the unsightly “scums” nor have the unpleasant odors associated with a heavy blue-green algal bloom.

Since the lake aeration system was discontinued in 2005, dissolved oxygen concentrations have dropped and now more closely resemble what is found in the other lakes. In 2016 the percentage of oxygen saturation in the hypolimnion was less than average, and severe oxygen depletion in it began in June and continued throughout the season. Lake Anne is also part of the EPA’s National Urban Lake Monitoring Program, but specifics on Lake Anne could not be located prior to the completion of this report.
Along with Lake Newport, Lake Anne was one of the first lakes to have its shorelines invaded by purple loosestrife. Now another invasive plant, creeping water primrose (*Ludwigia perploides*), has been found by the Lake Anne dam. Both invasive plant species are currently being removed manually.

In 2004, 2011, and 2015 RA completed shoreline stabilization projects to mitigate erosion problems by placing biologs and natural plantings at selected locations along Lake Anne’s shoreline. Biologs are biodegradable structures made of coconut fiber and planted with native water-loving plants. The plant roots help to stabilize the structure and to re-establish a natural shoreline in eroded areas.

The last fishery survey of Lake Anne was conducted in 2007. It indicated that the fishery was healthy and well balanced. Largemouth bass, the primary target of recreational fishermen, showed good growth rates and indicated an adequate forage base. No special fishery management recommendations were deemed necessary at the time.

**Lake Thoreau**

Lake Thoreau (Exhibit IV.B-9) has a surface area of 40 acres, but its watershed encompasses only 390 acres. The resulting watershed-to-lakesurface area ratio of about 9.8: 1 is exceptionally low for a reservoir and helps explain the relatively good water quality in Lake Thoreau, which historically is the least degraded of the Reston lakes. It has a mean depth of 20.3 feet, the highest dissolved oxygen concentrations in the hypolimnion, and typically the greatest water clarity.

In 2016 Lake Thoreau experienced its best water clarity since 2009 and had the lowest TSI of all the lakes. Chlorophyll a concentrations and phytoplankton densities fell in 2016, but until this season, water clarity had been decreasing and algae densities increasing (especially potentially noxious blue-green algae) for the previous eight years. As in the other Reston lakes, Lake Thoreau conductivity values greatly increased in the past few years. The reasons for these changes are not evident but should be monitored closely. Much of the water entering Lake Thoreau comes from storm drains that serve Reston National Golf Course, Campus Commons, and Soapstone Drive.

Although Lake Thoreau typically has the most desirable water quality of the Reston lakes, it has experienced nuisance invasions of numerous aquatic plants in recent years. The Reston Lake Management Treatment log indicates various aquatic herbicides have been used to control these nuisance aquatic plant outbreaks: Yellow floating heart (*Nymphoides peltata*) was treated from 2011 to 2015 with Renovate MaxG (initially) and with Renovate OTF (after 2012), Eurasian water milfoil (*Myriophyllum spicatum*) was treated with Aquathol-K in 2012 and 2013, variable-leaf pondweed (Potomageton diversifolius) was treated with Clean Amine in 2012 and 2013, fire flag (*Thalia geniculata*) was treated with Glyphosate in 2014, alligator weed (*Alternanthera philoxeroides*) was treated with Glyphosate in 2015, and fanwort (*Calbomba caroliniana*) was treated with a mixture of Clipper Aquatic Herbicide and Reward Aquatic Herbicide in 2015. No aquatic plant treatments were performed in 2016, but it is expected that fanwort may again need to be treated in 2017. Fanwort, variable-leaf pondweed, and hydrilla currently appear to be the most problematic species.
During 2016, RA installed 225 feet of biologs and native plantings to help stabilize the shoreline of Lake Thoreau. Another 160 feet of native plantings were also added along a rocky shoreline to help prevent erosion. The most recent fishery survey of Lake Thoreau indicated that the fishery was "out of balance." Although both largemouth bass and sunfish species were reproducing, their growth rates were abnormal. Results of the survey suggested that there were too many predator fish for the available forage fish. It was recommended that the ratio of forage fish to largemouth bass be increased through selective removal of 4- to 12-inch largemouth bass, with no harvesting of any largemouth bass from 12 to 18 inches in length. Stocking of more forage fish was another option, but was it was considered a more costly option. In 2015 RA placed five fish-attracting structures in Lake Thoreau: Plans are to monitor them in 2017 to determine whether they should be moved to shallower locations.

Lake Audubon

Lake Audubon (Exhibit IV.B-10) is the largest of the four Reston lakes (43.5 acres). It also has the most extensive watershed (1,558.5 acres), giving the lake a watershed-to-lake surface area ratio of 35.8:1. This ratio is the highest of any of the Reston lakes, making it the most difficult lake to protect owing to its susceptibility to external nutrient loading from phosphorus in stormwater runoff. It has a mean depth of 9.5 feet. Snakeden Branch is one of its main feeder streams.
The 2016 monitoring data indicated that whole lake dissolved oxygen percentage saturation values were slightly above average, but dissolved oxygen levels in the hypolimnion were still quite low, especially from July through September sampling events. Although algal blooms have occurred in Lake Audubon, their extent and severity are typically less than observed in Lake Anne and Lake Newport. They are, however, beginning to occur more frequently and with greater severity. *Microcystis*, a genus of blue-green algae which form algal blooms of economic and ecological importance, was present in the fall of 2015. These are the most common toxic blue-green algae in eutrophic fresh water, and they can produce potentially harmful neurotoxins and hepatotoxins, such as microcystin and cyanopeptolin. In 2016 the phytoplankton in Lake Audubon was completely dominated by blue-green algae from May through the end of sampling in September. It has been recommended that sources of phosphorus in the watershed be identified and monitored. It may become necessary to implement other in-lake management options to limit phosphorus or to resort to algaecide treatments as in Lake Anne, should algal blooms continue to worsen.

Hydrilla has been a long-time problem in Lake Audubon. The lake was chemically treated with Aquathol-K in 2002 and with Komeen and Reward in 2008 to control the infestation, but since then stocked grass carp have been used to keep it under control.

As for Lake Thoreau, the 2007 fishery survey found the Lake Audubon fishery to be “out of balance,” and fishery management recommendations (selective removal of small bass) were the same for both lakes. In 2015, rock steps were installed at a fishing point to help stabilize the shoreline and, in collaboration with the Boy Scouts of America, RA added three fish-attracting structures in Lake Audubon in 2016. In 2016 RA sponsored the first Kids Fishing Derby at Lake Audubon where bass 12 inches/under were not returned to the lake when caught.
Lake Newport

Lake Newport (Exhibit IV.B-11) is the smallest and newest of the four major Reston lakes. The overflow from Lake Newport travels downstream to Lake Anne. The lake was not added to the monitoring program until 1992. Lake Newport has a surface area of 12.3 acres and a watershed area of 134.4 acres. The watershed-to-lake surface area ratio of 10.9:1 is low for a reservoir and should help protect it from external sources of nutrient enrichment. It has a mean depth of 9.1 feet.

Exhibit IV.B-11: Lake Newport – Harpers Cove Viewed From Dam

Although Lake Newport experienced increasing algal blooms up through 2006, since then total phosphorus concentrations have remained constant, and chlorophyll a levels and algae densities have declined substantially. Overall water quality of Lake Newport was at its best in 2015 when it also exhibited the greatest year-to-year improvement in water quality of all four lakes. In 2016, however, many of its water quality parameters were back within their historical norms.

Historically Lake Newport has exhibited a shallow thermocline (temperature boundary within the lake) and has suffered from low dissolved oxygen concentrations in the deeper water. Should that situation continue or worsen in the future, Lake Newport’s shallow depth and small surface area may make it a good candidate for installation and operation of an aeration system that would eliminate the shallow stratification, perhaps in combination with copper sulfate treatments to control nuisance algae blooms should they also continue to be a problem.

White water lilies became a nuisance in Lake Newport in the early 2000s and were chemically treated with a glycophosphate herbicide in 2004. Their expansion into the coves and some nearshore areas of the lake in 2010 resulted in renewed treatments with Glyphosate in 2010 and from 2013 to 2015 to
diminish their presence significantly. An infestation of bladderwort was observed in 2015, and chemical treatment for its control was performed in two half-lake treatments in 2016 using the aquatic herbicides Clipper and Reward. In addition, 130 triploid grass carp were released into the lake in 2015 to help control future outbreaks of nuisance aquatic vegetation.

The 2007 fishery survey of Lake Newport found its fishery “out of balance” owing to an inadequate forage base for its largemouth bass population. Management recommendations were the same as for Lakes Thoreau and Audubon: Selected removal of small bass. The 2007 electro-fishing survey failed to collect black crappie from the two-day sampling effort, but black crappies are frequently caught by sport fishermen in the lake.81

**Bright and Butler Ponds**

Bright and Butler Ponds were created in 1989, and both have surface areas of about three acres and maximum depths of about 19 feet. Bright Pond (Exhibit IV.B-12) has a watershed of 93 acres, while the Butler Pond (Exhibit IV.B-13) watershed covers 178 acres. The watershed-to-surface area ratios for Bright and Butler Ponds are approximately 31:1 and 59:1, respectively. Both ratios are high and suggest that the ponds may be easily impacted by stormwater runoff.

Bright and Butler Ponds were first included in the Reston lake monitoring program in 2003 but are sampled only once per year. When sampling is only done once yearly, it is difficult to interpret results because climatological conditions immediately before and during sampling events can have a significant impact on water quality measurements. It also is difficult to determine whether changes in a water quality parameter are indicative of a trend or of short-term pond disturbance at the time of sampling.

It is clear, however, that both ponds are currently eutrophic. Unlike the four major lakes, conductivity values in the ponds declined in 2016. Total phosphorus concentrations in both ponds were high: Bright Pond had the highest value (0.054 milligrams per liter) of all the lakes and ponds in 2016. The pH values recorded for Bright Pond were relatively high at 8.7 in the epilimnion (near-surface waters) and 8.3 in the hypolimnion, but more neutral values were recorded for Butler Pond. Dissolved oxygen was also supersaturated in Bright Pond at the time of sampling. Supersaturation in still water during the daytime is often a sign that the photosynthetic activity of the aquatic plants is extremely high; the plants are releasing oxygen into the water faster than it can equilibrate with the atmosphere, while reducing hydrogen ion concentrations in the water and raising the pH.82 The high pH values seen in Butler Pond, therefore, were probably a natural but temporary phenomenon and not indicative of contamination from an external source.
Hydrilla was also observed growing in near-shore areas of Bright Pond in 2015 and 2016. Grass carp were stocked in both ponds in November 2015, to help control potentially nuisance aquatic vegetation. Phytoplankton assemblages were dominated by green algae in Butler Pond and by blue-green algae in Bright Pond at the time of sampling in 2016. Blue-green algal scums have periodically been observed near the dam on Bright Pond for the past few years.83
**Conclusions**

The Reston lakes and ponds are currently in fair condition but suffer from excessive nutrient enrichment and sediment accumulation. They are healthy enough to provide ample passive and active recreational opportunities, to offer wildlife habitat that increases biologic diversity, and to serve as aesthetically attractive community amenities. They also require active management, however, to prevent or otherwise control problems that could impair the services they provide to the community.

All Reston lakes and ponds are classified as eutrophic systems. Eutrophication is a long-term process that most natural lakes and ponds go through as they age and as nutrients and sediments slowly accumulate on a geologic timescale, but the Reston lakes are suffering from “cultural eutrophication,” which is a greatly accelerated process caused by human activities in the watershed. As nutrients (especially phosphorus) and sediments are flushed into the lakes after precipitation events, they decrease lake depth and stimulate the production of single-celled algae over slower growing submerged aquatic plants. Greater algae densities reduce water clarity, and dead and dying algae settle to the lake bottom where they decompose along with other organic material that has been washed into the lakes by storm events, thus depleting the bottom waters of dissolved oxygen. Low dissolved oxygen concentrations stress lake biological communities.

Cultural eutrophication is a common phenomenon for urban lakes. The good news is that the Reston lakes are only mildly eutrophic at this time, with TSI values typically in the low- to mid-50s. With its even lower TSI values, Lake Thoreau is in a transition between mesotrophic and eutrophic conditions.

Another very favorable factor is that Reston has established a long-term water quality monitoring program. Information derived from this program enables the detection of trends and helps in the formulation and implementation of management strategies to control or mitigate potentially adverse impacts of cultural eutrophication.

Unfortunately, the monitoring data also suggest that algal blooms are becoming more frequent and extensive in some lakes and that maintenance dredging is becoming more expensive. While in-lake chemical treatments for nuisance algal blooms and invasive plant infestations are working, there needs to be a more concerted effort to identify and control the sources of phosphorus loading and sediment erosion in the watershed – before they ever reach the lakes.

The relatively high ratios of watershed area to surface water area for Lake Audubon and Lake Anne suggest that they are more vulnerable than the other lakes regarding external nutrient and sediment loading. Historic water quality data along with the costs and extent of maintenance dredging for these lakes support this premise.

Although there have been periodic fishery surveys conducted in the Reston lakes, the last recorded survey, done 10 years ago, showed an unbalanced fishery in three of the four lakes. It listed recommendations to correct the situation, but it is unclear whether such recommendations are being
implemented. Recreational anglers still catch sport fish in all the Reston lakes, but an assessment of the overall health of the fisheries cannot be made at this time for lack of current data.

**Recommendations**

RA should:

- Continue the Reston lake and pond environmental monitoring program.
- Identify sources of phosphorus and sediment loading in the lake watersheds and implement Low-Impact Development methods and stream reach restoration projects wherever practical.
- Conduct a new fishery survey of the four major lakes to assess fishery management needs.
- Conduct microbial analyses of lake water in early spring to determine the extent of contamination from animal waste, especially overwintering Canada geese.
- Expand education and outreach programs to educate the public about the status of the Reston lakes and ponds, the causes and consequences of cultural eutrophication, and what homeowners, clusters, and corporations can do about it.
IV.C. Stormwater Management

Background

Watersheds are dynamic. The landscape now known as Reston has changed drastically since its earliest, largely forested state. When Reston was first developed in the 1960s, much of the area was no longer forested, having been converted into pasture or cropland reflecting its uses as a dairy farm and a distillery. The originally forested land could receive up to an inch of rainfall without generating any appreciable overland runoff because virtually all the precipitation would have infiltrated into the groundwater or have been taken up by trees or other vegetation and eventually released as water vapor through the process of evapotranspiration.\textsuperscript{54} Even in its intermediate state as pasture and crop land, much of what is now Reston probably absorbed much of the initial precipitation which fell in smaller rain events. As development of Reston occurred, however, much of the pasture and crop land was converted to buildings, roads, parking lots, driveways, sidewalks, and other impervious surfaces that prevented the infiltration of stormwater and exacerbated runoff. Most of this later development during the 1960s and 1970s took the form of a mix of 80 percent mid-to high-density residential areas, with pockets of commercial and office areas. \textbf{Exhibit IV.C-1} illustrates the extent of impervious areas in Reston by watershed. Collectively across all of Reston, impervious areas represent 35 percent of the acreage.

As discussed in \textbf{Chapter IV.A. Streams}, impervious surfaces related to land development result in greater volumes and velocities of runoff, or stormwater, during rain events. In general, public management of stormwater to prevent localized flooding and downstream damage to man-made structures initially focused on directing flows to receiving waters such as streams and wetlands as quickly as possible. What gradually became evident as public concern about streams and wetlands increased in the 1960s and 1970s was that these receiving waters were seriously compromised by “out-of-sight, out-of-mind” stormwater management solutions. Unfortunately, stormwater management techniques addressing impacts on receiving waters were not commonly used in Fairfax County during the period in which Reston developed, resulting in few measures to attenuate the increased peak flows due to urbanization of Reston’s currently developed areas. Because more than a third of Reston’s land cover is composed of impervious surfaces, most of which are directly connected to receiving waters, damaged streams result from the lack of structures to mitigate the impact of stormwater. Also, even though Reston made the progressive choice to use cluster developments in its residential areas to increase the amount of stream buffer zones, these healthy and abundant stream buffers are often bypassed with concrete piping or flumes. Consequently, the natural attenuation that could be provided by the stream buffers was never fully realized because stream flows were concentrated in channels leading to streams, rather than managed to maximize spreading-out flows across to the floodplains.
The U.S. Clean Water Act (CWA) regulates most aspects of water quality via the National Pollutant Discharge Elimination System (NPDES). The NPDES limits pollutants in stormwater to further the CWA’s goals of fishable and swimmable waters. Virginia is one of 46 states which the U.S. Environmental Protection Agency has authorized to issue permits as the tool to achieve these goals. Virginia’s Department of Environmental Quality issues the state’s NPDES permits for stormwater. Fairfax County's NPDES stormwater permit requires limiting pollutants such as oil, fertilizer, pet waste and trash and is implemented by a broad range of county agencies and partners particularly the Stormwater Planning Division and the Maintenance and Stormwater Management Division.
Fairfax County’s stormwater management ordinance establishes standards for controlling impacts from the quantity (volume and velocity) of stormwater and also sets standards limiting stormwater pollutant loadings. Redevelopment, such as that planned or under way in the areas surrounding the Reston-Herndon Transit Stations, is required by this ordinance to meet current quantity and quality standards, although certain grandfathered redevelopment sites are only required to reduce pollutant loadings by 10 percent instead of the 20 percent requirement imposed on other developments.\textsuperscript{86}

The Virginia Department of Transportation (VDOT), as the owner of state highways and related structures and facilities, is required to comply with stormwater regulations and holds its own NPDES permit. Under these requirements, VDOT has been treating nearly 900 acres of impervious road surface area through a system of 190 stormwater basins throughout Fairfax County, including those state facilities within Reston, under the requirements of the 1990 stormwater regulatory requirements. Under the new stormwater regulations effective in 2014, runoff from all existing and proposed impervious pavement on VDOT highway improvement projects will need to be treated before it is discharged into adequate outfalls. These new requirements will increase the acreage of impervious road surfaces subject to runoff controls, as well as expand the number of Best Management Practice measures for treatment of stormwater runoff from highways.

All of Fairfax County, including Reston, lies within the watershed of the Chesapeake Bay. Significant efforts have been taken and resources expended throughout the 64,000 square-mile Chesapeake Bay watershed to restore the water quality and living resources of the Bay. Virginia’s efforts are guided through various management initiatives under the Chesapeake Bay Program (CBP) and pollutant limits established under the Chesapeake Bay Total Maximum Daily Load (TMDL) process.

One element of Fairfax County's implementation of the CBP, including the more-recent Chesapeake Bay Watershed Agreement of 2014, is the County's Chesapeake Bay Preservation Ordinance. Among other policies and requirements are the designation of and the regulation of development within Resource Protection Areas (RPAs). These RPA’s are generally defined as those areas within 100 feet of a perennial (year-round) stream or water body. Restrictions basically seek to preserve undeveloped portions of RPAs by limiting structures and pavement, which increase impervious areas. Based on a combination of hydrological, physical, and biological characteristics, many of Reston’s streams were identified as perennial by field work completed between March 2002 and October 2003. Additional information on the Chesapeake Bay Ordinance and a link to Chesapeake Bay Preservation Area mapping may be found on Fairfax County’s Chesapeake Bay Preservation Ordinance website: \url{http://www.fairfaxcounty.gov/dpwes/environmental/cbay/}

**Existing Conditions**

The effect of directly connected impervious surfaces on stream geometry and health has been much studied.\textsuperscript{87} The consensus of this body of research suggests that the increased frequency of erosive flows due to the presence of connected impervious areas and flow paths causes streams to become incised and over-widened until a state of quasi-equilibrium has been re-established between erosion and deposition in the stream. Many stream reaches in Reston appear to exhibit this unstable state of transition. Exhibit IV.C-2 shows a typical outfall in Reston. In it, the stormwater is transported across
the forested buffer along an impervious flow path directly into the stream, and the streambed has dropped due to channel incision. Systemic channel incision throughout a watershed, as is the case in Reston, effectively disconnects streams from their floodplains. The storm flows that would normally leave the channel and dissipate their energy, depositing their sediment load and recharging surficial groundwater aquifers, are instead confined due to the incising action. More stream erosion therefore takes place, and sediment pulses are transported further downstream rather than naturally distributed along the length of the stream.

Exhibit IV.C-2: Flume-style Concrete Outfall in Reston

In addition to physical changes to the stream, the lack of surficial groundwater aquifer recharge means that during drier times of the year, when the groundwater would ensure some water remained in Reston streams, streams now can become entirely dry. This drying-up of what were previously streams that flowed year-round has serious effects on plants and animals that would normally inhabit the stream. Cyclical dry periods make it difficult for stream biota to re-establish healthy stream communities when water returns during wetter periods.

Extensive streambed and bank erosion, along with the associated sediment-laden runoff, has also led to problems outside the streams. As stated above, Reston dammed several streams to create lakes. When high-energy sediment-laden runoff enters the lakes, their sediment immediately drops out. Substantial amounts of deposition can lead to situations like those shown in Exhibit IV.C-3 and Exhibit IV.C-5. Consequently, as described in Chapter IV.B. Lakes and Ponds, Reston’s lakes require periodic and expensive dredging to remove this sediment.
Since Reston was initially developed, numerous methods of stormwater management using detention and retention have become widely practiced, and even newer methods known as Low-Impact Development (LID) are now being implemented in many places. Detention structures, such as dry ponds, are impoundments which fill during storms then gradually release all their water over a period of time, reducing both the volume and velocity of stormwater flows reaching streams by slowing their release. Between storms, detention structures dry out. Further, studies done in the 1980s determined that retention structures, or wet ponds, in addition to reducing water volumes and velocities, can also reduce the amount of contaminants in stormwater (oil, metals, trash, organic material, animal waste, etc.) that otherwise would reach the receiving streams. Instead, these contaminants remain in the ponds, with some of the organic load being incorporated in vegetation planted in these ponds. Contaminated sediment retained in wet ponds is periodically dredged and placed in sanitary landfills such as those used for municipal waste. Unfortunately, little of Reston’s area benefits from either dry ponds or wet ponds. Exhibit IV.C-4 illustrates the portions of Reston’s land area currently controlled by stormwater measures such as retention, detention or infiltration. It shows how little of Reston’s stormwater is managed in ways that reduce impacts to streams and water quality. As the Dulles Corridor develops in response to the Metro Silver Line, this situation may improve because many of the newer developments are required to meet somewhat more stringent detention or retention requirements.
Exhibit IV.C-4: Reston Area Controlled by Stormwater Measures
LID methods aim to infiltrate, evaporate, or transpire through vegetation much of the rainfall that reaches a site. These low-impact methods are most commonly incorporated in some newer designs and involve on-site infiltration and detention of rainfall using grading, vegetation, and smaller structures such as rain barrels or cisterns. Green roofs, permeable pavers, soil amendments, rain gardens, bio-retention, tree box filters, and many other techniques are employed in LID. Depending on the design and various other factors, incorporation of LID in new development and installation of LID methods as retrofits to existing properties can greatly reduce the impact of stormwater. Reston’s many forested areas, buffers, and extensive urban trees provide some transpiration, but to have a significant effect in reducing stormwater quantities and increasing water quality, many more areas of Reston would need to be retrofitted with LID measures. For more information see: https://www.epa.gov/nps/urban-runoff-low-impact-development

Other problems in Reston’s watersheds that stem from or exacerbate stormwater issues include tree loss, infrastructure damage to bridges and other structures, property loss, flooding, loss of vernal (springtime) pools which provide habitat for amphibians, and invasive species better adapted to flooding and drought cycles becoming established in floodplains. Better management of the areas of Reston currently without stormwater management measures, in conjunction with the ongoing stream restoration efforts, could reduce many of these problems.

Exhibit IV.C-5: Erosion Running Into Lake
Conclusions

The state of the environment for stormwater management in Reston is poor. Today more than a third of Reston’s land area is impervious to rainfall. Active stormwater management in Reston is limited, with relatively few structures that detain and release storm flows at a rate that limits damage to Reston’s streams. This lack of active stormwater management structures leads to poor water quality and the downstream transport of pollutants such as sediment, causing various physical and biological problems in Reston’s streams and lakes.

A combination of stormwater retention, detention, and LID on-site measures could improve the quality and resilience of Reston’s water resources, improving water quality and habitat for biota. With most of Reston fully developed, opportunities to incorporate new stormwater measures are largely confined to areas redeveloping in the future and to voluntary introduction of onsite measures by residents and local land owners.

Recommendations

RA should:

- Track and block any requested waiver of stormwater management and mitigation requirements during the land development or redevelopment process, whether separate from or as part of a development proffer.
- In light of the limited use of stormwater management controls during the period Reston was developed, insist that Fairfax County require that all proposed redevelopment in Reston meet current stormwater pollutant loading requirements without grandfathering.
- Identify failing Fairfax County-owned stormwater management structures including culverts and detention/retention structures; advocate prompt evaluation and either replacement or repair.
- Undertake a program to develop and offer incentives for Reston property owners and/or associations to retrofit their properties with stormwater management measures, especially onsite Low-Impact Development techniques. Incentives considered might include grants, low-interest loans, property tax variations, or financing schemes relying on opportunities such as Virginia’s Clean Water Revolving Loan Fund’s Stormwater Loan Program, and a Fairfax County Conservation Assistance Program grant.
- Continue to manage and to preserve Reston’s urban forests and tree canopy on RA and homeowners’ land, including when reviewing redevelopment proposals, to preserve the stormwater mitigation function performed by well-developed root systems.
IV.D. Drinking Water

Background

Reston gets its potable water from the Potomac River via the James J. Corbalis, Jr. Treatment Plant operated by Fairfax Water and located in Sterling, Virginia (Exhibit IV.D-1). The plant uses ozone as a primary disinfectant, flocculation-sedimentation, biologically active filters with carbon caps, and chloramine final disinfection. Residual solids from the treatment process are dewatered and land-applied off site.

Exhibit IV.D-1: The James J. Corbalis, Jr. Water Treatment Plant in Sterling, VA

The treatment plant routinely monitors more than 170 water quality parameters. Monitoring of seventeen of these parameters is required by state and federal regulations. They include water quality characteristics of Finished Water Quality (water leaving the treatment plant for distribution or storage), Process Water Quality (water at various points during the treatment procedures), and Distribution System Water Quality (treated water piped to homes and businesses), as listed below:

Finished Water Quality
- alpha emitters
- barium
- beta/photon particles
- fluoride
- nitrate
- nitrite
- radium

Process Water Quality
- total organic carbon
- bromate
- turbidity

Distribution System Water Quality
- total coliform bacteria
- fecal coliform/E.coli bacteria
- copper
- lead
- total trihalomethanes
- haloacetic acids
- total chlorine
Existing Conditions

Based on the 2016 Annual Water Quality Report, none of these regulated water quality parameters exceeded state or federal limits for safe drinking water. Fairfax Water also tests for several unregulated metals, the microbial pathogen Cryptosporidium, and selected emerging water quality concerns such as pharmaceuticals and health care products and endocrine disruptor compounds. Fairfax Water has also voluntarily conducted special monitoring studies of perchlorate and hexavalent chromium. To date, results from these additional monitoring projects have not detected a problem for Fairfax County drinking water. For more information on drinking water quality in Fairfax County, see www.fairfaxwater.org/water/water.htm.

Conclusions

Reston’s drinking water supply is of good quality. Fairfax Water not only monitors for regulated contaminants but also routinely monitors emerging chemicals of concern.

Recommendations

Because Reston has no authority or responsibilities for monitoring or treating its drinking water and there are no evident problems with the quality of potable water received from Fairfax Water, there are no recommendations.
V. Vegetation — Introduction

The Piedmont Physiographic Province, in which Reston is situated, supports many plant species. Contributing to its diversity are the region’s ample precipitation, humid summers, and mild winters. The Piedmont is also the northern limit for the range of several southern species and the southern limit for several northern species. It also supports some plants more commonly associated with the flat Coastal Plain Province to the east and others more adapted to the higher-elevation Blue Ridge Province to the west.

In addition to climate and physiography, soil conditions are a major controlling factor for the composition of plant communities, and Fairfax County has more than 100 soil types. Despite the density of development in Reston and the associated impervious surfaces, there are some intact and semi-intact natural soil profiles which support plant diversity. Also, the diversity of plant communities associated with different soil profiles support diversity in the wildlife they attract. Reston’s many continuous and discontinuous buffers, natural area parcels (including meadows, wetlands, and forest), and watersheds make for a unique natural community in which soil types determine plants, plants determine wildlife, and people are positioned near and connected to nature.

Nature and human activity have interacted to change the flora of what is now Reston. Originally, the land was mostly wooded with a mixture of hardwood and conifer species. With European settlement, much timber was removed and the soil cultivated. When the land was purchased to create Reston, it was mostly rolling pasture and part of the largest farm in the state of Virginia – a dairy farm. It was also the site of the Bowman distillery.

According to Fairfax County’s land use assessment, Reston today has nearly 50 percent tree cover, with small areas of grass, playing fields, meadows, and wetlands. These plant communities provide a host of beneficial services to residents but also are facing several serious threats, including physical loss from increased urbanization, invasive non-native animal and plant species, overabundant deer populations, and unauthorized debris removal and disposal activities.

Beyond these immediate environmental challenges, global climate change is likely to have longer-term consequences for Reston’s plant communities. Changes in atmospheric carbon dioxide (CO₂) concentrations, altered precipitation patterns, greater temperature extremes, and lengthening growing seasons all affect how well plants can germinate, grow, reproduce, and compete with one another. These factors also affect the distribution of plant pathogens and plant-animal relationships. The following chapters of this report describe the condition of Reston’s tree cover, meadows, and wetlands in the context of their most important immediate environmental challenges. Future impacts of climate change on trees are not addressed. Native poison ivy (Toxicodendron radicans) vines, however, are benefitting from increased CO₂ and have grown larger leaves, producing bigger plants and developing more potent toxic oil.
V.A. Tree Cover

Background

The Piedmont region’s forest canopy consists of upland and lowland forests primarily of maple, oak, hickory, tulip poplar, blackgum, pine, red cedar, and beech trees. The woodland deciduous forest is one of the best-known habitats in the eastern United States and is known worldwide for its stunning fall colors. Forests comprise a complex ecosystem made up of soil, water, trees, shrubs, microorganisms, and climate.

Before Reston existed, 4,000 acres were purchased by Smith-Bowman from Kentucky in 1927 and named Sunset Hills Farm. In 1947 the farm was expanded by 3,000 acres and became the largest in Northern Virginia. Therefore, in 1961, when Robert Simon purchased the land for Reston, it was rural, mostly rolling pastures and woodlands. In 1963, construction began on the new town of Reston. As parcels were developed, the surrounding area was either allowed to reforest or was reforested with native tree seedlings. Management plans were developed for each parcel, and Reston’s urban forests were planted by staff, volunteers, and a youth maintenance corp. Today, more than 50 years later, Reston’s urban forests are among its most prominent features and most important environmental attributes (Exhibit V.A-1).

Exhibit V.A-1: Aerial View of Reston’s Urban Forests

Reston has been designated a Tree City by the Arbor Day Foundation each year since 1994. RA has twice received the Gold Leaf Award from the Mid-Atlantic Chapter of the International Society of Arboriculture for Reston’s Arbor Day activities and for educating residents about trees. Reston’s America in Bloom Award in 2003 was for its commitment to the natural environment. Many residents have indicated that the town’s attractive woodlands and connecting pathways were instrumental in their decisions to move to Reston.

Of Reston’s 1,300 acres of open space, about 800 acres are natural area parcels managed and maintained by RA. There are three wooded areas in Reston also owned by the Fairfax County Park Authority (FCPA): South Lakes Park, Stevenage Road Park, and Stuart Road Park. Other significant natural areas adjacent to Reston and owned by FCPA are Fred Crabtree Park and Lake Fairfax Park. Some Reston clusters and private property also have wooded areas.
Reston’s 800 acres of natural area are further divided into about 450 separate parcels. The largest wooded parcel RA owns is the Walker Nature Center (WNC) which comprises 72 acres. Other wooded areas include the Snakeden and Glade stream valleys, Bright Pond natural area, Buttermilk Creek Trail, North Hills Park, and the Twin Branches Nature Trail area. Many of the other natural wooded buffer areas are much smaller parcels, with some only 20 feet wide. Although these small parcels provide screening and wildlife value, they also are easily overwhelmed with invasive species from adjacent properties, creating a fragmented forest. Forest fragmentation is a form of habitat in which forests are reduced (either naturally or due to human activity) to relatively small, isolated patches. For more information on fragmented forests, see: http://www.takepart.com/article/2015/03/25/earths-forests-are-broken.

There is a growing understanding of the importance of the urban forest to the human condition. Trees in urban areas provide numerous benefits to humans by enhancing environmental, economic, and aesthetic values. Environmental value is provided by ecosystem services such as carbon storage, carbon sequestration, air pollution reduction, and interception of precipitation which can reduce stormwater runoff and erosion and recharge groundwater. Trees also provide substantial ecological benefits to wildlife, serving as food sources, breeding grounds, and cover. Other specific characteristics of urban forests that benefit society include their potential for reducing energy use in buildings and affecting aesthetics and even property values. Additionally, the influence forests have on the physiological and psychological wellbeing of humans is receiving more attention from the medical community. Spending time in a forested environment (termed “Forest Bathing”) is commonly prescribed for patients in Japan to lower blood pressure and stress hormone levels and to counter depression. Urban forests are, however, also vulnerable to the impacts of humans, who are part of the ecosystem of an urban forest. Human actions, both positive and negative, can have a ripple effect throughout the forest.

In 2012 the University of Vermont Spatial Analysis Laboratory developed the Urban Tree Canopy (UTC) analysis for Fairfax County. These data were updated in 2016 using satellite imagery from 2015. This information is now being used to calculate the environmental benefits of the County’s urban forests, such as carbon sequestration, stormwater management, air and water quality benefits, and energy conservation, based on science and Web-based tools like i-Tree developed by the U.S. Department of Agriculture’s Forest Service. These efforts are in support of the County’s Tree Action Plan Core Recommendations and will be further revised and updated in Fiscal Year 2017.

Reston is one of the top 10 fastest growing areas in Virginia, and the pace of development is expected to increase, primarily due to the Metro Silver Line expansion. This development changes the environment of the urban forest. How it is done will impact the health of the remaining forests and the ecological services they provide. Open spaces established as the result of new development/redevelopment can be designed to accommodate more tree plantings and maximize the beneficial services such trees provide.

Awareness of rapid tree canopy loss in the early 1970s prompted Fairfax County to adopt its first tree preservation and planting ordinance by 1973, and since then various task forces and committees, and
most recently a County Tree Commission, have engaged the community in examining how to limit the loss of tree cover during land development. In 2005 the Tree Commission submitted a Tree Action Plan to the County Board’s Environmental Committee which in turn directed the Urban Forest Management Division to form a Tree Action Plan Work Group (TAP Work Group) focused on the following three goals:

1) Commit to preserve current tree assets by fostering health and regeneration of specimen trees and urban forest,
2) Enhance the legacy for future generations by increasing the quantity and quality of trees and wooded areas, and
3) More effectively integrate urban forestry with planning and policy making.

Fairfax County now implements several programs and policies directed at the preservation and conservation of urban forests. In 2006, it also developed a “20-Year Strategic Plan to Conserve and Manage Fairfax County’s Urban Forest” available here. In 2008, the County Board of Supervisors adopted a “Tree Conservation Ordinance” which became Chapter 122 of the Fairfax Code of Regulations, further emphasizing tree preservation over tree planting when meeting County tree canopy requirements. For more information, click here.

Currently the Urban Forest Management Division (UFMD) of the County’s Department of Public Works and Environmental Services coordinates and implements the county’s efforts to manage its urban forest resources, including advancing the RA Board of Directors’ Environmental Vision to:
- Increase tree conservation in land development,
- Improve air quality through tree conservation policies and practice,
- Improve water quality and stormwater management through tree conservation, and
- Foster an appreciation for the urban forest and inspire county residents to protect, plant, and manage trees and forest stands on public and private lands.

RA also has established tree protection and conservation policies and directives. Tree removal policies are determined by the Design Review Board. Policies for all types of Reston properties can be accessed on the RA website:
https://www.reston.org/LinkClick.aspx?fileticket=phjab2HYxKM%3d&tabid=382&portalid=3&mid=1547

**Existing Conditions**

**Exhibit V.A-2** illustrates existing land uses as a percentage of Reston’s total area. Tree cover is the dominant class as indicated by the following percentages:

- Tree Cover 49.6%
- Tree over Impervious 6.3%
- Grass/Shrub 14.6%
- Buildings 9.0%
- Bare Soil 0.1%
- Impervious 18.3%
- Water 2.1%

For comparison, the overall tree cover goal for Fairfax County is 53 percent.
According to the tree inventory done by Wetland Studies and Solutions, Inc. for Reston stream work (see Chapter IV.A Streams), 67 species were identified in Reston’s riparian areas (near lakes and streams) alone. The majority of Reston’s existing upland woodlands are mixed hardwoods typically dominated by red and white oaks, yellow poplar, red maple, and blackgum.

The red oak (*Quercus rubra*) is one of the most common and widespread species, found in a variety of forest types. It is also commonly used as an ornamental because of its beautiful fall color, ease in transplanting, longevity, and symmetrical growth. White oaks (*Quercus alba*) can be differentiated from red oaks by the rounded lobes on their leaves and whitish flaky bark. They generally have a rounded crown and stout branches and tend to hold their leaves throughout the winter, providing cover from winter winds. Many birds use white oak leaves and twigs as nesting material and food. The leaves and acorns of oaks are a primary food source for many species of wildlife. The number of acorns that a white oak tree produces varies. Some seasons, it produces none at all. Grey squirrels are responsible for spreading many of the acorns and dispersing this species throughout the forest. White oak acorns mature in one year and germinate in the fall while red oak acorns usually mature in two years and germinate in the spring. This time variation in the ripening of acorns helps make food sources available to wildlife for a longer time. More than 96 species of wildlife use acorns as a food source. Among the many birds that consume them are wood ducks, blue jays, white-breasted nuthatch, brown thrasher, and wild turkey. Mammals that eat acorns include raccoons, flying squirrels, eastern chipmunks, white-footed mice, and deer.

Yellow poplar (*Liriodendron tulipifera*) or tulip trees are distinctive and easy to recognize in the forest year-round. Their trunks are generally straight and very tall with narrow crowns. They produce an abundance of brown seeds that flutter to the ground like a helicopter; only a small percentage of the seeds germinate. Cardinals are especially attracted to the seeds. Yellow poplars are cross-pollinated by honeybees and produce a dark, strong-flavored honey. The leaves have four to six lobes with a deep notch at their apex. A member of the magnolia family, they turn a bright yellow in the fall.
Exhibit V.A-2: Reston Land Cover
Red maples (*Acer rubrum*) are commonly found in both dry and moist sites from Maine to Florida. They are fast-growing, flower early in spring before leaves appear, and provide dense shade during the summer. Buds of all maples are opposite each other on either side of the twig. Some part of a red maple is red in each season: Red buds in winter, red flowers in spring, red leaf petioles in summer, and a spectacular display of red fall color after the first frost. This maple is the favorite food of the white-tailed deer and is one of the most common hosts of mistletoe (*Phoradendron leucarpum*). Mistletoe is a commonly used Christmas green, is parasitic on sunny branches, and produces berries that cedar waxwings and bluebirds consume.

Blackgums (*Nyssa sylvatica*) trees, also called black tupelo, are another common tree of Reston’s woodlands. They can be identified by their branches sprouting at a 90-degree angle from the trunk. They are typically the first tree in Reston to turn a crimson red color in the fall, as early as the end of August. Blackgums produce small bluish black berries eaten by robins, pileated woodpeckers, mockingbirds, and thrushes. The tree also produces excellent honey.

The understory and wood edges of Reston’s deciduous forest are rich in diversity. Light, soil type, seedbank, and moisture determine the exact species composition. Seedbank refers to the quantity of seeds in the soil. Redbud (*Cercis canadensis*) and eastern flowering dogwood (*Cornus florida*) are two spectacular spring bloomers common to Reston’s woodland understory and forest edges. Redbuds are in the legume or pea family as evident from their pod-shaped seeds. Redbud branches appear delicate and suffer from dieback (dying from the tips of its leaves or branches inward), but they rejuvenate on sucker branches. Their magenta flowers are attached to the branch, are edible, and can add color to a spring salad.

Dogwoods are one of the most important forest trees because many kinds of wildlife use their seeds, fruits, flowers, twigs, bark, and leaves as food. At least 36 species of birds eat the dogwood’s high fat-content berries, as do many kinds of mammals. In the fall, the rapidly decomposing leaves are food for many detritivores (organisms that process decomposing organic matter), from bacteria to land snails. In addition to being a source of food for many animals, dogwoods also play a key role in the calcium cycle of the forest. Calcium is an essential nutrient for both plants and animals. Unlike most other trees and plants, dogwoods have the ability to “mine” calcium from soil and rocks. The trees concentrate the mineral in their leaves and wood. When the leaves fall in autumn, that calcium becomes available to the rest of the plants and animals in the forest. Dogwoods in many areas, including Virginia, are succumbing to the dogwood anthracnose fungus (*Discula destructiva*), a non-native fungus that has killed over 95 percent of the dogwoods in some locations. Dogwood trees growing in lower elevation areas such as Reston are much less likely to die from anthracnose than trees growing at higher elevations; dogwoods growing above 3000 feet elevation are at highest risk.

The forest shrub layer is adapted to grow in low-light conditions and under openings in the forest canopy. Both highbush and lowbush blueberry (*Vaccinium corymbosum* and *V. angustifolium*, respectively) fill the shrub layer niche in Reston’s forest. They prefer acid soil yet grow in both moist and dry sites. Similar in appearance, these blueberries form colonies that provide a bountiful food source, with the berries, leaves and twigs all eaten by wildlife. Many songbirds including bluebirds,
thrushes, and the scarlet tanager eat the fruit. The prolific flowers are white to pinkish and urn shaped. Red in fall, these native Reston species are excellent for home landscaping, especially along a hedgerow or fence line.

There are many species of viburnum (Viburnum spp.) that grow as part of the shrub layer in a variety of Reston sites. All of them have opposite buds and produce drupes, a kind of fleshy fruit eaten by wildlife in fall and early winter. The fruit can also be made into preserves. One of the more common species is blackhaw viburnum (V. lentago), sometimes called plum viburnum, a reference to the shape of its leaves. Blackhaws attain a height of about 20 feet and have clusters of white flowers in the spring with dark blue drupes.

Reston also has groves of evergreen forest. In some areas, there are American hollies (Ilex opaca), stands of pines (Pinus spp.), or eastern red cedar (Juniperus virginiana). Hollies, with their spiny leaves and brilliant red berries, are well known as Christmas decorations, but they also provide dense shelter and food for songbirds. One particularly good-quality stand of holly grows in the moist woods on WNC’s south side.

Virginia pines (Pinus virginiana) and eastern red cedars are temporary forest trees in terms of succession: They are pioneer species that colonize old fields left to grow fallow and are typically replaced by hardwoods over time. Fire, cutting, and disturbance by utilities regenerate a pine forest. Both Virginia pines, also called scrub pines, grow thickly, their mass making up for their sometime spindly growth. They grow in poor soils and have two short needles per bundle or fascicle. Eastern red cedars are important as a nesting site for birds and are used as a larval food source by the olive hairstreak butterfly (Callophrys gryneus). Their dark blue berries are eaten by cedar waxwings, also called cedarbirds.

Exhibit V.A-3: English Ivy Pulling Down a Tree
The extent of tree cover alone is not indicative of a forest’s health. Currently Reston’s urban forests are facing a number of threats in addition to those presented by development and re-development activities. These threats include competition from invasive plant species, overgrazing and browsing by deer, infestations of invasive insects, and open space violations such as unauthorized removal of deadwood and dumping.

In 2016, RA developed and began implementing a systematic assessment of Reston’s natural areas by RA staff and citizen scientist volunteers. Preliminary survey results (see Exhibit V.A-2) indicate that 38 percent of the urban forest is dominated by 50 percent or more invasive plant species. Only 10 percent of the forest contains 0-5 percent invasive species. Of the invasive species found in the forest, the two most abundant invasive species are bush honeysuckles, (Lonicera spp) and English ivy (Hedera helix) (see Exhibit V.A-3 and Exhibit V.A-4). Exhibit V.A-5 lists these and other invasive plant species impacting Reston’s urban forests. [http://www.dcr.virginia.gov/natural-heritage/invsppfdlist](http://www.dcr.virginia.gov/natural-heritage/invsppfdlist)

**Exhibit V.A-4: Bush Honeysuckle Shrub**
The Virginia Invasive Plant Species List comprises species that are established — or may become established — in Virginia, cause economic and ecological harm, and present ongoing management issues.

The list is for educational purposes only and has no regulatory authority.

To be included on the list, there must be demonstrable evidence that a species poses a threat to Virginia’s forests, native grasslands, wetlands or waterways.

The Virginia Department of Conservation and Recreation’s Invasive Species Assessment Protocol, approved by the Virginia Invasive Species Working Group, May 2015, was used to conduct a risk assessment for each listed species. Species were ranked as exhibiting high, medium or low levels of invasiveness based on their threat to natural communities and native species.

www.dcr.virginia.gov/natural_heritage/invspecies.shtml

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<th>Scientific Name</th>
<th>Common Name</th>
<th>Virginia Invasiveness Rank</th>
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<th>Plant %</th>
<th>Coastal %</th>
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continued
Invasiveness rank is higher for species that:

- Alter ecosystem processes, such as succession, hydrology or fire regime.
- Are capable of invading undisturbed natural communities.
- Cause substantial impacts on rare or vulnerable species or natural communities or high-quality examples of more common communities.
- Are found widely distributed and generally abundant where present.
- Disperse readily to new areas.
- Are difficult to control.

**Early detection species**

The list includes a subcategory of invasive plants that are considered early detection species. These species not yet established or, if established, are not yet widespread in Virginia but known to be highly invasive in habitats similar to those found here. If discovered in Virginia, these species need to be quickly mapped, photographed and reported to DCR.

The management goal for early detection species is eradication, as preventing the establishment and spread of newly arrived species will save valuable natural and economic resources.

**INFORMATION**

For more information, or to report early detection species, contact Stewardship Biologist Kevin Heffernan with the Virginia Department of Conservation and Recreation at 804-786-9112 or kevin.heffernan@dcr.virginia.gov

**Photo credits:**

Tree-of-heaven, Chuck Barger; University of Georgia, Bugwood.org. Pragmites, Jil M. Swearingen, USDI National Park Service, Bugwood.org. Wavyleaf grass, Kerri L. Kyde, Maryland Department of Natural Resources, Bugwood.org.

**Citation:**

RA is using this information, in part, to establish restoration priorities and staff work schedules while optimizing its limited resources for removing selected invasive plants from the natural areas. Removal techniques being used include mechanical, chemical, and manual approaches, depending upon the location and invasive plant species identified. The percentage of invasives per acre of natural areas is shown in Exhibit V.A-6:

Exhibit V.A-6: Invasive Plant Dominance in Natural Areas of Reston

Another current threat to the health of Reston’s forests is the increasing deer population. At high population densities, deer can greatly alter the appearance and ecology of forest vegetation both directly and indirectly. Overabundant deer populations can denude forests of their shrubs and saplings, jeopardizing future regeneration. Birds that nest in shrubs, or in the intermediate layers of the forest, may decline. In some forests native white trilliums that once dominated the forest floor have all but disappeared, replaced by garlic mustard, an invasive exotic that deer avoid (Exhibit V.A-7). Garlic mustard, in turn, produces antifungal chemicals that can suppress native plant growth by disrupting mutualistic associations between native tree seedlings and belowground mycorrhizal fungi. The possible connections between deer, garlic mustard, and soil fungi illustrate the profound complexity of forest ecosystems.
In addition to garlic mustard, some other plants resist deer herbivory (eating of plants), owing to chemical or morphological defenses or low digestible content. Among major woody plants found in Reston, black cherry, American beech, spicebush, and mountain laurel are among the species less palatable to deer. Native herbs that are consistently avoided by deer include white snakeroot, black bugbane, mayapple, blue cohosh, Pennsylvania sedge, and eastern hay-scented fern.

Deer also feed on invasive exotic plant species and can suppress the growth of some of them, but in many cases, the invasive species appear to be disproportionately resistant to deer herbivory. Examples include Japanese stilt grass, garlic mustard, dame’s rocket, black swallow-wort, creeping buttercup, chervil, celandine, goutweed, glossy buckthorn, Japanese barberry, multiflora rose, jetbead, wine raspberry, and tree-of-heaven.

White-tailed deer also consume the seeds and fruits of many plant species, and when excreted, a surprisingly large number of seeds remain viable, including a high proportion of exotics. Among the exotics are some highly invasive species, such as autumn olive, wine raspberry, and multiflora rose. Reston’s response to the overabundant deer population is described in more detail in Chapter VI.E Wildlife Management Issues.

In addition to the long and growing list of invasive plants that out-compete native vegetation, there are a host of insect threats to Reston’s urban forests. Among the most problematic are the gypsy moth (<i>Lymantria dispar dispar</i>), hemlock wooly adelgid (<i>Adelges tsugae</i>), the emerald ash borer (<i>Agrilus planipennis</i>), fall cankerworm (<i>Alsophila pometaria</i>), and orange striped oak worm (<i>Anisota senatoria</i>). The tent caterpillar (<i>Malacosoma americanum</i>) is a native insect that defoliates wild and ornamental cherry trees, crab apple trees and maples. This defoliation occurs early enough in the spring, however, that trees will re-leaf-it and not cause long-term damage.

Gypsy moths (<i>Lymantria dispar dispar</i>) are an invasive pest first introduced to the United States from Europe in 1869. They can cause major defoliation of trees. They have been present in Reston, and control is coordinated with Fairfax County. A fungus which attacks the larvae has been introduced into the environment. Although defoliation from gypsy moth caterpillars has declined in recent years, Fairfax County Forest Pest Management staff continues to monitor the gypsy moth. No control treatments were deemed necessary in the County in 2015 or 2016. Gypsy moth populations, however, are cyclical, and it is not uncommon for outbreaks to occur following dormant phases.

The hemlock wooly adelgid, a member of the true bug (hemiptera) order of insects, is native to East Asia. It sucks the sap of hemlocks and spruce trees. Native eastern hemlock (<i>Tsuga canadensis</i>) is relatively rare in Fairfax County, but it is found in Reston. Fairfax County has begun treating selected stands of hemlock owing to the rarity of this species and its natural beauty. County staff will continue...
to inventory the county to identify the natural stands of eastern hemlock deserving protection. In 2016, county staff treated trees in two native stands, in Dranesville and Springfield magisterial districts, by injecting the insect growth regulating pesticide azadirachtinor. RA’s management approach is to avoid planting hemlocks.

Ash trees are popular landscape trees due to their size and pyramidal shape. The ash tree is also the host plant for the ash sphinx moth (*Sphinx chersis*). The emerald ash borer is a beetle introduced from northeastern Asia that lacks effective biological controls in North America. It was first identified in the United States in Michigan in 2002. Since then, its population has exploded, and it is now killing millions of ash trees nationwide, including in Reston. At the present rate of tree loss, it is possible that ash trees will disappear completely from U.S. forests, as did the American chestnut, which was once a prominent part of our forests before the chestnut blight. Although ash trees make up a relatively small part of Reston’s urban forest, many dead and dying ash trees have already been removed in Reston.102

The fall cankerworm (*Alsophila pometaria*) is a native pest that feeds on a wide variety of hardwood trees. It typically has periodic outbreaks causing defoliation. The last two outbreaks in Northern Virginia were in 2012 and 2013. Fairfax County’s Urban Forest Management Division established a Cankerworm Task Force in 2015 to develop a strategy for controlling future outbreaks. This pest has had limited impact on Reston’s forests.

The orange striped oak worm (*Anisota senatoria*) is the larva of a native moth which defoliates some Reston oak trees, but it generally occurs in the fall when the leaves are about to fall off anyway. RA does not treat for these potential pests.
Another on-going threat to the health of Reston’s forest is the loss of deadwood from the forested environment. The importance of deadwood in the forest cannot be overstated. Snags (dead trees, Exhibit V.A-8), logs, and sticks on the ground constitute the coarse woody debris that occurs naturally in the woods and are signs of a healthy forest. Snags are used by owls, woodpeckers, bluebirds, chickadees, bats, and tree frogs. Raccoons, squirrels, and foxes nest in hollow logs, and downed wood on the forest floor is important habitat for salamanders, skinks, and many kinds of invertebrates. A potential limiting factor for some wildlife is the number and size of standing dead trees suitable for nesting. For example, Reston’s largest woodpeckers (red-bellied and pileated woodpeckers) require dead trees larger than 14 inches in diameter for nesting. The unauthorized removal of these materials and clearing of understory reduces wildlife habitat and adversely impacts the recycling of essential nutrients and minerals to the forest ecosystem.

Conversely, too much deadwood and organic debris deposited as unauthorized dumping, however, can be destructive to the urban forest. When excessive amounts of additional brush and leaves are concentrated in a small area, their decay can deprive tree roots of oxygen and moisture which can kill the trees. Large loads of organic yard debris can overwhelm natural systems, smothering the forest floor and killing woodland wildflowers, ferns, and the tree seedlings that will ensure the next generation of forest.

The potential negative impacts of unauthorized dumping include the following:

- Loss of native vegetation and the food/habitat they provide for wildlife
- Destruction of plant layers
- Reduced plant regeneration
- Reduced wildlife populations
- Soil erosion
- Loss of “sense of place”
- Changed perception of what a natural area should look like
- Loss of biodiversity
Exhibit V.A-9: Unauthorized Dumping of Yard Debris

Other open space violations such as mowing, clearing, and chemical spills, as well as poor construction and maintenance practices by utility companies also occasionally cause damage to Reston’s urban forests.

Conclusions

The state of Reston’s tree cover is fair.

Reston now has relatively extensive tree cover, with much of its urban forest having been established after the land was first purchased for development in the early 1960s. Reston is nationally recognized for its tree cover and tree care, as attested by the many awards it has received from professional arboriculture organizations. Today its forested parcels are generally in fair condition. They support a healthy diversity of tree species that in turn can support a wide variety of wildlife. Apart from their contributions to wildlife habitat, Reston’s urban forests provide many important ecological, economic, and aesthetic services. These include: Capturing and storing carbon, reducing stormwater runoff, reducing soil erosion, improving air and water quality, providing a sense of place, enhancing property values, and providing visual screening. Trees also help residents conserve energy by reducing wind speed and providing cooling benefits through shade and evapotranspiration, the process whereby liquid water is released through stomata in the leaves and moves back into the water cycle as atmospheric water vapor. The importance of trees to a healthy Reston can hardly be overstated.

Reston’s existing urban forests, however, are being threatened by land development and re-development, invasive plant and animal species, deer overpopulation, and inappropriate debris removal and dumping in the woods. The high percentage of forest parcels now dominated by 50 percent or more invasive plant species, along with overbrowsing by deer, are the main reasons that
Reston Tree Cover is being rated as Fair instead of Good. Native, intact plant communities that exist on RA property need to be protected and restored to help preserve biodiversity, sustainable habitat, and healthy food webs. Human activities and exotic plants and animals that adversely affect these native communities need to be addressed and controlled or managed. Compared to other urban communities, Reston is fortunate to have the abundant urban forest parcels, but they need to be continuously monitored and carefully managed to keep them healthy and to maximize the many beneficial services they provide.

**Recommendations**

RA should:

- Increase the quality and quantity of tree cover by planting more trees and replacing removed trees with native species.
- Continue initiatives to emphasize deer management and removal of invasive plant species.
- Reinforce with better and broader communications the Design Review Board requirement for residents to request and receive permission prior to removing any trees over four-inch Diameter Breast Height.
- Increase outreach and communication on sound woodland management practices, including leaving dead trees (“snags”), wherever they are not a hazard, for wildlife to use.
V.B. Meadows

Background

Meadows are an important habitat characterized by a predominance of grasses and wildflowers. Meadows provide a place for sun-loving species to survive, and they increase the biodiversity of Reston’s natural areas otherwise dominated by forest habitat. When left undisturbed and unaffected by fire, meadow habitats in Eastern North America undergo a process known as “old-field succession” in which they become colonized by shrubs and fast-growing, shade intolerant trees such as eastern red cedar and loblolly pine. These species, in turn, are eventually replaced by slower growing, more shade tolerant species, ultimately converting the meadow to forest. Because meadows are inherently transient systems, they require management to maintain them in a relatively stable state.

Prior to Reston’s development, much of the land was kept in pasture, supporting the largest dairy farm in Virginia. Today, large meadow or grassland habitat is simply no longer available in Reston due to development pressures to accommodate humans. RA actively manages Reston’s small remaining meadows as necessary, however, to stabilize and to restore them. Owing to the diversity of annual, biennial, and perennial plants that grow in a meadow, these habitats can appear unkempt even when well managed. This situation sometimes leads to residents’ complaints regarding the need for more frequent mowing of Reston’s meadows, and it underscores the need for better community education about the ecological importance of meadows and how they are managed.

Meadows are especially important habitats for pollinator species. Pollinator decline is well documented worldwide; however, the presence and status of pollinators have not been systematically studied in Reston. Population estimates of pollinator insects, particularly bees and butterflies, are difficult to confirm. Meadow lands also are often targets for development (e.g., for recreational fields or construction of storage units) because construction is typically less expensive in areas where no large trees need to be removed.

Existing Conditions

Exhibit V.B-1: Butterfly Weed

There are about 50 small meadows spread throughout RA land. All the meadows are mapped and vary greatly in size and species composition. Most of them are small “pocket” meadows, under one-quarter acre in size, except for Purple Beech and Stones Throw meadows, which are each about one acre. In total, Reston has about 12 acres of meadow habitat, not including the area around the transcontinental pipeline that runs through Reston. RA maintains the meadows and keeps a list of seed mixes that have been used at each site; the seed mixtures vary according to site characteristics. Typically, grasses make up 60-70 percent of the seed mix in meadows, while flowering plants such as black-eyed Susan (Rudbeckia hirta), tick-seed sunflower (Coreopsis tripteris), goldenrod (Solidago spp.), Joe-pye-weed (Eupatorium maculatum),
butterfly weed (*Asclepias tuberosa*) (*Exhibit V.B-1*) and other species make up the remainder of the seed mix (*Exhibit V.B-2*).

**Exhibit V.B-2: List of Sunny Wildflower Mix Sample**

<table>
<thead>
<tr>
<th>Plant Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indian Grass (<em>Sorghastrum nutans</em>)</td>
</tr>
<tr>
<td>Little Bluestem (<em>Schizachyrium scoparium</em>)</td>
</tr>
<tr>
<td>Bottlebrush Grass (Elymus hystrix L.)</td>
</tr>
<tr>
<td>Broom Sedge (<em>Carex scoparia</em>)</td>
</tr>
<tr>
<td>Round-leaved Thoroughwort (<em>Eupatorium rotundifolium</em>)</td>
</tr>
<tr>
<td>Narrow-leaved Mountain Mint (<em>Pycnanthemum tenuifolium</em>)</td>
</tr>
<tr>
<td>Hyssop-leaved Boneset (<em>Eupatorium hyssopifolium</em>)</td>
</tr>
<tr>
<td>Smooth Aster (<em>Symphyotrichum laeve</em>)</td>
</tr>
<tr>
<td>New England Aster (<em>Symphyotrichum novae-anglia</em>)</td>
</tr>
<tr>
<td>Flat-topped White Aster (<em>Doellingeria umbellata</em>)</td>
</tr>
<tr>
<td>Smooth Beardtongue (<em>Penstemon laeve</em>)</td>
</tr>
<tr>
<td>Rudbeckia hirta (Black-eyed Susan)</td>
</tr>
<tr>
<td>Wingstem (<em>Verbesina alternifolia</em>)</td>
</tr>
<tr>
<td>Maryland Golden Aster (<em>Chrysopsis mariana</em>)</td>
</tr>
<tr>
<td>Gray Goldenrod (Solidago nemoralis)</td>
</tr>
<tr>
<td>Prairie Dock (<em>Silphium terebinthinaceum</em>)</td>
</tr>
<tr>
<td>Butterflyweed (<em>Asclepias tuberosa</em>)</td>
</tr>
<tr>
<td>Boneset (<em>Eupatorium perfoliatum</em>)</td>
</tr>
<tr>
<td>Joe-pye Weed (<em>Eutrochium purpureum</em>)</td>
</tr>
<tr>
<td>New York Ironweed (<em>Vernonia noveboracensis</em>)</td>
</tr>
<tr>
<td>Wild Senna (<em>Senna marilandica</em>)</td>
</tr>
<tr>
<td>Showy Ticktrefoil (<em>Desmodium canadense</em>)</td>
</tr>
<tr>
<td>Annual Sunflower (<em>Helianthus annuus</em>)</td>
</tr>
</tbody>
</table>

Meadows are usually adjacent to a wooded parcel or shoreline and create excellent edge habitat. Edge habitat, also known as an “ecotone,” is created where two different habitats meet and generally is richer in species diversity because it contains species from both habitats (*Exhibit V.B-3*). Meadows provide habitat for a variety of wildlife including butterflies, praying mantises, fireflies, bluebirds, and indigo buntings. Which plants RA establishes in the meadows depend on light, soil type, moisture, and the ultimate height of the grass or flower. Meadows that are next to a pathway have a mow strip separating the meadow from the path for aesthetics and to define the meadow.
Meadow maintenance is necessary for a number of reasons, including controlling invasive plant growth, reducing undesirable weeds, and increasing biodiversity. Meadows may become overrun with giant ragweed, multi-flora rose, honeysuckle, tree seedlings such as Bradford pear or a multitude of other undesirable species. RA staff and volunteers remove the problem species by hand, by timed mowing, or by using a glyphosate herbicide.

Meadows are mowed yearly to stop their normal succession to forest and to control invasive plant problems. Mowing is normally done when the ground is frozen, to protect the soil, or after breeding season after ground-nesting birds have fledged their young. Mowing in mid-summer is the recommended practice if a meadow is overrun with invasive species. The Williams Gas Company mows the transcontinental pipeline bisecting Reston once a year to control tree growth, except for the Monarch Waystation area by Fox Mill Road. RA has an agreement with Williams Gas Company that RA will mow that meadow in the winter to keep the seed heads up as late as possible so it can be maintained as habitat for Monarch butterflies.

Conclusions

The quality of Reston’s meadows is rated as fair.

Meadows are important but transient biological communities. They are especially important for pollinator species, and they add to the species richness and biodiversity of the Reston landscape. Although Reston no longer supports large meadows or grasslands, it currently has 50 small pocket meadows that are actively managed by RA to keep them in a relatively stable state, to control their colonization by invasive and undesirable species, and to prevent their ecological succession to forest habitat. Although Reston’s remaining meadows are too small to support some native wildlife species that need large contiguous tracks of open habitat to feed and breed successfully, they do offer usable habitat to many plants and animals that are adapted to sunlight or are shade intolerant, while creating an ecotone (edge habitat) where organisms associated with two different habitats can intermingle to increase a site’s species richness.
Meadows can be prime targets for development because it is less expensive to develop an area that does not need trees removed. The value and importance of meadows are often misunderstood and unappreciated by the public owing to their un-manicured appearance.

**Recommendations**

RA should:

- Encourage residents and businesses to landscape using native plants instead of turf grass.
- Encourage planting of focus areas such as Monarch Waystation gardens to create small patches of meadow.
- Encourage combining small patches of meadow across properties to create contiguous, larger patches of meadow.
- Provide education on the appearance, importance, roles, and functions of meadows.
- Develop a rating system for volunteers to determine the quality of existing meadows.
V.C. Wetlands

Background

Wetlands are areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing season. Water saturation (hydrology) largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants (hydrophytes) and promote the development of characteristic wetland (hydric) soils.

There are many different kinds of wetlands. Reston’s wetlands primarily consist of non-tidal marshes and vernal pools. Non-tidal freshwater marshes are the most prevalent and widely distributed wetlands in North America. They frequently occur along streams in poorly drained depressions and in the shallow water along the boundaries of lakes and ponds. Water levels in these wetlands generally vary from a few inches to two or three feet, and some marshes may periodically dry out completely.

Due to their high levels of nutrients, freshwater marshes are one of the most productive and vital ecosystems on earth. They can sustain a vast array of plant communities that in turn support a wide variety of wildlife. As a result, marshes sustain a diversity of life that is disproportionate to their size. In addition to their considerable fish and wildlife habitat value, non-tidal marshes recharge groundwater supplies and moderate streamflow by providing water to streams. This function is especially important during periods of drought. The presence of marshes in a watershed helps to reduce damage caused by floods by slowing and storing flood water. As water moves slowly through a marsh, sediment and other pollutants settle to the substrate or floor of the marsh. Marsh vegetation and microorganisms also assimilate excess nutrients (such as nitrogen and phosphorus from fertilizer) that can otherwise pollute surface waters.

Vernal pools are seasonal depressional wetlands (Exhibit V.D-1). They are covered by shallow water for variable periods from winter to spring, but they may be completely dry for most of the summer and fall. These wetlands range in size from small puddles to shallow ponds. The pools collect water during winter and spring rains, changing in volume in response to varying weather patterns. During a single season, pools may fill and dry several times. In years of drought, some pools may not fill at all. Vernal pools support both aquatic organisms and terrestrial animals that live in the forest but need water to mate. Although small and temporary, the unique environment of vernal pools provides habitat for numerous rare or uncommon plants and animals that are able to survive and thrive in these harsh conditions. Many of these plants and animals spend the dry season as seeds, eggs, or cysts and then grow and reproduce when the ponds are again filled with water. Many species of frogs, salamanders, and newts depend on vernal pools for reproduction and survival of larval stages because due to their seasonal nature, vernal pools do not contain fish predators. Spotted salamanders, for example, could live 700 feet away from the vernal pool and migrate to the pool to mate. Migration distances vary with each species that come to mate in the pools. Vernal pools are a valuable and increasingly threatened ecosystem. As fragile ecosystems, they are quite susceptible to degradation and destruction from
construction activities, especially activities occurring in floodplains such as stream restoration and utility repairs.

Exhibit V.D-1: Vernal Pool

The loss of wetlands and the many services they provide have resulted in Federal, state, and county regulations and ordinances to protect them. Currently water quality standards for wetlands are developed by states, territories, and authorized tribes in accordance with U.S. Environmental Protection Agency (EPA) regulations 40 CFR Part 131. Because of the unique characteristics of wetlands relative to flowing surface waters, water quality standards for wetlands may differ from other surface water standards. For example, they may rely less on water chemistry parameters and more on diversity of vegetation or macroinvertebrate communities. Wetland standards may also differ from surface water standards by relying on additional parts of state laws and regulations that do not apply to instream water quality.

Under Section 404 of the Clean Water Act (CWA), wetlands may be legally destroyed, but their loss must be compensated for by the restoration, creation, or enhancement of other wetlands. The goal of this strategy is to result in "no net loss" of wetlands. Under Section 404(e) of the CWA, the U.S. Army Corps of Engineers (USACE) can issue general permits to authorize activities that have minimal individual and cumulative adverse environmental effects. General permits can be issued for a period of no more than five years. A nationwide permit is a general permit that authorizes activities across the country, unless a USACE district or division commander revokes the nationwide permit in a state or other geographic region. Nationwide permits authorize a wide variety of activities such as residential developments, utility lines, road crossings, mining activities, and wetland and stream restoration activities.

Section 401 of the CWA provides states and authorized tribes with an effective tool that helps them to address the aquatic resource impacts of federally issued permits and licenses. Under Section 401, a Federal agency cannot issue a permit or license for an activity that may result in a discharge to waters of the United States until the state or tribe where the discharge would originate has granted or waived a Section 401 Certification. Many states and tribes rely on the 401 Certification process as their primary regulatory tool for protecting wetlands and other aquatic resources.

The Virginia Department of Environmental Quality (VDEQ) provides Section 401 Certification through issuing a Virginia Water Protection individual or general permit or by certifying USACE nationwide or regional permits. In 2000, the General Assembly removed the dependence of the State non-tidal wetlands program on the issuance of a Federal permit, thus enabling VDEQ to use the Virginia Water Protection Permit Program to regulate other activities in the Commonwealth’s wetlands. Activities
such as certain types of excavation in wetlands and filling of isolated wetlands (which may not be under Federal jurisdiction) were added to the activities already regulated through the Section 401 Certification process.

Beginning in 2008, EPA, USACE and VDEQ jointly supported an order of preference for compensatory mitigation: 1) Through purchase of stream and wetland credits from approved commercial mitigation banks, 2) by payment of in-lieu funds, and 3) by permittee responsible mitigation (i.e., preservation, enhancement and creation) for compensation of unavoidable impacts to aquatic resources. As a result, the Virginia Department of Transportation now purchases wetland and stream credits from approved mitigation banks to fulfill compensatory requirements associated with some of its road construction projects in Fairfax County and elsewhere. Compensatory mitigation is ultimately subject to approval of the regulatory permitting agencies. Some of Reston’s wetlands were created as mitigation projects to compensate for the destruction of wetland habitats elsewhere. Reston’s stream restoration projects (see Chapter IV.A Streams) were also funded through this mechanism.

Existing Conditions

Reston does not have a complete inventory of its existing wetlands. Some of the more obvious marshlands include Lake Audubon-Stewart Bridge at the mouth of Snakeden Creek between Spyglass Cove Lane and Wake Robin Lane, the Lake Thoreau-Reston National Golf Course wetland area, between Purple Beech Drive and Upper Lake Drive, North Hills Park across from North Hills pool, Sunrise Valley Park off Sunrise Valley Drive and Monroe Street, and the cattail marsh at Hidden Creek Country Club between golf course holes 4 and 5 (Exhibit V.D-2). RA does not own, manage, or maintain the last two of these wetlands

Exhibit V.D-2: Cattail Marsh at Hidden Creek Country Club

©Doug Britt
Another unusual (for urban locations) kind of wetland occurs in Reston: Beaver ponds (Exhibit V.D-3). Reston’s expanse of wetlands varies with its beaver activity, as they move into stream valleys and create their own niche – in essence creating a new ecosystem. Currently, beaver activity is limited to the Glade Stream Valley Park, but not long ago, beavers were active in the stream valley downstream from Bright Pond. Although beavers extract a heavy toll on trees, their activity changes and enriches the natural area. Plant diversity is increased as the new openings in the forest canopy caused by beaver activity allow more sunlight to reach the forest floor. Cardinal flowers, Virginia bluebells, jewelweed, skunk cabbage, and jack-in-the-pulpits are a few of the moisture-loving terrestrial plants that thrive in the new habitat. Green and great blue herons, kingfishers, wood ducks are examples of birds attracted to such environments, and woodpeckers and owls often nest in the standing dead trees (snags) killed by the rising water levels behind beaver dams. Fish, crayfish, turtles, and raccoons also do well in this new environment.

Keeping beavers near residential areas, however, requires active surveillance and management. At some locations, RA has installed fences to protect parts of the natural stream valley. Individual trees have also been fenced to protect important species, and some culverts are now placed in beaver dams to control the water level to preserve paths and bridges.

Of all the wetlands in Reston, the Sunrise Valley Park wetlands are the most extensive and interesting, and they potentially have the highest quality because of the varied habitats they contain. This site is a composite of naturally occurring wetlands, created wetlands, a restored farm pond, and uplands buffers. The created wetlands area is about 3.3 acres out of 15.75 acres in total. It originated as a mitigation project required to compensate for wetlands that were disturbed during the building of Reston Town Center. It is a favorite spot for environmental education, birds and birders, wildlife and nature enthusiasts, dog walkers, and office workers looking for a quiet spot to take a lunch-time walk (Exhibit V.D-3).
At least 122 species of birds have been seen in these wetlands, and 23 species of birds are known to have nested there, including the blue heron, eastern towhee, hooded warbler, and swamp sparrow. A pair of great horned owls nested here in the past, and woodcocks once used the site for their unusual breeding display in the spring, but neither species has been seen using the site recently. Many amphibians and turtles also live in this wetland area.

Sunrise Valley Park is also a very active site for education and outreach programs for all ages of participants. It is used by RA’s summer and science camp programs, hug-a-tree program, family and adult programs such as Marsh Madness and twilight walks, and it was a field trip destination for many years for a wetland study program for the students at Sunrise Valley Elementary School. It is the only boardwalk in Reston where visitors can stand and observe nature. Winter and summer bird counts as well as seasonal dragonfly and butterfly counts are conducted here. The site has also been used for co-sponsored programs with George Mason University and for the Osher Life-long Learning classes for seniors.

The Sunrise Valley Park site is currently owned by Mass Life Insurance Company, and RA has no management authority over it. Unfortunately, this site is not being maintained for its wetland qualities, and it appears to be losing its previous biological diversity as non-native Bradford pears and autumn olives have invaded the shores. Water lilies are beginning to cover the pond, making it unsuitable for some waterfowl. The adjacent meadows are no longer being mowed, so they are reverting to early successional forest.106

Reston has several vernal pools, but due to their sensitive nature, their locations are not advertised. Since vernal pools are only seasonally wet, they are much more difficult to locate and inventory than
other wetlands, but they are very important to the survival of frogs and salamanders. They can be identified by certain species or obligates, which are species restricted to a certain environment. In our area these amphibians include wood frogs (*Lithobates sylvaticus*), marbled salamander (*Ambystoma opacum*) and spotted salamander (*Ambystoma maculatum*). Although vernal pools are usually considered as being a spring phenomenon, marbled salamanders start using such pools in September. They actually lay their eggs in the pools before the water is present, just under dry leaves inside the pool’s footprint. Since spotted salamander larva don’t completely finish using the pools until May-June, there are only two or three months out of the year that Reston’s vernal pools aren’t being used in some way. So, despite their vernal/temporary nature, they are vital amphibian habitats almost the entire year.

Other species that use vernal pools nearby (but which have not been documented in Reston) include spadefoot toads (*Scaphiopus holbrookii*), which have been found in the Mason Neck State Park; tiger salamanders (*Ambystoma tigrinum*), which can be found on the Delmarva Peninsula, and Jefferson salamanders (*Ambystoma jeffersonianum*), which have been found in the Leesburg area and are common west of Leesburg. There also is an undocumented report of fairy shrimp (*Branchinecta lynchi*) existing in Reston’s vernal pools.

More information about vernal pools can be found here: [http://www.virginiavernalpools.org/](http://www.virginiavernalpools.org/)
And additional information on salamanders can be found here: [http://amphibianrescue.org/tag/chopsticks-for-salamanders/](http://amphibianrescue.org/tag/chopsticks-for-salamanders/)

**Conclusions**

The condition of Reston’s wetlands is undetermined at this time because no systematic inventory of them has been conducted. The locations and total extent of its wetland resources have not been mapped or quantified, and what is known about the wildlife inhabiting wetland parcels comes primarily from anecdotal observations. It is clear from such observations, however, that Reston’s existing wetlands contribute to the richness of its flora and fauna. Although the total acreage of wetlands in Reston is unknown, it is a very small percentage of the landscape. For their small sizes, however, Reston’s wetlands play a disproportionately large role in its biological diversity, and many of the ecological services they perform are essential for a healthy environment. Consequently, it would be quite beneficial to know more about the actual condition of Reston’s remaining wetlands and to determine whether these valuable resources are being protected by the goal of “no net loss” or are otherwise being threatened by neglect or redevelopment activities.
**Recommendations**

RA should:

- Contact Mass Life Insurance Company to explore again the possibility of taking over the management of the Sunrise Valley Park wetlands to remove invasive plants, to mow the meadows, and to help restore the vitality of this potentially outstanding natural resource.
- Explore the possibility of partnering with an academic institution such as George Mason University or with a conservation organization to use undergraduate or graduate student labor or volunteer citizen scientists to help inventory, classify, and evaluate the wetland resources of Reston.
- Map the location of Reston’s vernal pools.
- Recruit citizen scientist volunteers to monitor the water levels in each vernal pool to develop a deeper understanding of these unique habitats and to document what species use these pools. Share data with other vernal pool monitors.
- Continue to offer education and outreach programs to inform residents about the value of wetlands to the overall environmental health of the community.
VI. Wildlife – Introduction

The wildlife of Reston includes birds, reptiles, amphibians, mammals, and a host of invertebrates. Collectively these organisms play crucial roles in maintaining healthy ecosystems. They pollinate native plants and agricultural crops, disperse seeds, fertilize soil, recycle minerals, decompose wastes, and some provide passive recreational opportunities for people who simply enjoy observing them in their natural settings. A few may be subject to population surges and are becoming a nuisance to the community and/or destabilizing the local ecology. Others may experience population declines that may even endanger their ability to recover. Predator-prey relationships in healthy ecosystems provide the checks and balances that help control population outbreaks of otherwise nuisance species. The presence or absence of some wildlife species can also be good indicators of the health of the environment because of their sensitivity to environmental stressors.

Some wildlife populations are experiencing serious population declines that may even endanger their ability to recover. In 2000, the U.S. Congress created the State and Tribal Wildlife Grants (SWG) program to help state and tribal wildlife agencies work with at-risk wildlife species. As a condition for receiving SWG funding, Congress mandated that each state and territory develop Wildlife Actions Plans (Action Plans) by October 2005. The Action Plans were conceived as an effort to guide states in identifying and addressing the needs of a wide array of wildlife and habitats of greatest conservation need.

As a recipient of a SWG, Virginia’s Department of Game and Inland Fisheries (DGIF) developed a 2005 Wildlife Action Plan (WAP), which has become a guiding force in wildlife conservation for the Commonwealth. The WAP represents a strategy to conserve Virginia’s wildlife resources and help keep species from becoming endangered. DGIF and partners have used the WAP to identify key species and habitats in need of conservation and to implement projects and research needed to address those issues on behalf of all Virginians. In 2015 the DGIF updated the WAP, providing the opportunity to review the status of species of greatest conservation need (SGCN) and their habitats, revise conservation priorities, and reprioritize conservation actions. It can be reviewed at http://bewildvirginia.org/wildlife-action-plan.

The updated Virginia WAP identifies 883 species that are in decline. Habitat loss is the single greatest challenge impacting these species. The WAP identifies strategies to conserve and restore these species. In addition to a statewide overview, the WAP describes strategies for 21 multi-county planning regions which are roughly consistent with Virginia’s Planning District Commissions. For each planning region, the WAP identifies the local wildlife priorities, the habitats those species rely upon, threats impacting these species and habitats, and conservation actions that can be taken to address those threats.

Reston falls into the WAP’s Northern Virginia Planning Region. Of Virginia’s 883 SGCN, 84 are believed to either occur, or have recently occurred, within the Northern Virginia Planning Region. Of these 84 species, 39 SGCN are dependent upon habitats provided within the Northern Virginia Planning Region. These species constitute the priority SGCN for the region. The WAP identifies priority places for either conservation or restoration within each planning region, programs working to address threats or to define best management practices, and data that could be used to document and evaluate the success
of conservation actions. Finally, the updated WAP describes climate trends that have been projected for Virginia and identifies actions that can be taken to conserve wildlife under changing climatic conditions.

Much of what is known about wildlife in Reston comes from anecdotal information, citizen scientist projects, and from education/outreach programs sponsored by RA’s Walker Nature Center. Recently there has been increasing interest in cataloging the flora and fauna of Virginia, including invertebrates, through BioBlitzes. A BioBlitz is an intense period of biological surveying which attempts to record all the living species within a designated area. Groups of scientists, naturalists, and volunteers conduct an intensive field study over a continuous time. There is a public component to many BioBlitzes, with the goal of getting the public interested in biodiversity. To encourage more public participation, these BioBlitzes are often held in urban parks or nature reserves close to cities.107

In 2017 the RA Board approved and adopted the Reston Natural Resource Management Plan, which is used by the RA natural resources staff as a guide to managing the community’s resident and migratory wildlife.108 The following chapters describe what is currently known about the state of Reston’s wildlife.
VI.A. Birds

Background

“Birds are indicators of the environment. If they are in trouble, we know we'll soon be in trouble.”
Roger Tory Peterson

While technical instruments may be used to measure some changes in the environment, some living species also serve as particularly good indicators of changes in ecosystems. The proverbial “canary in a coal mine” was valued because it was affected by poison gases before humans would be, therefore warning humans of impending danger. Birds are particularly useful environmental indicators because they are plentiful and widespread creatures, because more than one species of bird will often respond to the same environmental change, and because there is growing documentation about how birds react to given changes.  

Across North America, populations of 30 percent of wintering bird species are in serious decline, and 432 of North America’s 1154 bird species are now on a Watch List of species of highest conservation concern. This means they are at risk of extinction unless serious conservation action is taken.

Of the 260 species of birds seen in Fairfax County since January 2015 by observers reporting to eBird, Cornell University’s massive citizen science database of worldwide bird sightings, about 58 percent have been seen in Reston. Reston does not support all the species found elsewhere in Fairfax County either because we have lost some types of habitat, such as large meadows and extensive pine forest, or because the area of some types of habitat is very limited. Numerous studies indicate that the greater the diversity of habitats and bird species, the better the greater ecosystem functions.


Reston residents are among the 60 million Americans who enjoy watching birds. In addition to the aesthetic qualities and interesting behavior that inspire and entertain people, birds are important to Reston’s environment because they disperse seeds and plants, pollinate plants, eat weeds, dispose of carrion, transport nutrients, and control insects and other arthropods as well as rodents.

Both terrestrial birds and waterbirds disperse seeds of hundreds (and likely, continent-wide, thousands) of plant species, ensuring plants are found in disconnected habitat spaces and sparing humans the considerable cost of planting wetlands and other vulnerable habitats. Corvids, birds in the
crow family, cache—and so, in effect, plant--seeds of native trees and shrubs. Seeds that are not eaten later by the birds and their young wind up shaping the composition and distribution of our forest areas. Humans also indirectly benefit because these dispersed plants control soil erosion and sedimentation and aid in flood prevention, water purification, and other vital environmental functions. Birds are now shifting distribution of plants in response to climate change, which may help some plant species avoid extinction. Birds play a role in pollinating plants and eating weeds, but the extent of their influence is not well understood.

The several species of Reston birds that scavenge at least some of their food by eating dead animals they did not kill provide a cost-free service by reducing human exposure to rotting matter and therefore our exposure to infectious disease. Parts of the world where vulture populations have been reduced have experienced proliferations of rats and feral domestic animals, which carry diseases to which humans are susceptible.

As with other animal species that are highly mobile and use multiple habitats, birds transport nutrients like phosphorus and nitrogen across ecosystems and improve soil quality. Nutrient transport by waterbirds to land, for example, counters the runoff of nutrients from land into water via runoff and erosion. An overload of nutrients, such as that produced by an invasive bird whose population is out of balance like the Canada goose, however, negatively affects plant growth and water quality.

Cavity excavators and “keystone species,” such as Reston’s charismatic pileated woodpecker, have a great impact in relation to their abundance. They aid forest decomposition, eat insects that are harmful to trees, and excavate holes that are used by other species—in the pileated’s case, by nine types of mammals and several other bird species. The red-bellied woodpecker, common in Reston, preys on the emerald ash borer, an insect which kills our ash trees, and the abundance of woodpeckers in general is considered a strong indicator of healthy habitat. Another cavity nester, the four-inch-long Carolina chickadee, feeds its nestlings more than 5000 caterpillars every year. Nearly all terrestrial birds feed their young on insects.

Several efforts contribute to the understanding of Reston birdlife. RA conducts outreach with monthly bird walks that engage residents in walking our trails and learning about birds. Leaders and participants have the option to report sightings to eBird. Walker Nature Center (WNC) also conducts and retains data on bird counts that provide a snapshot of species seen by varying numbers of teams on one day in winter and one day in summer each year. These counts also serve as an outreach activity. Volunteers who are experienced birders conduct Breeding Bird Surveys (BBS) once a year at nine Reston locations.

The most extensive data collected on Reston birds are available from eBird: Residents and visitors to Reston locations report sightings regularly, and data compiled from eBird sightings at 25 Reston “Hotspots” from 2015 to 2017 are cited in this report, reflecting submission of 660 checklists. Although the BBS and eBird data are the most systematically collected data on birds visiting and breeding in Reston, it is not possible from any of these data to determine the population number of any given species. It is possible over time, however, to determine if a given species is seen regularly in Reston.
Existing Conditions

Reston is one of the few areas in Northern Virginia to support several different types of habitat, and these small mosaics have demonstrated their value by allowing Reston, a relatively small town, to support about 150 species of birds. Exhibit VI.A-1 shows that of the 28 species of birds in Northern Virginia that the 2015 WAP identified as species of greatest conservation need (SGCN),124 15 occur in Reston. It also describes the type of habitat each species requires.

A noteworthy example of an uncommon bird adapting to the urbanization of Reston is the peregrine falcon, Falco peregrinus (Exhibit VI.A-2). Populations of this normally cliff-dwelling bird of prey were once extirpated from the Eastern United States as a result of exposure to organochlorine pesticides, especially DDT and its metabolites. After DDT was banned in the United States, in the 1970s, peregrine populations began making a slow comeback. Their populations recovered sufficiently enough by 1999 to remove them from the U.S. Fish & Wildlife Service’s Endangered Species list. Today there are an estimated 1,650 breeding pair in the United States and Canada.125 In 2015 a pair of peregrines built a nest on one of the high-rise buildings in Reston Town Center – the first ever recorded breeding pair in Reston. The same pair (presumably–they mate for life) was observed nesting in Town Center again in 2016, and as this report was being drafted, a nest was again observed with three nestlings. Peregrines prey almost exclusively on other birds. During the nesting season in Reston, they prey largely on European starlings (Sturnus vulgaris), a common non-native species not protected by the Migratory Bird Treaty Act that also nests and feeds in Town Center.126
### Exhibit VI.A-1: Priority SGCN in Northern VA Planning Region

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Not in Reston -- In Reston</th>
<th>Habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank Swallow</td>
<td>Riparia riparia</td>
<td>Habitat includes open and partly open situations, frequently near flowing water. Nests are in crevices and, on gravel banks, in rebar diegray at the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.</td>
<td></td>
</tr>
<tr>
<td>Barn owl</td>
<td>Tyto alba</td>
<td>Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.</td>
<td></td>
</tr>
<tr>
<td>Belted Kingfisher</td>
<td>Myiagra spegneri</td>
<td>Primarily along water, both freshwater and marine. Including lakes, streams, wooded coves and rivers, seacoasts, bays, estuaries, and mangroves. Perch in trees, on overhanging branches, posts and utility wires.</td>
<td></td>
</tr>
<tr>
<td>Black-and-white warbler</td>
<td>Alethea leucura</td>
<td>Habitat generalist with broad habitat tolerances.</td>
<td></td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td>Conocoryphus nigricollis</td>
<td>Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets.</td>
<td></td>
</tr>
<tr>
<td>Brown thrasher</td>
<td>Toxostoma rufum</td>
<td>Shrubs and bushes in desolate forest openings and forest edge, shrubby areas and gardens, in migration and winter also in scrub.</td>
<td></td>
</tr>
<tr>
<td>Chimney swift</td>
<td>Chaetura pelagica</td>
<td>Habits rural and urban environments having both an abundance of flying anthropods and suitable roosting nesting sites.</td>
<td></td>
</tr>
<tr>
<td>Eastern kingbird</td>
<td>Tyrannus tyrannus</td>
<td>Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and grasses, and parks in more closely associated with forest clearings and borders.</td>
<td></td>
</tr>
<tr>
<td>Eastern meadowlark</td>
<td>Stanistes magna</td>
<td>Gravelly, sandy, open fields, pastures, cultivated lands; sometimes marshes.</td>
<td></td>
</tr>
<tr>
<td>Eastern towhee</td>
<td>Pipo erythrophthalmus</td>
<td>Marshes, forest and swamps, regenerating swamps, open or lightly forested, particularly those with a well-developed understory, included riparian, mid-late successional fields, riparian thickets, overgrown fencerows, scrub or small tree thickets, and other shrubby habitats.</td>
<td></td>
</tr>
<tr>
<td>Eastern whip-poor-will</td>
<td>Ammodytes velox</td>
<td>Forest and open woodland, from lowland to montane forest and pine-oak association.</td>
<td></td>
</tr>
<tr>
<td>Eastern wood-pewee</td>
<td>Contopus virens</td>
<td>Insulated woodlot, pasture, and shrubland habitats including deciduous, coniferous, or mixed forests.</td>
<td></td>
</tr>
<tr>
<td>Field sparrow</td>
<td>Spizella pusilla</td>
<td>Open fields, bushy thickets, overgrown pastures, thorn scrub, deciduous forest edge, sparse Sergent growth, fencerows.</td>
<td></td>
</tr>
<tr>
<td><em>Glossy ibis</em></td>
<td>Plegadis falcinellus</td>
<td>Wooded wetlands, extant marshes and wetlands and saltmarshes.</td>
<td></td>
</tr>
<tr>
<td>Grasshopper sparrow</td>
<td>Ammodramus savannarum</td>
<td>Grassland chappar.</td>
<td></td>
</tr>
<tr>
<td>Gray catbird</td>
<td>Dendroica carolina</td>
<td>Shrubs, dense brushy and shaly areas, undergrowth and forest edge, hilltops, and gardens, dense second growth.</td>
<td></td>
</tr>
<tr>
<td>Green heron</td>
<td>Butorides virescens</td>
<td>Swamps, marshes, marshes, and margins of ponds, rivers, lakes, and lagoons.</td>
<td></td>
</tr>
<tr>
<td>Kentucky warbler</td>
<td>Odontorhyncus torquatus</td>
<td>Habitats deciduous forest, dense second growth. Swamps.</td>
<td></td>
</tr>
<tr>
<td>King rail</td>
<td>Rallus elegans</td>
<td>Variety of fresh water and marshes and marshes.</td>
<td></td>
</tr>
<tr>
<td>Least bittern</td>
<td>Podilymbus australis</td>
<td>Freshwater marshes.</td>
<td></td>
</tr>
<tr>
<td>Loggerhead skimmer</td>
<td>Lepidopetrum sodalis</td>
<td>Gravelly, sandy, open areas with scattered trees.</td>
<td></td>
</tr>
<tr>
<td>Northern Flicker</td>
<td>Colaptes auratus</td>
<td>Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, tree line association, parks.</td>
<td></td>
</tr>
<tr>
<td>Ruffed grouse</td>
<td>Bonasa umbellus</td>
<td>Dense forest with some deciduous trees in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood forest to eastern deciduous forest and oak-cove woodland.</td>
<td></td>
</tr>
<tr>
<td>Rusty blackbird</td>
<td>Turdus bicolor</td>
<td>Wooded swamp and wooded wetland winter habitat.</td>
<td></td>
</tr>
<tr>
<td>Wood thrush</td>
<td>Hylocichla mustelina</td>
<td>Deciduous or mixed forests with a dense tree canopy and a fairly well-developed undergrowth, especially where moist.</td>
<td></td>
</tr>
<tr>
<td>Yellow-billed cuckoo</td>
<td>Conocoryphus flaviceps</td>
<td>Open woodland especially where undergrowth is thick), parks, deciduous riparian woodland.</td>
<td></td>
</tr>
<tr>
<td>Yellow-breasted chat</td>
<td>Seiurus aureus</td>
<td>Secondary growth, shrubby old pastures, thickets, bushy areas, scrub woodland understory, and forest edges, and forest edges, including wet places near streams, pond edges, or prairies; thickets with few tall trees, early-successional stages of forest regeneration, commonly in sites close to human habitation.</td>
<td></td>
</tr>
</tbody>
</table>

* Critical Conservation Need: Species face an extremely high risk of extinction or extirpation. Populations of these species are at or below levels that face immediate threat(s), and/or occur within an extremely limited range. Intense and immediate management action is needed.

# Very High Conservation Need: Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.
The greatest environmental threats to birds nationwide are:

1. Habitat loss
2. Predation by outdoor cats
3. Collisions with building windows
4. Collisions with automobiles

1. Habitat Loss
By far, the greatest cause of bird population declines is habitat loss. As development occurs, some birds are able to adapt or even to flourish in a different habitat, but others are unable to do so. See Chapters IV.A-D Water Resources and V.A-C Vegetation for information on RA efforts to conserve water, to prevent erosion, and to control invasive species in all the habitats below.

Forest (mature, open woods, pine, riparian): During the Civil War, Reston lost much of its original forest habitat. Although 49.6 percent of Reston’s land now has tree cover, some of these trees are
invasive species that do not host as many insects and other creatures upon which birds feed as do native species. The WAP recommends the following action to protect forest SGCN bird species like wood thrush and northern flicker, which are found in Reston: “Implement appropriate forestry best management practices to conserve water and prevent erosion; work to conserve larger forest patches through acquisition, easement or other mechanisms; and monitor and control invasive species.” Much Reston forest habitat has been lost to development, and our remaining forest habitat in Glade Stream Valley, WNC, Twin Branches Nature Trail, Bright Pond Nature Trail, and Buttermilk Creek Nature Trail connecting to Lake Fairfax Park will continue to require focused conservation efforts.

Open: Reston’s open habitat includes grasslands and shrub lands, but SGCN bird species like the eastern kingbird and yellow-breasted chat are rarely seen here. Reston development has eliminated most open habitat. Some of Reston was built on abandoned farmland, which had usually reverted to grassland, if not completely to native grasses, shrubs, or forbs. WAP’s recommendation for open habitat is to “restore/create areas of native grasses, shrubs, and forbs; maintain open habitats with periodic disturbance; and conserve where feasible through acquisition, easement, etc.” A few small open spaces are preserved in Reston at Fox Mill meadow, Pony Barn meadow, Purple Beech meadow, Polo Club meadow, along the transcontinental pipeline, and as meadows adjacent to the Golf Course Island and the Lake Anne garden plots.

Marshy: Reston has minimal marshland to support birds like the green heron. WAP’s recommendation for these areas is to “Establish/ enhance vegetative buffers around wetlands; ensure adequate mitigation and restoration under permitting; and control invasive species.” Reston did not have much marsh habitat before it was developed, but the creation of Reston’s lakes did result in some small marshy areas near the head of Lakes Thoreau and Audubon. The areas below the Bright Pond flood control dam and the beaver-influenced lower end of the Glade Stream Valley are also marshy. Most significant is the Sunrise Valley Wetlands, which was created pursuant to the Clean Water Act policy of “no net loss” of wetlands. It has some potential to provide significant marsh habitat, but it is not under RA management.

Woodland Lakes, Streams: WAP’s recommendation for these areas is to “Establish/ restore forest corridors around streams and rivers; decrease nutrient, sediment, and pollution runoff through better management of agriculture and livestock waste and stormwater; control invasive species; and improve connectivity.” Many of Reston’s lakes and streams, which support the SGCN belted kingfisher, have connected forest corridors around them.

Exhibits VI.A-3, VI.A-4, and VI.A-5 provide snapshots of how three bird species are doing in Reston.
Eastern Bluebird (Sialia sialis)

Eastern bluebirds are seen every week by someone along Reston’s roads, field edges, golf courses, and other open areas. The International Union for Conservation of Nature and Natural Resources (IUCN) rates them as a species of least concern, which means they are at lowest risk of becoming extinct worldwide.

Insects caught on the ground are a bluebird’s main food for much of the year. Major prey includes caterpillars, beetles, crickets, grasshoppers, and spiders. In fall and winter, bluebirds eat large amounts of fruit including mistletoe, sumac, blueberries, black cherry, tupelo, currants, wild holly, dogwood berries, hackberries, honeysuckle, bay, pokeweed, and juniper berries. Eastern bluebirds have been recorded eating salamanders, shrews, snakes, lizards, and tree frogs.

Eastern bluebird populations fell in the early twentieth century as aggressive introduced species such as European starlings and house sparrows made available nest holes increasingly difficult for bluebirds to retain. In the 1960s and 1970s, establishment of bluebird trails and other nest box campaigns alleviated much of this competition, especially after people began using nest boxes designed to keep out the larger European starling. Eastern bluebird numbers have been recovering since.

Reston set up Eastern bluebird nestboxes in the 1980s. Eight teams of volunteers monitor 32 boxes weekly from March to August and report data to WNC and the Virginia Bluebird Society. In 2016, 29 bluebirds fledged from these Reston nestboxes.
Wood Thrush  (*Hylocichla mustelina*)

Wood thrush migrate to eastern North America after wintering in Central America. They cross the Gulf of Mexico in a single night’s flight, typically arriving in Reston at the end of April and staying here until October, breeding between May and July. IUCN rates the wood thrush as a species of least concern, at lowest risk of becoming extinct worldwide. The Virginia WAP, however, considers wood thrush a Species of Greatest Conservation Need (SCGN) in the area including Reston because of loss of breeding habitat.

A consummate songster, the wood thrush can sing “internal duets” with itself. In the final trilling phrase of its three-part song, it sings pairs of notes simultaneously, one in each branch of its Y-shaped syrinx, or voicebox. The two parts harmonize with each other to produce a haunting, ventriloquial sound. This reclusive bird’s cinnamon brown upperparts are good camouflage as it scrabbles for leaf-litter invertebrates deep in the forest, though it pops upright frequently to peer about, revealing a boldly spotted breast.

Though still numerous, wood thrush are rapidly declining. This may be in part due to cowbird nest parasitism at the edges of fragmenting habitat and to acid rain’s depletion of their invertebrate prey. They are also believed to be particularly vulnerable to window collisions.

Wood thrush breed throughout mature deciduous and mixed forests, most commonly those with American beech, sweet gum, red maple, blackgum, eastern hemlock, flowering dogwood, American hornbeam, oaks, or pines. They nest somewhat less successfully in fragmented forests and even suburban parks where there are enough large trees for a territory. Ideal habitat includes trees over 50 feet tall, a moderate understory of saplings and shrubs, an open floor with moist soil and decaying leaf litter, and water nearby. Wood thrush are therefore less likely to find suitable habitat in Reston unless tree cover containing the above native tree species is maintained or improved. Reston citizen scientists regularly report sightings of wood thrush, but there are no programs focused specifically on wood thrush conservation.
Chimney Swift (*Chaetura pelagica*)

Best identified by its silhouette, the smudge-gray chimney swift nimbly maneuvers over rooftops, fields, and rivers to catch insects. Its tiny body, curving wings, and stiff, shallow wingbeats give it a flight style as distinctive as its fluid, chattering call. Often referred to as a “flying cigar,” this enigmatic little bird spends almost its entire life airborne. When it lands, unable to perch because of its tiny feet, it clings only to vertical surfaces.

©Jim McCulloch; Wikimedia Commons

Chimney swifts fly high in the sky during the day and roost in chimneys at night. This species has suffered sharp declines as chimneys fall into disuse across the continent or are covered by caps. IUCN rates the chimney swift as Near Threatened, and it is an SGCN in a WAP tier for a species that may be rare in parts of its range, particularly on the periphery, and which has demonstrated a declining trend (or for which a declining trend is suspected). Long-term planning is necessary to stabilize or increase populations. The WAP also notes that managers have only identified research needs for the species or “on the ground” conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstances.

Chimney swifts nest in chimneys and on other vertical surfaces in dim, enclosed areas, including air vents, wells, hollow trees, and caves. They forage over urban and suburban areas, rivers, lakes, forests, and fields, consuming large amounts of flying insects. Chimney swifts may take up residence in a brick chimney if the chimney cap is left off. A long-distance migrant, chimney swifts head to South America each winter, flying across the Gulf of Mexico or skirting it along the Texas coast.¹³⁰

Chimney swifts are seen in Reston but not often, in large numbers, or in many locations.

2. Predation by Outdoor Cats

Nationwide, cats are estimated to kill 1.3 to 4 billion birds each year, with 69 percent of these kills attributable to feral or unowned cats.¹³¹ The EAC has developed a position paper on outdoor cats. There are no Fairfax County laws controlling outdoor cats. Other than removing any structures for feral cats found in Reston Common Areas, there is no current Reston effort to control the feral cat population or to prevent domestic pet cats from running loose outdoors. In regard to threats to birds, Fairfax County law requires dogs be licensed and on a leash or inside, but there is no similar law for cats. Reston’s rules indicate dogs are to be walked on a leash in accordance with Fairfax County regulations. Cats, while in the Common Area, must also be walked on a leash. Except for service dogs,
no pets are permitted on active recreation areas including but not limited to such areas as playgrounds, picnic and multi-purpose courts, and play fields.\textsuperscript{132}

3. **Collisions With Building Windows**

Rough estimates indicate between 100 million to 1 billion birds are killed annually nationwide in collisions with building windows, with over half of casualties because of collisions with buildings 11 stories or under in height.\textsuperscript{133} At night, nocturnal migrants (including most songbirds) crash because they fly into lighted windows. Some of these nighttime collisions are accidental, but much more often the nocturnal migrants are lured to their deaths by the lights. For reasons not entirely understood, lights divert nocturnal migrants from their original path, especially in low-ceiling or foggy conditions. In the lighted area, they mill about, sometimes colliding with one another or the lighted structure.\textsuperscript{134}

Reston has no data on bird mortality due to window collisions. As Reston grows (vertically in many cases), bird-friendly window practices and reduced nighttime lighting on buildings with glass might reduce bird mortality. RA’s Central Services Facility is investigating the cost of installing bird-friendly windows during its renovation, but other new buildings are being constructed without any guidance from the environmental authorities in this respect. In Chicago, San Francisco, Oakland, and throughout Minnesota, when federal funding or environmental certification is sought for buildings, developers are required to reduce the collision risk that building windows pose.\textsuperscript{135}

4. **Collisions with Automobiles**

Nationwide, 200 million birds are killed annually in collisions with automobiles. No Fairfax- or Reston-specific data is available on the number of birds killed in Reston.

**Other Causes**

Birds in Reston are also killed by fishing lines, habitat loss due to deer browse, power lines, rat poisons, and horticultural chemicals. Carrion eaters—including bald eagles, hawks, and owls—are especially threatened by ingesting lead (such as in bullets used by hunters outside Fairfax County), by accidental exposure to some veterinary drugs, and by climate change (decomposition accelerates as temperature increases, making less food available to carrion eaters).

**Negative Effects on Humans**

Birds sometimes negatively affect humans by:

- Building nests in locations where their excrement affects human activity
- Damaging buildings when building nests or locating food (for example, woodpeckers may make holes in wooden buildings when feeding on insects)
- Dispersing seeds of non-native invasive plants
- Flocking near airport runways built on bird-friendly habitat

Canada geese, while protected by the Migratory Bird Treaty Act, are considered a pest in Fairfax County.\textsuperscript{136} See Chapter VI.E Wildlife Management Issues, for information on how they are managed in Reston.
**Current RA Bird-Related Efforts**

- Summer, Winter Bird Counts: Day-long counts by WNC-organized volunteers
- Bluebird Nestboxes: WNC installs nestboxes which are monitored weekly by volunteers during the nesting season
- Canada geese egg addling: Parks, Recreation, and Events (See Chapter VI.F Wildlife Management Issues for more information)
- Environmental film showings monthly and an environmental short film event yearly at WNC
- Reston Bird Checklist – issued periodically, most recently in 2015
- Monthly bird walks cosponsored by RA, Audubon Society of Northern Virginia, and The Bird Feeder store

**Conclusions**

The state of the environment for birds in Reston is fair.

In an area comprising about four percent of Fairfax County, Reston supports 150 of the 260 species of birds seen in Fairfax County since January 2015. Reston’s remaining forest habitat continues to support most SGCN species that require forest habitat like the wood thrush and northern flicker, and some open habitat species like eastern bluebird, ruby-throated hummingbird, and indigo bunting are doing well in Reston along field-forest edges. SGCNs that require larger grassland habitat such as the meadowlark, grasshopper sparrow, and barn owl, however, are not found in Reston. Reston’s small amount of marshland supports one SGCN, the green heron, though not others such as the least bittern or glossy ibis. The SGCN particularly dependent on woodland lakes and streams, the belted kingfisher, is seen in Reston year-around. Erosion of habitat due to development will further threaten these and other bird species in Reston.

No Reston-specific data are available on how many birds are killed by outdoor cats, collisions with building windows, or in collisions with automobiles, but there is also no reason to conclude that Reston’s cats, buildings, and automobiles are not contributing proportionately to the nationwide statistics on bird fatalities cited in this report.
Recommendations

RA should:

- Continue the current RA mission to preserve and protect natural areas by focusing residents, RA Maintenance, and businesses on improving and expanding habitat for birds by:
  - Prioritizing bird conservation in the RA natural areas surrounding Lake Fairfax Park including Buttermilk Creek, which has by far the greatest diversity of habitats and breeding birds in Reston,
  - Focusing on forest bird conservation from WNC through Glade Stream Valley to Twin Branches--along with Lake Fairfax, this is the best area in Reston for forest-interior breeding birds,
  - Better managing grasslands by working with Transco to coordinate a mowing schedule along its pipeline that will preserve milkweed and other plants used by birds,
  - Obtaining habitat management rights from Mass Life for Sunrise Valley Wetlands
- Issue guidelines for residents on humane control of outdoor cats after EAC formulates recommendations based on review of its 2017 discussion paper.
- Form a volunteer group like Lights Out DC (http://citywildlife.org/programs/lights-out-dc/) to monitor whether birds are being killed by colliding with windows of tall glass buildings. RA has no baseline data on the number of bird deaths from window collisions. WNC now has the necessary permits.
- Include in the RA Design Review Board review process future outdoor lighting recommendations, including reduction of outdoor lighting during spring and fall migration. (See Recommendations for VIII. Light Pollution)
- Continue to support alternatives to automotive transportation to reduce the number of birds killed by automobiles.
- Host programs to teach residents how use eBird for documenting bird sightings. Because the most thorough data on birds seen throughout the year is in eBird, to continue to document bird diversity in Reston, WNC should encourage Reston residents to participate in it and other citizen science bird-related efforts like the Virginia Breeding Bird Atlas.
VI.B. Mammals

Background

Reston, a Wildlife Habitat Community certified by the National Wildlife Federation, hosts at least 31 species of mammals. Reston’s policy is to protect and to co-exist with wildlife to the greatest extent possible. Although no systematic studies or inventories of Reston’s mammals have been conducted to date, its varied habitats and forested stream corridors, which connect it to the more extensive wooded floodplain of the Potomac River, create opportunities for various mammals to live in Reston (Exhibit VI.B-1)

The Endangered Species Act of 1973 provides both for the conservation of species, including mammals that are endangered or threatened in all or a significant part of their range, and for the conservation of the ecosystems on which they depend. The Virginia Wildlife Action Plan (WAP) indicates no endangered mammal species live in Reston.

When wildlife populations exceed the carrying capacity of an area, conflicts between wildlife and residents can ensue. RA’s Parks, Recreation, and Events Department provides education and tips to residents to foster co-exist with wildlife, handling resident calls on a case-by-case basis. Virginia State law forbids relocation of wildlife.

RA has deemed the feeding of non-domesticated wild animals (except songbirds) to be a nuisance, and it is prohibited. Practices that attract nuisance species or those that may be vectors for infectious diseases, including, but not limited to, leaving pet food out of doors overnight in a location accessible to non-domesticated wild animals, are also deemed a nuisance and are prohibited.

Exhibit VI.B-1: Rabbit in Reston

Of the 31 mammalian species for which the Walker Nature Center has compiled resident sightings, one is monitored in detail by Fairfax County and Reston: White-tailed deer. Suburban deer populations have increased tremendously in many areas because of abundant food sources and too few predators. They now pose safety concerns to drivers, destroy young trees and understory plants, invade gardens, and act as vectors for certain tick-borne diseases. In addition to wild mammals, both feral and domesticated unleashed outdoor cats are prevalent in Reston. Outdoor cats kill 12.3 billion animals and from 1.3 to 4 billion birds per year in the United States. The EAC has drafted a 2016 position paper on outdoor cats.

See Chapter VI.E Wildlife Management Issues and the 2017 RA Natural Resource Management Plan for more information on deer management and Chapter VI.A Birds for more information on outdoor cats.
Virginia’s Department of Game and Inland Fisheries has profiled all wildlife species found in the state, including mammals: See [https://www.dgif.virginia.gov/wildlife/information/](https://www.dgif.virginia.gov/wildlife/information/)

Movement of mammals and their access to food and water can be impeded by roads and fragmentation of the landscape. Wildlife corridors that help connect otherwise isolated pockets of similar habitats can benefit mammals that need larger home ranges. Emerald Network initiatives were launched nearly 20 years ago in Europe to ensure functional connectivity among land and water sources in to aid populations of wild creatures including mammals. In the United States, organizations including Conservation Corridor and the National Wildlife Federation (NWF) are working to provide pathways that wildlife can use to cross expanses of key habitat. NWF specifies that many of these solutions are low cost and improve motorist safety.

**Existing Conditions**

RA Staff have compiled a list of mammals seen in Reston ([Exhibit VI.B-3](#)) based on resident reports and observations of WNC staff. Population sizes are unknown. There has been no systematic monitoring or study of Reston’s mammals other than of White-tailed deer as outlined in Chapter VI.E Wildlife Management Issues and the 2017 RA Natural Resource Management Plan.

Humans excepted, Reston no longer has any apex predators like wolves, which are not preyed upon by other species. Mammals have widely varying roles in the environment. For example:

Coyotes function as predators high on the food chain, usually preying on rodents and other small varmints and sometimes on small deer fawns (Exhibit VI.B-2). Their population in Reston is unknown. Fairfax County, in its [Environmental Quality Advisory Council--2016 Annual Report on the Environment](#) (EQAC Report), indicates that while coyotes will sometimes prey on small pets (e.g., cats and very small dogs) and the public needs to be kept informed on measures to prevent this, the public also needs to develop awareness of the beneficial aspects of coyotes in controlling populations of small rodents and excessive numbers of small deer fawns as well as in controlling populations of Canada geese. As the EQAC Report observes, as a natural predator, they are not subject to the restrictions of the Federal Migratory Waterfowl Act.”
Exhibit VI.B-3: Mammals of Reston
Compiled by RA Staff, 30 March 2017

Abundant = seen throughout Reston, every year, frequently, in plentiful numbers although not necessarily seen in groups
Common = seen in many places around Reston, every year, frequently, often more habitat specific
Uncommon = often seen in more specialized habitat, some years or infrequently
Rare = low probability of observing this species, infrequent observations, usually transient individuals

Abundant
White-tailed Deer
Southern Flying Squirrel
Eastern Gray Squirrel
Eastern Chipmunk
White-footed Mouse
House Mouse
Eastern Mole
Norway Rat
Raccoon
Red Fox

Common
Groundhog
Virginia Opossum
Eastern Cottontail Rabbit
Meadow Vole
Northern Short-tailed Shrew
Striped Skunk
Big Brown Bat
Eastern Red Bat

Uncommon
Beaver
Muskrat
Coyote
Least Shrew
Star-nosed Mole
Black Rat
Long-tailed Weasel
Silver Haired Bat
Hoary Bat

Rare
Little Brown Bat
Tri-colored Bat
River Otter
Bobcat
Black Bear
Beavers create new habitats that benefit a variety of other animals when their dams slow the flow of moving waters and allow other wildlife and plant species to colonize this modified ecosystem. In Fairfax County, whenever possible, beavers are tolerated on parkland though exclusion methods can be employed to protect vegetation and property from damage. There have been reports of three pairs of beaver in Reston but not of any kits (babies) (Exhibit VI.B-4).

Exhibit VI.B-4: Reston Beaver in The Glade Stream Valley

© Sheryl Pollock
Bats eat substantial numbers of insects, including nuisance species such as mosquitoes. A single bat can eat 600 mosquitoes per hour. Bats also pollinate flowers and disperse seeds. Neither the EQAC Report nor the Virginia WAP address the status of bats. The US Fish & Wildlife Service lists three species of bats as threatened in Virginia: Gray, Indiana, and big-eared. Many bat species are in serious decline internationally and nation-wide because of many threats, including habitat loss, climate change, and pesticides. Several species of colonially nesting bats in the United States and Canada may be driven to or near extinction by a fungal disease, White Nose Syndrome (WNS). Of the 13 bat species found in Virginia, five bat species have been reported in Reston: Little brown, big brown, eastern red, silver haired, and hoary. Of these, little brown, big brown, and silver-haired bats nest colonially and so may be most affected by WNS. The little brown bat, which used to be the most abundant bat species in Reston, is now considered rare.

Some mammal-borne diseases threaten humans. See Chapter VI.E Wildlife Management Issues for information on Lyme disease, which is carried by ticks hosted by deer. Rabies is another concern: In Fairfax County, the main reservoirs for rabies are raccoons, skunks, foxes, and bats. Occasionally, beavers and groundhogs are diagnosed with rabies, and dogs and cats may act as secondary transmitters of the disease after having contracted rabies from wildlife. The EQAC Report characterizes the incidence of rabies in Fairfax County as “fairly stable” but notes a “worrisome trend in cat rabies has been observed, particularly in the southern portion of the county,” with rabid cats identified each year since 2010. The report recommends that since feral cats often live in small groups, they should be closely monitored as a potential rabies hazard. Among other diseases, cats can also transmit Toxoplasmosis and Bartelllenosis to humans.

Although Reston’s system of underpasses and culverts may aid mammals in avoiding transit via road, current RA planning guidelines do not address the benefits of establishing or preserving wildlife corridors.
Conclusions

Of the 31 mammalian species for which WNC has compiled resident sightings, one is monitored in detail by Fairfax County and Reston: White-tailed deer. Suburban deer populations have increased tremendously in many areas because of abundant food sources and too few predators. They now pose safety concerns to drivers, destroy young trees and understory plants, invade gardens, and act as vectors for certain tick-borne diseases. In addition to wild mammals, both feral and domesticated unleashed outdoor cats are prevalent in Reston. Outdoor cats kill 12.3 billion animals and from 1.3 to 4 billion birds per year in the United States. The EAC has drafted a 2017 position paper on outdoor cats. See Chapter VI.E Wildlife Management Issues and the 2017 RA Natural Resources Management Plan for more information on deer and outdoor cat management.

There are not enough data available to draw a conclusion on the state of mammals in Reston. Although RA staff has catalogued 31 species of mammals that have been observed in Reston, the population levels of these mammals and their effects on the environment are poorly understood. A more thorough inventory of resident mammal species would be helpful for understanding how to best manage the various habitats in Reston’s natural areas.

Although Reston’s system of underpasses and culverts may aid mammals in avoiding transit via road, current RA planning guidelines do not address the benefits of establishing or preserving wildlife corridors or the potential disruption of wildlife access to food and water when contiguous habitat is fragmented and isolated. Present guidelines do not ensure these issues are considered during Reston’s planning processes. It should also be recognized and accepted that some wildlife cherished by the community also needs to be humanely managed in suburban environments that lack natural predators, especially when species exceed the carrying capacity of the habitat.

Recommendations

RA should:

- Tap partnerships with universities and youth-related organizations to survey and study Reston’s mammals, perhaps employing BioBlitzes as a survey technique.
- Direct the DRB to study and incorporate a wildlife corridor concept into planning guidelines.
- Adopt a position encouraging residents to keep domestic cats indoors and to raise awareness about the impact of outdoor cats on wildlife.
VI.C. Reptiles and Amphibians

Background

Reptiles and amphibians, collectively known as herptofauna or herptiles, are an important component of Reston’s wildlife. They are important in the food chain because they consume invertebrates such as spiders, insects, centipedes, millipedes, ants, and snails. In turn, they are eaten by some birds and mammals, as well as by some snakes. Amphibians are especially good indicators of environmental health because the thin skin of frogs and salamanders can absorb toxic chemicals and makes them susceptible to radiation damage and pathogenic organisms. Also, the dual aquatic/terrestrial life cycle of amphibians exposes them to multiple pollutants.

Amphibian populations are declining globally. Climate change and pathogenic fungi are contributing to this decline. Virginia, however, has a relatively rich diversity of salamander species, supporting about 10 percent of the world’s species. In the United States, massive die-offs of amphibians are often caused by Ranavirus. Scientists at the U.S. Geological Survey’s National Wildlife Health Center have isolated ranaviruses associated with die-offs in over 25 states involving more than 20 species of turtles and amphibians in mortality events ranging from one to thousands of affected individuals. Some events may involve a single species; others may involve multiple species. In states east of the Mississippi River, especially Atlantic coastal states, mortality events tend to involve all species within the wetland (frogs, toads, and salamanders). Research is also currently underway to determine if compounds from frogs and toads can be used in anti-cancer and anti-HIV medicines.

RA Environmental Education staff members operate a pond study station at Reston festivals, and WNC staff members provide reptile and amphibian programs throughout the year for participants of all ages. RA is committed to co-existing with wildlife and conserving Reston’s natural resource diversity. Residents’ most common concern about herptiles centers on their fear of snakes. RA staff finds there is often unnecessary fear and misunderstanding about snakes and their place in the environment (Exhibit IV.C-1). Staffers often refer residents to a booklet, A Guide to the Snakes of Virginia, from the Virginia Department of Game and Inland Fisheries for identification and habitats. They also encourage residents to learn about the benefits and behavior of local snakes and techniques for co-existing with native wildlife, such as those promoted in the publication entitled Resolving Conflicts with Wildlife, Snakes of Fairfax County.
Existing Conditions

Sixteen species of amphibians (nine frog and toad species and seven salamander species) and 20 species of reptiles (seven turtle species, 11 snake species, and two lizard species) have been reported from Reston (Exhibit VI.C-2), but all of these species have been identified anecdotally by people observing and reporting individual reptiles or amphibians. There has been little organized effort to collect data about their abundance, habitats, trends, and what threatens them. There may be other species present that have not yet been reported, and some of the species on the list may have been extirpated. Of the Priority Species of Greatest Conservation Need within the Northern Virginia Planning Region listed in the 2015 Virginia Wildlife Action Plan, only one is a herptile: The wood turtle.
Exhibit VI.C-2: Reptiles and Amphibians Seen in Reston

**Frogs and Toads**
- *Lithobates sylvaticus* Wood Frog
- *Lithobates palustris* Pickerel Frog
- *Pseudacris crucifer* Spring Peeper
- *Lithobates clamitans* Green Frog
- *Lithobates catesbeianus* American Bullfrog
- *Anaxyrus americanus americanus* American Toad
- *Anaxyrus fowleri* Fowler's Toad
- *Pseudacris feriarum* Upland Chorus Frog
- *Hyla chrysoscelis* Cope's Gray Treefrog

**Salamanders**
- *Ambystoma maculatum* Spotted Salamander
- *Plethodon cinereus* Eastern Red-backed Salamander
- *Notophthalmus viridescens* Eastern Newt
- *Plethodon cylindraceus* White-spotted Slimy Salamander
- *Pseudotriton montanus* Mud Salamander
- *Eurycea bislineata* Northern Two-lined Salamander
- *Ambystoma opacum* Marbled Salamander

**Turtles**
- *Chelydra serpentine* Snapping Turtle
- *Trachemys scripta elegans* Red-eared Slider
- *Terrapene carolina* Box Turtle
- *Chrysemys picta* Painted Turtle
- *Kinosternon subrubrum* Eastern Mud Turtle
- *Pseudemys rubriventris* Northern Red-bellied Cooter
- *Pseudemys concinna* River Cooter

**Snakes**
- *Nerodia sipedon* Northern Water Snake
- *Agkistrodon contortrix* Copperhead
- *Thamnophis sirtalis* Gartersnake
- *Diadophis punctatus* Ring Neck
- *Elaphe obsolete* Ratsnake
- *Carphophis amoenus* Worm Snake
- *Regina septemvittata* Queen Snake
- *Opheodrys aestivus* Rough Green Snake
- *Coluber constrictor constrictor* Northern Black Racer
- *Storeria dekayi dekayi* Northern Brown Snake
- *Storeria occipitomaculata occipitomaculata* Northern Red-bellied Snake

**Lizards**
- *Plestiodon inexpectatus* Five-lined Skink
- *Plestiodon laticeps* Broad-headed Skink

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The only herptile recorded from Reston that is a non-native species is a turtle: The red-eared slider (*Trachemys scripta elegans*). Red-eared sliders can detrimentally affect ecologically similar species because they use limited food resources more efficiently for their growth and development than native species and because they compete for nesting, basking, and hiding spaces. Red-eared sliders can also hybridize with some native turtles. Native turtles also have no immunity to parasites and diseases sometimes carried by red-eared sliders. Red-eared sliders are commonly found in the pet trade and have been introduced into the environment by their owners when they are dumped in ponds and lakes. Exhibit IV.C-3 illustrates the population range of this non-native species in the United States. The mustard color indicates the native range for the Red-eared slider; the reddish color indicates nonindigenous occurrences:

**Exhibit VI.C-3. Range for Red-eared Slider.**

Many of the herptile species in Reston rely on wetlands such as the areas below the Bright Pond flood control dam, the beaver-influenced lower end of the Glade Stream Valley, the small marshy areas near the head of Lakes Thoreau and Audubon, the Sunrise Valley Wetlands, the Carter Lake wetland, Waterside Pond, The Glade Stream, Snakeden Branch, and Buttermilk Creek (see Chapter V.C Wetlands). These are especially important habitats for Reston’s amphibian species. Sadly, one-third to one-half of all amphibians are globally threatened with extinction. There are several causes for this decline, including climate change and the spread of a disease caused by the fungal chytrid pathogen. In 2014, tadpoles living in the pond at the Walker Nature Center were tested by a wildlife biologist from the Smithsonian Conservation Biology Institute for *Ranavirus*. All the tadpoles tested negative for the virus at that time.

Reston also has vernal pools, temporary wetlands that fill with water during the early spring and dry out in the summer (see also Chapter V.C Wetlands). Vernal pools are not connected to any permanent body of water, so they do not have fish predators. They provide critical habitat for wood frogs and spotted salamanders, which live in the upland forest and come to the pools to mate and lay eggs (See Exhibit VI.C-4). They then return to the surrounding forest for the rest of the year. Tadpoles emerge from the hatching egg masses, and as the young transform into adult frogs and salamanders, they eventually also migrate to the surrounding forest.
Stream restoration projects in Reston often improve wetland habitat for reptiles and amphibians. If not done carefully, however, the work can destroy vernal pools, which are quite fragile systems.

An excellent source of information on the status of frogs can be found at Frogwatch (https://www.aza.org/frogwatch).

Conclusions

Reston’s natural areas contain a diversity of habitats that appear capable of supporting a reasonable number of reptile and amphibian species. The variety of reptiles and amphibians recorded in Reston suggests that the environment is healthy, but without a more rigorous understanding of the community’s herptiles, much remains unknown about the status of its reptile and amphibian residents, including whether or not their populations are sustaining, expanding, or declining.

Recommendations

- RA should coordinate a BioBlitz to develop a checklist and to survey reptiles and amphibians.
VI.D. Invertebrates

Background

Invertebrates are animals lacking backbones and include worms, centipedes, millipedes, spiders, snails, slugs, crustaceans, corals, insects, and many obscure groups unfamiliar to most people. Invertebrates, the broadest category of animal life, represent 95 percent of the 1.4 million known extant (living) animal species on the planet. Among invertebrates, arthropods (insects, crustaceans, spiders, and their relatives) make up the most diverse group, collectively accounting for 1.2 million of the known living animal species.\(^{159}\) Diverse and abundant, they play many critical roles in maintaining healthy ecosystems. These roles include pollination, decomposition, and nutrient cycling. They also serve as major food sources for other animals and can be both pests and pest controllers. Many invertebrates are sensitive to environmental conditions, so they have the potential to be used as indicators of the state of the environment.

Conducting butterfly and dragonfly counts is becoming a popular outdoor activity for amateur naturalists across the country. For example, the North American Butterfly Association (NABA) holds a Fourth of July Butterfly Count each year to monitor butterfly distribution, relative population sizes, trends, and effects of weather and habitat changes across North America and issues annual reports containing results.\(^{160}\) Such counts provide a “snapshot in time” of the species present at a given site, but the numbers and types of species observed can be greatly influenced by local weather events, the number and proficiency of the observers, time spent, the number of sites sampled, and the count leader’s approach. In 2010, Reston joined NABA and began contributing data to their Fourth of July count.

Bees are also an important insect indicator of environmental health. The recent decline in European honey bee and native bee populations has intensified efforts to monitor these insects statewide because their decline has both ecological and serious economic consequences.\(^{161}\) The concern began in 2006 with the documented rapid and nationwide disintegration of honeybee colonies from Colony Collapse Disorder (CCD). The problem would be alarming enough if it were just limited to the introduced European honey bees, but also in peril are many of the 3,500 solitary species of native bees, most of which are even better pollinators than their European cousin. The decline in native bees is not only a threat to agriculture but also to natural ecosystems.\(^{162}\) The exact cause of CCD has been elusive, but currently it is believed to be a combination of environmental stressors including pesticides, parasites, viruses, and possibly nutritional deficiencies. These same stressors, especially pesticides, are affecting native bees. Habitat loss from urban and farmland development also reduces the number and diversity of wildflowers and flowering shrubs from which nectar is obtained, reducing sustainable habitat for native bees.\(^{163}\)

Virginia’s 2015 Wildlife Action Plan (WAP) identifies several invertebrate Species of Greatest Conservation Need (SGCN) for the Northern Virginia Planning Region.\(^{164}\) None of the listed invertebrate SGCNs has been recorded in Reston or its vicinity. The SGCN butterfly species are the dotted skipper (Hesperia attalus), and the persius duskywing (Erynnis persius), which both need open habitats,
including grasslands and shrublands that are often comprised of abandoned agricultural lands, glades, and barrens.

The invertebrates of Reston are largely unstudied with the exception of a few RA or citizen scientist projects involving insects (specifically, butterflies, dragonflies, and certain insect pests and deleterious invasive species) and benthic macro-invertebrates, many of which are insects. See Chapter IV.A Streams for information on benthic macro-invertebrates (invertebrates living on the bottom of streams and lakes, which are large enough to see with the naked eye). See Chapter IV.E Wildlife Management Issues for information on ticks and mosquitoes and Chapter V.A Tree Cover for information on insect pests affecting trees.

**Existing Conditions**

**Butterflies**

Butterflies can be valuable indicators of the state of the environment. Their service as pollinators of native plants and as food sources for other wildlife, especially birds, makes them an important component of the ecosystem. One-day butterfly counts have been conducted in Reston in early July almost every year since 1994. WNC staff members have compiled these and other reported butterfly observations into a Reston Butterfly Checklist Summary spreadsheet. Each species is classified as to its relative abundance based on the one-day count: Abundant, Common, Uncommon, or Rare. See Exhibit VI.D-7, which follows this chapter’s recommendations.

One species of concern nationwide is the monarch butterfly, *Danaus plexippus* (Exhibit VI.D-1). Monarchs are famous for migrating from North America to Mexico to spend the winter. The return migration north in the spring typically requires at least two generations to complete the trip. Along the way, adult females mate and lay their eggs on plants in the milkweed family. No individual butterfly makes the entire return trip to Northern Virginia. Monarchs are very host-specific, preferring to feed and to lay their eggs on plants in the milkweed family, so a decline in the population may be caused by a scarcity of milkweed plants.

*Exhibit VI.D-1: Monarch Butterfly at Bright Pond ©Don Coram*

According to NABA in 2013, “Virginia has experienced a huge drop in monarch sightings over the past several years, [and] this year’s total ... is dramatically lower than any year in the past eight.” There was a slight recovery statewide in 2014 and 2105, but it was nowhere near the average number reported in the years before 2013. Reston was no exception—no sightings were recorded during the one-day counts from 2013 to 2016, although anecdotal reports indicate a few monarchs were observed in Reston on other dates.
The National Wildlife Foundation has a Garden for Wildlife program of which the Mayors' Monarch Pledge and the Butterfly Heroes Pledge are campaigns targeted for monarch butterflies. Reston Chief Executive Officer Cate Fulkerson was the first mayor/CEO in Virginia to sign the National Wildlife Foundation Mayors’ Monarch Pledge, which reads in part:

“We, the undersigned mayors and local government chief executives, are deeply concerned about the decline of the monarch butterfly population. ... Therefore, we hereby commit to help restore habitat for the monarch and encourage our citizens to do the same, so that these magnificent butterflies will once again flourish across the continent.”

Reston is one of only four towns in Virginia that have made this pledge. One of the actions pledged is to establish Monarch Waystations, of which there are now six in Reston, including at RA Headquarters. These waystations provide milkweed plants preferred by monarchs. Other actions include public communication via Walker Nature Center newsletters and articles in RA News, a native plant sale, "seed bombs" made and dispersed by local elementary schools, a policy to avoid mowing milkweeds in highway median areas, the aforementioned annual butterfly count each July, and an invasive plant removal program.

The annual NABA reports also provide butterfly count data for neighboring sites that can be compared to Reston’s to help assess Reston’s environment for butterflies. The sites selected for comparison were Washington, DC; Audrey Carroll Audubon Sanctuary (ACAS), Prince George’s County, and western Montgomery County, Maryland; Airlie Center and Waterford, Virginia. From 2010 to 2015, Reston tallied 39 species, but the neighboring sites tallied 41 additional species not seen in Reston. This suggests that Reston’s butterfly habitat does not have as much host plant diversity as neighboring count sites, although for some species it is probably instead due to a difference in the number of observers or other non-environmental factors. The larvae of many butterfly species require specific plant hosts, so the apparent absence of these butterflies in Reston suggests their favored or obligate food sources are not available in Reston’s habitats. Several of the missing larval food sources are not flowers, which are often thought of as the primary food for butterflies, but rather trees (hackberry, pawpaw, etc.) and sedges.

Exhibit VI.D-2 and Exhibit VI.D-3 profile two butterfly species seen very often in Reston.
Exhibit VI.D-2: Eastern Tiger Swallowtail Butterfly

The Virginia State Butterfly is the eastern tiger swallowtail, *Papilio glaucus*. State-wide, the number of swallowtails observed in the NABA counts is down by nearly 50 percent from 2013, but this resident butterfly has been seen regularly in Reston since counts began in 1994, and the number counted in Reston in 2015 was nearly as high as 2013. Tiger swallowtail larvae feed on a variety of plants: cottonwood, tulip poplar, sweet bay, cherry and others commonly found in Reston.

© Don Coram

Exhibit VI.D-3: Cabbage White Butterfly

Now one of our most common butterflies in Reston and throughout Virginia, the cabbage white butterfly, *Pieris rapae*, was introduced from Europe in the 19th Century and is now very much at home in developed areas, more so than natural habitats. Its larvae’s food sources include plants in the cabbage family, nasturtium, watercress, mustards, and others. Because the larvae feed on some agricultural crops, cabbage whites are sometimes considered pests.

© Don Coram

Dragonsflies

Dragonsflies provide important control of many insect pests, particularly mosquitos. They also can be an indicator species for the state of the environment. Habitats include vegetated edges of lakes and ponds, woodland streams, and grasslands, depending on species and gender.

RA has been conducting a one-day citizen science dragonfly count each year since 1998; data are available for six years (2009-2013, 2015-2016). These data do not indicate population size but do indicate that certain species of dragonfly that can adapt to various habitats are present in Reston.

The most numerous dragonfly seen based on the one-day count data is the blue dasher (*Pachydiplax longipennis*, Exhibit VI.D-4). Typically, hundreds of these are seen in a single day. This small dragonfly is only about 1.4 inches long and is found in a wide variety of habitats including rather disturbed or polluted waters. They were found in almost every wetland where counts occurred and were so abundant that on many of the counts, the observers stopped counting them.
Another dragonfly seen often is the eastern amberwing (*Perithemis tenera*, Exhibit VI.D-5). This is a very small dragonfly, only 0.9 inches long. Amberwings are also found in a wide variety of wetlands. On a typical count, dozens are seen.

Other dragonflies seen regularly in Reston include the slaty skimmer (*Libellula incesta*), common green darner (*Anax junius*), common whitetail (*Libellula Lydia*), eastern pondhawk (*Erythemis simplicicollis*), widow skimmer (*Libellula luctuosa*), black saddlebags (*Trameca lacerate*), and halloween pennant (*Celithemis eponia*), all of which are adaptable to a variety of habitats.
In addition to the common dragonflies, other less common species have been seen in Reston. For example, the black-shouldered spinylegs (*Dromogomphus spinosus, Exhibit VI-6*) has only been recorded in Reston four times, possibly because its habitat is limited to muddy-bottomed streams or large windswept lakes. Other uncommon dragonflies include Cyrano darner (*Nasiaeschna pentacantha*), least clubtail (*Stylogomphus albirostra*), arrowhead spiketail (*Cordulegaster obliqua*), clamp-tipped emerald (*Somatochlora tenebrosa*), ruby meadowhawk (*Sympetrum rubicundulum*), and the calico pennant (*Celithemis elisa*).

Within Reston’s boundaries from 1998 to 2014, 39 species of dragonflies were observed and recorded by Kevin Munroe, a former RA staff member and local dragonfly expert, who has also created a valuable website as a reference for dragonflies of Northern Virginia. The number of species and, particularly, the unusual species observed in Reston suggest that the state of the environment for dragonflies may be good. Several uncommon dragonfly species that are associated with forested streams and seepages, such as those in Buttermilk Creek, the Blue Smoke forests streams, and Twin Branches, may be affected detrimentally if construction activities affect seepages, which are particularly fragile systems.

**Chapter V.A Tree Cover** addresses invertebrate pests affecting Reston’s trees. One other insect pest of note, the Japanese beetle (*Popillia japonica*) is an invasive pest that first arrived in the United States from Japan around 1916. They feed on more than 200 species of plants, many of which are common to residential gardens. Their effect on the Reston landscape is primarily cosmetic. The beetles are most active on warm, sunny days, and they prefer plants that are in direct sunlight. A single beetle does not eat much, but group feeding by many beetles can result in severe damage. There are various pesticides, hormone traps, and bacteria that can be used to control these beetles. *Bacillus thuringiensis* (Bt) is a naturally occurring soil bacterium typically used as a microbial insecticide. The Bt strain registered for the Japanese beetle is for use on the grub stage only. RA has previously used Bt for control but is not now doing so. During a particularly severe infestation, the larvae can cause damage to sports fields, which have been treated in the past to curtail infestations in Reston.
Conclusions

For invertebrates, the state of the environment in Reston is unknown although very limited data collected by citizen science outreach counts do not indicate the situation is problematic for butterflies and dragonflies.

Based on one-day counts, the butterflies that are generalists seem to be doing fine, but some species that need very specific larval host plants are absent or rarely seen in Reston although they do inhabit other sites in the region – probably owing to insufficient host plants in Reston. Reston’s monarch program is laudable; similar programs may be warranted for other uncommon or rare species.

The dragonflies that are regularly seen in Reston are generalists, while those species with specific singular habitat requirements such as forest seepages are uncommon and may be potentially endangered by loss of habitat in stream valleys.

Very little is known about the occurrence or health of other insect taxonomic groups and other invertebrates in Reston.

Recommendations

RA should:

- Consider partnering with other organizations, such as not-for-profit conservation organizations and government agencies, to host a Reston natural areas BioBlitz to help inventory the invertebrates currently inhabiting Reston.
- Preserve Reston’s natural areas and aggressively remove invasive species which otherwise compete with or replace native food sources for resident invertebrate species.
- Expand the butterfly conservation plan (beyond monarchs) to plant specific host plants to encourage more species diversity.
### Exhibit VI.D-7. Butterflies of Reston Checklist

Abundant: Purple; Common: Green; Uncommon: Orange; Rare: Red

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SCIENTIFIC NAME</th>
<th>FLIGHT PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SWALLOWTAILS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black Swallowtail</td>
<td>Papilio polyxenes</td>
<td>March-October</td>
</tr>
<tr>
<td>Eastern Tiger Swallowtail</td>
<td>Papilio glaucus</td>
<td>April-October</td>
</tr>
<tr>
<td>Spicebush Swallowtail</td>
<td>Papilio troilus</td>
<td>April-October</td>
</tr>
<tr>
<td><strong>HARVESTERS &amp; COPPERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Copper</td>
<td>Lycaena phlaeas</td>
<td>April-August</td>
</tr>
<tr>
<td><strong>WHITES &amp; SULPHURS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage White</td>
<td>Pieris rapae</td>
<td>March-November</td>
</tr>
<tr>
<td>Clouded Sulphur</td>
<td>Colias philodice</td>
<td>April-November</td>
</tr>
<tr>
<td>Orange Sulphur</td>
<td>Colias eurytheme</td>
<td>March-November</td>
</tr>
<tr>
<td><strong>GOSSAMER WINGS- HAIRSTREAKS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banded Hairstreak</td>
<td>Satyrium calanus</td>
<td>June-August</td>
</tr>
<tr>
<td>Juniper Hairstreak</td>
<td>Callophrys gryneus</td>
<td>April-August</td>
</tr>
<tr>
<td>Gray Hairstreak</td>
<td>Strymon melinus</td>
<td>March-November</td>
</tr>
<tr>
<td>Red-Banded Hairstreak</td>
<td>Calycopis cecrops</td>
<td>March-October</td>
</tr>
<tr>
<td><strong>GOSSAMER WINGS- BLUES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Tailed-Blue</td>
<td>Everes comyntas</td>
<td>March-October</td>
</tr>
<tr>
<td>Spring Azure</td>
<td>Celastrina ladon</td>
<td>March-October</td>
</tr>
<tr>
<td><strong>SNOUTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Snout</td>
<td>Libytheana carinenta</td>
<td>May-October</td>
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<tr>
<td><strong>NYMPHALIDAE- HELICONIANS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variegated Frilllary</td>
<td>Euptoieta claudia</td>
<td>April-November</td>
</tr>
<tr>
<td>Great Spangled Frilllary</td>
<td>Speyeria cybele</td>
<td>May-October</td>
</tr>
<tr>
<td>Meadow Frilllary</td>
<td>Boloria bellona</td>
<td>April-September</td>
</tr>
<tr>
<td><strong>NYMPHALIDAE- BRUSHFOOTS</strong></td>
<td></td>
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</tr>
<tr>
<td>Pearl Crescent</td>
<td>Phyciodes tharos</td>
<td>April-November</td>
</tr>
<tr>
<td>Question Mark</td>
<td>Polygonia interrogationis</td>
<td>Year Round</td>
</tr>
<tr>
<td>Eastern Comma</td>
<td>Polygonia comma</td>
<td>Year Round</td>
</tr>
<tr>
<td>Mourning C loak</td>
<td>Nymphalis antiopa</td>
<td>March-November</td>
</tr>
<tr>
<td>American Lady</td>
<td>Vanessa virginiensis</td>
<td>April-November</td>
</tr>
<tr>
<td>Painted Lady</td>
<td>Vanessa cardui</td>
<td>April-October</td>
</tr>
<tr>
<td>Red Admiral</td>
<td>Vanessa atalanta</td>
<td>April-October</td>
</tr>
<tr>
<td>Common Buckeye</td>
<td>Junonia coenia</td>
<td>April-November</td>
</tr>
<tr>
<td><strong>ADIMIRALS AND RELATIVES</strong></td>
<td></td>
<td></td>
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<tr>
<td>Red-Spotted Admiral</td>
<td>Limenitis arthemis</td>
<td>April-October</td>
</tr>
<tr>
<td>Viceroy</td>
<td>Limenitis archippus</td>
<td>May-October</td>
</tr>
<tr>
<td><strong>NYMPHALIDAE- SATYRS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little Wood Satyr</td>
<td>Megisto cymela</td>
<td>May-August</td>
</tr>
<tr>
<td>Common Wood Nymph</td>
<td>Cercyonis pegala</td>
<td>June-October</td>
</tr>
<tr>
<td>Family</td>
<td>Species</td>
<td>Active Period</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>NYMPHALIDAE - MILKWEED BUTTERFLIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MONARCH</td>
<td>Danaus plexippus</td>
<td>April-November</td>
</tr>
<tr>
<td>HESPERIIDAE - SPREADWING SKIPPERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILVER-SPOTTED SKIPPER</td>
<td>Epargyreus clarus</td>
<td>April-October</td>
</tr>
<tr>
<td>HORACE'S DUSKYWING</td>
<td>Erynnis horatius</td>
<td>April-September</td>
</tr>
<tr>
<td>NORTHERN CLOUDYWING</td>
<td>Thorbyes pylades</td>
<td>May-August</td>
</tr>
<tr>
<td>WILD INDIGO DUSKYWING</td>
<td>Erynnis baptisiae</td>
<td>April-October</td>
</tr>
<tr>
<td>COMMON SOOTYWING</td>
<td>Pholisora catullus</td>
<td>April-August</td>
</tr>
<tr>
<td>HESPERIIDAE - GRASS SKIPPERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LEAST SKIPPER</td>
<td>Ancyloxypha numitor</td>
<td>April-October</td>
</tr>
<tr>
<td>EUROPEAN SKIPPER</td>
<td>Thymelicus lineola</td>
<td>June</td>
</tr>
<tr>
<td>FIERY SKIPPER</td>
<td>Hylephila phyleus</td>
<td>June-October</td>
</tr>
<tr>
<td>PECK'S SKIPPER</td>
<td>Polites peckius</td>
<td>April-October</td>
</tr>
<tr>
<td>TAWNEY-EDGED SKIPPER</td>
<td>Polites themistocles</td>
<td>May-August</td>
</tr>
<tr>
<td>CROSSLINE SKIPPER</td>
<td>Polites origenes</td>
<td>May-September</td>
</tr>
<tr>
<td>LONGDASH SKIPPER</td>
<td>Polites mystic</td>
<td>May-July</td>
</tr>
<tr>
<td>NORTHERN BROKEN DASH</td>
<td>Wallengrenia egeremet</td>
<td>June-August</td>
</tr>
<tr>
<td>LITTLE GLASSY WING</td>
<td>Pompeius verna</td>
<td>April-September</td>
</tr>
<tr>
<td>DELAWARE SKIPPER</td>
<td>Anatrytone logan</td>
<td>June-August</td>
</tr>
<tr>
<td>SACHEM SKIPPER</td>
<td>Atalopedes campestris</td>
<td>April-November</td>
</tr>
<tr>
<td>ZABULON SKIPPER</td>
<td>Poanes zabulon</td>
<td>April-October</td>
</tr>
<tr>
<td>DUN SKIPPER</td>
<td>Euphyes vestris</td>
<td>May-October</td>
</tr>
</tbody>
</table>
VI.E. Wildlife Management Issues

Background

Although Reston’s wildlife is a valuable asset to the overall health of the community’s natural areas, some species can become problematic, especially when their populations surpass the natural carrying capacity of the landscape to support them, when they become disease vectors, or when they cause property damage. RA maintains programs designed to control two problem species: Canada geese and whitetail deer. RA also has a draft 2017 Beaver Management Plan that is implemented when beavers periodically populate Reston streams. In addition, RA has also sponsored mosquito monitoring and control measures when deemed necessary and provided advice on tick management. RA staff members periodically respond to resident requests for help in dealing with other wildlife concerns on a case by case basis. The most frequent of these other concerns involve fox and coyote sightings, woodpeckers, and copperhead snakes.

Existing Conditions

Canada Geese

Geese populations (Exhibit VI.E-1) have increased due to the favorable habitats that Reston provides, including golf courses, stormwater impoundments, office park ponds, and lakes. Conflicts arise when geese aggressively protect their nests and young, pull up and eat shoreline plants, and deposit fecal matter on docks and boats. Goose excrement can accumulate at considerable rates and can detrimentally affect water quality (see Chapter IV.B Lakes and Ponds) The amount of fecal material produced by a goose each day can vary, but they defecate frequently, from 28 to 92 times per day, with wet weights of the fecal material averaging from one to three pounds per day. RA estimates Canada geese numbers based on the citizen science winter and summer bird counts that WNC has conducted since 1998. These are one-day snapshots of the geese observed and can vary considerably based on the number of observers and weather conditions. The average for summer counts is 764 geese, and the average for winter counts is 517 geese.

Exhibit VI.E-1: Canada Geese (Branta canadensis)

One method of controlling the geese population is to reduce the number of hatchlings by addling the goose eggs. The process of addling involves temporarily removing fertilized eggs from the nest, terminating embryo development by coating the egg with food grade corn oil, and placing the egg back in the nest. Geese treat the returned eggs as if they are still developing, so they do not begin laying again. The RA egg addling program has addled 1643 eggs between 2002 and 2016 from 389 nests located on both residential and commercial property (Exhibit VI.E-2). RA holds a Federal permit for egg addling and before addling is done, receives permission from the owner of every property where geese
are targeted. Each RA staffer involved in this process is listed on the Federal permit, and a requirement of the permit is that no one is allowed to feed the geese. If the eggs are not addled, a female goose may produce 50 young in her lifetime.

Although most homeowners give permission to addle the eggs found on their property, not all consent. In those cases, RA provides suggestions on how to deter geese from coming on to the homeowner’s property. Such tactics include making sure flowerpots have plants in them, using fishing line and streamers to cordon off decks and boats, placing pinwheels in strategic locations, and other related deterrent methods.


Exhibit VI.E-2: Total Canada Goose Nests and Eggs Addled by RA 2002-2016

<table>
<thead>
<tr>
<th>Location</th>
<th>Nests</th>
<th>Eggs Addled</th>
<th>*Untouched</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Newport</td>
<td>13</td>
<td>57</td>
<td>124</td>
</tr>
<tr>
<td>Lake Anne</td>
<td>95</td>
<td>325</td>
<td>2</td>
</tr>
<tr>
<td>Lake Thoreau</td>
<td>103</td>
<td>485</td>
<td>36</td>
</tr>
<tr>
<td>Lake Audubon</td>
<td>75</td>
<td>299</td>
<td>29</td>
</tr>
<tr>
<td>Bright Pond</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Butler Pond</td>
<td>7</td>
<td>26</td>
<td>3</td>
</tr>
<tr>
<td>Sunrise Valley Wetland</td>
<td>22</td>
<td>108</td>
<td>7</td>
</tr>
<tr>
<td>Wharf</td>
<td>13</td>
<td>65</td>
<td>2</td>
</tr>
<tr>
<td>Commercial Properties</td>
<td>58</td>
<td>273</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>389</strong></td>
<td><strong>1643</strong></td>
<td><strong>221</strong></td>
</tr>
</tbody>
</table>

White-tailed Deer

The white-tailed deer, also known as whitetail, (Exhibit VI.E-3) is the largest wild animal in Reston and one of the most common and easily recognized. Whitetail are highly adaptive and are thriving in suburban landscapes because they have an abundant food supply, edge habitat is present, and predators are lacking. There is considerable debate about how many deer are too many and what methods of control should be used. Their overbrowsing is one of the primary contributing factors to the spread and success of non-native invasive plant species (See Chapter V.A Tree Cover). The Fairfax County Deer Management Program can be reviewed here:
http://www.fairfaxcounty.gov/living/wildlife/deer-management/

See also the detailed discussion of Fairfax County’s Deer Management Program in the EQAC Report:
RA has established four deer exclosure areas in Reston to study the effects of deer on the native vegetation. Since 2014, the Fairfax County Park Authority has collected browse impact survey data from approximately 30 parks participating in their deer management program. These data indicate overbrowsing by white-tailed deer is having a significant impact on native ecosystems. Browse levels vary among parks and are locally heavy in some locations.

In 2015, deer populations were estimated by the Fairfax County wildlife biologist using wildlife camera surveys in 13 parks. The average deer population density was estimated to be 129 deer per square mile (sq mi), with a median of 89 deer per sq mi and a range of 30 to 340 deer per sq mi. Estimates remain highly variable among parks, and parks with no hunting typically have higher initial population estimates. Ideal population densities for healthy forested systems are thought to be closer to 20 deer per sq mi. \(^{173}\) Surveys were planned for approximately 20 additional parks in 2016 using the same camera survey technique.

Controlled deer hunts are currently conducted to help control deer populations in some parks adjacent to Reston: Difficult Run Stream Valley, Fred Crabtree Park, Little Difficult Run Stream Valley. \(^{174}\) To
control deer, RA recommends planting deer-resistant plants or applying to the Design Review Board for permission to install fencing.

At the November 2015 RA Board meeting, the following motions were passed:

**Board Motion 1:** The board moved to direct staff to participate with Fairfax County’s controlled deer hunts on adjacent RA property, as approved by staff on a case-by-case basis and in accordance with agreements subject to review and approval by RA’s Legal Counsel.

**Board Motion 2:** The board moved to direct staff to work with DRB to revise the Design Guidelines to consider options for individual lots for the purposes of excluding deer from individual member properties.

**Board Motion 3:** Move to approve amendments to Use & Maintenance Standards Resolution 12 on Hunting; this modifies requirements related to member notification and liability insurance coverages.

Currently, there is no hunting on RA property, but homeowners may request RA Board approval to bow hunt on their own property. The text of a RA Board resolution on hunting requirements passed in November 2015 is in endnote three.\textsuperscript{175} Per the revised Use & Maintenance Standards Resolution 12,\textsuperscript{176} the RA Board Operations Committee is responsible for examining whether resident requests to hunt meet the following conditions before such requests are forwarded to the next regular meeting of the Board of Directors for consideration:

i. The Member’s Lot (“Requestor”) is at least ½ acre; or if two adjoining Lot owners make a hunting request then the total size of both Lots shall be taken together to determine whether the ½ acre minimum has been met.

ii. The hunting request is proposed to take place only during the Fairfax County Urban Archery Season; from ½ hour before sunrise to 1:00 pm or at such other times as specified in the Board approval, and shall not take place on weekends, holidays, and non-school days.

iii. The proposed hunt is to be held no less than 50 yards away from an occupied residence, with the exception of the requesting Lot owner’s residence, dwelling, or building, and 75 yards away from any street, alley, sidewalk, natural surface trail, paved pathway, bus stop (school or otherwise), tot lot/playground, roadway, highway, public land or public place.

iv. The Requestor or his/her agent can furnish proof that they hold a valid hunting license or proof of attending hunter education classes.

v. If the Member is utilizing a qualified organization (i.e. one that qualifies/certifies its hunters) the Board may direct staff to work with that organization’s coordinator to determine the best location for successful hunting on the Member’s lot.

vi. The Board of Directors, within its discretion for good cause shown, may waive any of these requirements as it deems appropriate for the circumstances.
During the 2016-2017 urban archery seasons, 16 deer were harvested in 55 hunt outings on the approved lots in Reston. The hunts averaged three hours each, for an approximate total of 165 hours of hunting effort.

**North American Beaver**
Beavers (Exhibit VI.E-4) are excellent engineers and are capable of creating aquatic habitats that attract a diversity of wildlife including amphibians, reptiles, and numerous wading birds and other waterfowl (See Chapter V.C Mammals). The trees that die from flooding also create good habitat for mammals, butterflies, and numerous birds such as woodpeckers, owls, and hummingbirds.177

**Exhibit VI.E-4: North American Beaver (Castor canadensis) in The Glade Stream Valley**

Beavers come and go in Reston depending on predators, disease, food supply, and changes in the watershed. The potential beaver area is 0.03 percent of Reston’s total natural area. The only area in Reston large enough to support beavers is in The Glade Stream Valley by Twin Branches Road. This area was fenced to stop the beavers from moving downstream. Over time in the Glade Valley, beavers will set up territory, stay for several years, leave for several years, and eventually return. This is the pattern that has played out over the last couple of decades. The combined effect of this activity and RA’s draft 2017 Beaver Management Plan is expected to result in a series of open wetlands with wooded slopes in the eastern half of the Glade and a stretch of uninterrupted woodland and flowing streams in the western half.
RA tries to protect resident beavers while also minimizing their destruction of important streamside trees and preventing them from entering Reston’s major lakes and ponds. Beavers that come into the lakes are trapped and may be euthanized due to the concern that they will try to construct bank dens in Reston’s earthen dams, thereby weakening the structures. Euthanization is a necessary management option because Virginia state law prohibits the relocation of wildlife.

**Mosquitos**

RA had a mosquito monitoring program when much of its early stream restoration work was in progress, but the program was discontinued around 2010. Twelve mosquito species were collected during this study period. The three most commonly found species were:

1. *Culex pipiens/Culex restuans*, the primary vector of West Nile Virus
2. *Culex territans*, which feeds on amphibians, with frogs being their primary host. This mosquito species does not feed on humans
3. *Anopheles punctipennis*, which commonly feeds on humans but is not a vector for West Nile Virus

According to information from Fairfax County, mosquito breeding areas are currently under scrutiny due to the spread of mosquito-borne illnesses. West Nile virus, the Zika virus, and equine encephalitis are among the diseases that can be carried by mosquitoes in Fairfax County. Mosquitoes known to transmit disease, like the yellow fever mosquito (*Exhibit VI.E-5*), which transmits Zika, are container breeders that are most likely to be found in discarded trash, clogged rain gutters, or containers in homeowner yards, rather than in natural bodies of water. Some of these mosquitoes can even breed in a container as small as a bottle cap. Ephemeral water bodies usually contain predator species that exert some control over mosquito populations.


*Exhibit VI.E-5: Yellow Fever Mosquito (Aedes egypti)*
Ticks
Ticks have become more familiar to the public because of the increase in Lyme disease (Exhibit VI.E-6) caused by the bacterium Borrelia burgdorferi which is carried by northern deer ticks. Residents encounter ticks in landscaped lawns, gardens, and during outdoor recreational activities and through contact with their pets. Pets should be treated monthly with a tick repellant. Less than half of all northern deer ticks (Exhibit VI.E-7) are carriers of Lyme disease. Usually ticks carrying Lyme disease must be attached for 24 hours before they can transmit the disease to people or pets, but it only takes a few hours for them to transmit the much rarer but sometimes deadly Powassan virus (POW), which has recently been detected in Virginia for the first time. To protect against ticks, RA recommends residents use insect repellent containing deet (diethyltoluamide), cover arms and legs with clothing, and check humans and pets after they have been outside. A lint brush will pick up even small ticks as well as collect seeds from spreading from one natural area to another. For more tips on controlling tick exposure, see: http://usefultipsforhome.com/outdoor/1-simple-tip-keep-ticks-off-summer-long/

The Center for Disease Control issues additional guidance on identification, tick removal, and disease symptoms: https://www.cdc.gov/ticks/index.html

Most RA environmental staff members who work in the field have been infected with Lyme disease and have been successfully treated. RA has applied for funding to spray pesticide for ticks around play areas, but funding was denied.

Exhibit VI.E-6: Virginia Lyme Disease Cases in 2016
Three tick species found in Reston and throughout Fairfax County can transmit disease to humans:

- **Northern deer/black-legged ticks** (*Ixodes scapularis*, Exhibit VI.E-7) are native to the deciduous forests of eastern North America. Unfed female northern deer ticks have a reddish body and a dark brown dorsal scutum located behind the mouthparts; male northern deer ticks are dark brown. Females are approximately 3.5 mm (.14 inches) in length, much longer than male ticks, which range from 2.0 to 2.7 mm (0.80 to 0.11 inches) in length. Nymphs are approximately 1.0 mm in length. These ticks have a two-year life cycle. As larvae and nymphs, they use small mammals such as the white footed mouse as their host but will also feed on humans or other mammals and birds; as adults they use white-tailed deer as their preferred host. They are a serious problem in Reston, because they spread Lyme disease and potentially other diseases such as Babesiosis, Anaplasmosis, and the sometimes lethal Powassan virus (POW).

- **Lone Star Tick** (*Amblyomma americanum*) The most commonly found tick in Fairfax County, the female Lone Star tick has a characteristic white or yellow mark on the end of the scutum behind its mouthparts, from which the common name is derived. Both males and females are reddish brown and about 3.0 to 4.0 mm (0.12 to 0.16 inches) long. *Tularemia* and *Ehrlichiosis* are transmitted by this species. It has also been linked with a Lyme disease-like illness called southern tick-associated rash illness (STARI) which may be caused by the spirochete *Borrelia lonestari*. The Lone Star tick does not transmit the Lyme disease spirochete *Borrelia burgdorferi*. 
Lone Star ticks have a non-specific host preference and will seek blood meals from virtually any mammal.

- **American Dog Tick** (*Dermacentor variabilis*) Adult American dog ticks are reddish brown and about 5.0 mm (.20 inch) in length. They can be distinguished from deer ticks on the basis of white markings on the perimeter of the dorsal scutum. As the common name suggests, dogs are the preferred hosts of adult American dog ticks but they will feed on other medium to large mammals including humans. The immature stages feed on small mammals, including meadow voles and white-footed mice. The American dog tick transmits *Rocky Mountain spotted fever* and *Tularemia* in the eastern region of the United States.

**Coyotes/Foxes**
Coyotes and foxes are here to stay, and it is best to learn how to coexist with them. Foxes are omnivores who hunt mainly small rodents, birds, and rabbits, but they will occasionally eat vegetables, fruit, mice, and fish (*Exhibit VI.E-8*). Coyotes eat small game such as rodents, rabbits, fish and frogs, and may even eat deer fawns.

The best way to prevent foxes and coyotes from becoming a nuisance for homeowners is to avoid providing habitat for them on residential property by leaving pet food outside and not covering and securing garbage cans. RA has deemed the feeding of non-domesticated wild animals (except songbirds) to be a nuisance, and it is prohibited. Practices that attract nuisance species or those that may be vectors for infectious diseases, including, but not limited to, leaving pet food out of doors overnight in a location accessible to non-domesticated wild animals, are also deemed a nuisance and are prohibited.181

Residents are sometimes concerned about their pet cats becoming prey. For this reason and others described in Chapters VI.A Birds and VI.B Mammals, homeowners are urged to keep their cats indoors.

*Exhibit VI.E-8: Red Fox (*Vulpes vulpes*)*
Woodpeckers
RA receives many calls from residents when woodpeckers peck on wood-sided homes. Woodpeckers are federally protected, and most commercial repellents have not proven effective or are not approved by the U.S. Environmental Protection Agency. Temporary Mylar balloons and streamers appear to be effective deterrents. Pest inspections may also be recommended because the woodpeckers are often hunting wood boring insects. Dead trees (snags) left on or near residential properties may provide more attractive feeding opportunities for woodpeckers than wood houses.

Copperhead Snakes
Copperhead snakes (Exhibit VI.E-9) are native to Virginia and have been found in Reston. They are the only venomous snake found in Fairfax County. When RA receives a call regarding a copperhead sighting, staff members let other residents know that one has been seen in the area so they can exercise caution and watch for them. Juvenile black rat snakes and northern water snakes are often misidentified as copperhead snakes.

Exhibit VI.E-9: Copperhead snake (Ankistrodon contortrix)
Conclusions

The status of Wildlife Management Issues in Reston is fair.

The management of wildlife concerns is taken seriously by RA, which has several staff members experienced in dealing with wildlife issues that periodically arise on both homeowner and RA properties. Reston’s responses are governed by County, State, and Federal programs and policies. The two main ongoing wildlife management programs in Fairfax County and Reston focus on control of Canada geese and white-tailed deer. Both animals continue to be a nuisance, but egg addling and controlled hunting do remove animals from the community. Whether these initiatives alone are enough to control population sizes and limit these animals’ negative impact on Reston’s ecosystems remains uncertain.

Recommendations

RA should continue managing wildlife management issues as described in this chapter.
VII. Hazardous and Toxic Materials

Background

The U.S. Environmental Protection Agency (EPA) defines the term toxic as a waste that, when consumed or absorbed, is harmful or fatal to living things. It defines a hazardous material as any waste that is ignitable, corrosive, reactive, or toxic.\textsuperscript{182}

Federal regulation of toxic and/or hazardous wastes stems from two acts: The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) the Resource Conservation and Recovery Act (RCRA). EPA may designate any waste “potentially hazardous to human health or the environment when ... improperly managed” as hazardous, and then establish regulations for its management and disposal. The Toxic Substances Control Act (TSCA) requirements focus specifically on mitigating harm to the public from toxic wastes. Under TSCA, substances such as lead paint or asbestos are managed to limit public exposure and harm.

Existing Conditions

Compared with more industrial areas of the country, Reston has few major issues with hazardous materials, primarily because there are no ongoing manufacturing or industrial activities. Nevertheless, Reston’s businesses and residents possess and use hazardous materials in many ways, to include gasoline sold from gas stations and used in cars or heating oil for homes and other buildings stored in underground storage tanks (USTs).

The most frequent instances of hazardous materials being released in Reston have been relatively minor spills and accidents that release hazardous material onto the ground where it can enter storm sewers, streams, and lakes.\textsuperscript{183} For example, Fairfax County Fire and Rescue Department records include various spills, such as gasoline from auto accidents or anti-freeze from leaking public transportation bus systems. The database in which these records are currently stored can only be searched by entering specific street addresses, rather than broader geographic limits,\textsuperscript{184} so it is not currently feasible to quantitatively characterize the materials involved and number and distribution of incidents in Reston.

RA has undertaken a program of marking storm sewer inlets with colorful oval discs (\textbf{Exhibit VII-1}), warning residents not to dump oil and other hazardous materials into storm drains, which eventually drain to the Chesapeake Bay. The Storm Drain Marking Program requires marking more than four thousand storm drains; about half of Reston’s storm drains have been marked to date. The program has prioritized marking those drains capturing runoff from larger parking lots that account for approximately three quarters of the total storm drain capture area.\textsuperscript{185}
One type of surface contamination reaching Reston streams and lakes involves the use of coal tar sealants on areas such as driveways paved with asphalt to extend the life of the original paving. Studies by the U.S. Geological Survey (USGS) have identified this viscous liquid painted or sprayed on asphalt as a major source of contamination by Polycyclic Aromatic Hydrocarbons (PAHs), a suspected human carcinogen known to be toxic to aquatic life. PAHs have been found in house dust, runoff, and the atmosphere—released by foot traffic, tire action, volatilization, and wind and rain scouring.

Evidence of contamination from these practices in Reston was found by USGS scientists testing sediment from Lake Anne. For example, sealcoat contributes over 80 percent of PAHs in Lake Anne (in sediment), and PAH concentrations there are about twenty times higher than in Decker Lake, Utah, even though the areas have similar population density and level of urban development.

The use of coal-tar sealant has been banned by the City of Washington, DC as well as most suburban Maryland counties. It is generally replaced with an asphaltic equivalent without significant PAH contamination issues and at a similar cost. Local jurisdictions in Virginia would require authorization from the Virginia State Legislature to allow similar a similar ban in Reston or in Fairfax County.

Storage tanks for petroleum products are found aboveground and underground at various locations in Reston and can represent a potential source of hazardous materials. More acutely hazardous products such as gasoline tanks at filling stations and motor pools are regulated by Virginia’s Department of Environmental Quality (VDEQ). Larger aboveground tanks (>660 gallons) holding all types of petroleum products are regulated by VDEQ, but smaller aboveground tanks and many underground storage tanks storing less-hazardous materials such as heating oil are not regulated, although if spills are identified these must be reported.

Underground storage tanks (USTs) for heating oil are common in some parts of Reston (see Exhibit VII-2), primarily at single family residences, and are considered unregulated in that regular monitoring and testing is not required. Over the past five years in Reston, during reporting years 2012 through 2016, 28 spill reports were recorded with VDEQ for leaking USTs, an average of five to six each year, primarily heating oil tanks at residences. Only two of the 28 reports were for non-residences: North County Government Center in 2016 and Tall Oaks Village Center in 2015. Each of the 28 spill reports was investigated, remediated where necessary, and other than one recent case in late 2016, satisfactorily closed. Responses to leaks generally include repairing or replacing the tank to eliminate the leak and sometimes remediation. Heating oil in smaller quantities in soil undergoes natural degradation by
bacteria and does not often present a significant environmental risk unless the spill reaches ground water and/or surface water.\textsuperscript{191}

When spills reach aquifers or streams, remediation can include removing contaminated soil or using intercept wells to withdraw contaminated groundwater for treatment. One leaking heating tank in Reston, reported in 2009 at the Reston Community Center at Hunters Woods, was found to be impacting Snakeden Branch and required multiple intercept wells over a period of years to reduce contamination from groundwater moving toward the stream. Intercept wells at this site are no longer showing any contamination reaching Snakeden Branch, and this case is anticipated to be closed out by VDEQ by the summer of 2017.\textsuperscript{192}

On the western edge of Reston is an interstate pipeline, operated by Colonial Pipeline (offices in Alpharetta, Georgia) which moves various petroleum products such as gasoline, diesel, and jet fuel from the Gulf Coast to the northeast. Reston’s only Superfund site was one of seven spills in the late 20\textsuperscript{th} century for which Colonial was sued by the EPA.\textsuperscript{193} Superfund is a federal program designed to fund the cleanup of sites contaminated with hazardous substances and pollutants. This program was established under CERCLA. The location of the Reston spill is a closed Superfund site at which preliminary assessments began in 1996, and it is currently registered as an Archived superfund site by the EPA requiring no clean up action or further investigation.\textsuperscript{194}

In recent years, concerns have been expressed that expired prescription medicines are being disposed of in municipal solid waste or in sanitary sewers and contaminating surface and ground water. Concerns largely relate to the impact of certain medications, even in very small doses, on fish and other aquatic species.

Currently, certain federal and state regulations govern the disposal of pharmaceuticals that are identified as hazardous and must be disposed of as regulated medical waste. Virginia Department of Environmental Quality (VADEQ) and the EPA both regulate these hazardous pharmaceuticals.\textsuperscript{195} Fairfax County prohibits the discharge of regulated medical waste, including hazardous pharmaceuticals, to the county sanitary sewer under Fairfax County Sanitary Sewer Ordinance, Chapter 67.1.

In addition, as part of inspections of medical facilities conducted by Fairfax County's Industrial Waste Section (IWS), operators are asked about how unused pharmaceuticals are managed. Operators of medical facilities in the county are generally knowledgeable about the regulations on hazardous pharmaceutical disposal.\textsuperscript{196} Medical facility operators in the county are also generally aware of the need to limit pharmaceutical waste and to prevent disposal down the drain. IWS has informed operators about EPA's guidance on pharmaceutical management.\textsuperscript{197}
This guidance includes best management practices for non-regulated pharmaceutical wastes. In the absence of state and federal law governing the disposal of non-regulated pharmaceuticals, however, Fairfax County has not adopted regulations to limit the disposal of non-regulated pharmaceuticals in sanitary sewers. Nonetheless, the County understands the importance of preventing the disposal of pharmaceuticals down the drain because of concerns raised in the scientific community about pharmaceutical constituents passing through the wastewater treatment system to receiving surface waters and causing adverse effects on aquatic life.
In addition, Fairfax County participates in National Prescription Drug Take Back Day (most recently on 29 April 2017) when expired drugs were accepted by various county locations, including the Reston District Police Station.

Only one entry in the EPA's Toxic Release Inventory (TRI) is shown for Reston: Air pollutants released from a long-closed computer chip fabrication operation. TRI tracks the management of certain toxic chemicals that may pose a threat to human health and the environment. U.S. facilities in different industry sectors must report annually how much of each chemical is released to the environment and/or managed through recycling, energy recovery, and treatment. (A "release" of a chemical means that it is emitted to the air or water, or placed in some type of land disposal.) The information submitted by facilities is compiled in the TRI, which helps support informed decision-making by companies, government agencies, non-governmental organizations, and the public.

In 1987 and 1988 Automata Inc, located at 11091 Sunset Hills Road reported releasing toxic solvent vapors, a form of air pollution. Automata reported releasing 138,174 pounds of two pollutants over these two years: 35,558 pounds of 1,1,1-trichloroethane and 67,058 pounds of dichloromethane. While toxic when inhaled in significant quantities, there are no records of any human health or other impacts of these emissions. Shortly after this time, Automata was purchased by a firm in Sterling, Virginia and ceased business. No other emissions are shown for any locations in Reston on the TRI since the inventory was established just over thirty years ago in 1986.

Conclusions

The state of the environment for hazardous and toxic materials in Reston is good. Reston is not without issues related to hazardous materials, but the information currently available indicates the exposure to and contamination by most hazardous materials is low. Still, there are legitimate concerns: The need for careful monitoring of USTs, the potential for coal-tar sealant contaminating water bodies and living areas with toxic residue, and the need to raise public awareness of the need to avoid dumping hazardous materials into storm drains.

Recommendations

RA should:

- Prioritize completion of the storm drain marking program.
- Educate the public about the dangers of coal-tar-based pavement sealers and encourage the Fairfax Board of Supervisors to urge the Virginia Legislature to ban the sale of coal-tar-based asphalt sealers in Virginia. Alternatives to coal-tar-based sealers include asphalt-based sealers. Product analyses indicate that coal-tar-based sealcoat products contain about 1,000 times more Polycyclic Aromatic Hydrocarbons (PAHs) than sealcoat products with an asphalt base.
VIII. Light Pollution

Background

Light pollution is an unwanted consequence of outdoor lighting that has at least four components:

- Urban sky glow: Brightening of the night sky over inhabited areas.
- Light Trespass: Light falling where it is not intended, wanted, or needed.
- Glare: Excessive brightness causing visual discomfort. High glare levels can decrease visibility.
- Clutter: Bright, confusing, and excessive groups of light sources, often found in over-lit urban areas. Clutter contributes to the above three other factors.  

Light is measured in several ways:

- The color temperature of light is measured in degrees Kelvin,
- Light intensity, or the amount of light emitted by a fixture or a source, is measured in Lumens.
- Illuminance, or the amount of light hitting a vertical or horizontal surface, is measured in foot-candles or the international equivalent, lux. This measurement is used to determine whether an area is properly lit or if it has light trespass. This measurement is also used by lighting designers to determine fixture intensity, style, height, and location in order to provide the correct amount of illuminance.

Across America, High Pressure Sodium (HPS) lights have been used for artificial lighting. Currently, these are being replaced in some locations by Light Emitting Diode (LED) lights. As of March 2017, about 10 percent of America's street lights have so far been converted to LEDs, but the Department of Energy has estimated that if the entire country switched to LEDs over the next two decades it would save $120 billion over that 20-year period. LED lights that do not scatter light and therefore do not affect the view of the nighttime sky are now in development but are not yet available on the market.

Artificial lighting that is brighter than fire is a very recent development in evolutionary terms, so the long-term effects of nighttime light on humans and other species are not yet completely understood. There is a clear scientific consensus, however, that color temperature affects the circadian rhythm in both plants and people as well as production of melatonin, a hormone that affects human sleep and wake cycles. Excessive and poorly directed lighting exacerbates documented problems that night lighting causes for wildlife mating, migrating, navigating, and feeding. Diurnal and nocturnal species of birds, insects, bats, aquatic invertebrates, and reptiles are affected. For many plants and animals, darkness is required, and interrupting it is detrimental. For example, some plants can't flower and therefore can't reproduce if artificial light interrupts the night sky, fireflies require dark skies for mating, hatchling turtles are disoriented by lights on their natal beaches, and birds are killed during migration by flying into tall lighted structures. Root zones of trees may also be adversely affected if lighting is installed near them because cutting tree roots leads to decay in the long-term, and cutting roots close to the trunk dramatically reduces the stability of a tree. Loss of trees in natural areas can create windows for sunlight along pathways, negating the trees' benefit in the summer while also creating opportunities for invasive plants. Light fixtures that are dimmed or timed to go off during off-peak periods can aid tree health and dormancy.
Bright nighttime light destroys the natural darkness of nocturnal landscapes (nightscapes) and obscures living creatures’ view of the star-filled sky. It also wastes electricity and can significantly invade the private and personal space of nearby residents.\textsuperscript{203}

The American Medical Association adopted guidance in June 2016, \textit{Human and Environmental Effects of Light Emitting Diode (LED) Community Lighting}, that reviewed the adverse health effects of nighttime lighting on humans and concluded that pervasive use of nighttime lighting disrupts various biological processes, creating potentially harmful health effects related to disability glare and sleep disturbance. The guidance also recommended that communities considering conversion to LED street lighting use lights that are lower on the index for correlated color temperature (CCT) and noted concerns about the spectrum of white LED lights now marketed as providing energy efficiency and long-term cost savings, indicating these lights suppress melatonin during the night and influence circadian physiology more than high pressure sodium lights. The guidance cites recent large surveys associating bright nighttime residential lighting with reduced sleep time, dissatisfaction with sleep quality, nighttime awakenings, excessive sleepiness, impaired daytime functioning, and obesity and notes concerns that white LED street lighting patterns could contribute to the risk of chronic disease in populations exposed to them. Finally, the guidance notes more study is needed to accurately assess the potential circadian impact of exposure to these lights.\textsuperscript{204}

In a response to this AMA-approved report, scientists at the Lighting Research Center at Rensselaer Polytechnic Institute stressed that more research is needed about the effects of long-wavelength light exposure (amount, spectrum, duration) on circadian disruption before it can be concluded that white LED lights are a causative factor in modern maladies.\textsuperscript{205}

The Institution of Lighting Engineers (ILE) has established maximum limits for sky glow, light trespass, and glare.\textsuperscript{206} Many factors influence perception of light beyond fixtures or lumens. Timers can be used to turn off lighting during non-peak hours near residential areas.

The Fairfax County \textit{Environmental Quality Advisory Council--2016 Annual Report on the Environment} (EQAC Report) contains a comprehensive section on light pollution with which EAC is in accord.\textsuperscript{207} As the EQAC Report’s Light Pollution chapter also points out: “Much outdoor lighting is used in the interest of providing security. These safety concerns often result in bad lighting rather than real security. One reason often cited for today’s bright lights is that high wattage is needed to deter crime. However, studies have shown that if light is overly bright with excessive glare, it makes it easier for a person to hide in the deep shadows created by objects in the harsh glaring light. This might actually encourage crime rather than discourage it. The debate as to whether or not additional light provides more safety has been emotional rather than factual. The few rigorous studies that have been done reveal no connection between higher lighting levels and lower crime rates. This may be due to people with nefarious intent taking more risks in better lit areas.” An English study found little evidence of harmful effects of switch off, part-night lighting, dimming, or changes to white light/LEDs on road collisions or crime. Designed environments can help deter crime--green space has been documented as a crime deterrent.\textsuperscript{208}
Current Reston lighting guidelines (26 February 2009 and 1 May 2003 cluster standards)\textsuperscript{209} are based on the Fairfax County Lighting Ordinance of 2003 and reference a Fairfax County 1995 Lighting Task Force report. The 2003 Ordinance is described in A Guide to Fairfax County’s Outdoor Lighting Standards.\textsuperscript{210}

As the 2016 EQAQ Report notes, The Countywide Policy Element of the Comprehensive Plan for Fairfax County, Virginia recognizes the nuisance of light emissions from increasing urbanization and recommends efforts be made to avoid creating sources of glare that interfere with visual acuity. \textsuperscript{211} The County’s Zoning Ordinance contains standards for illumination limits, but the issue of glare is still being studied and is addressed in detail in the 2016 EQAC Report. Public hearings scheduled for 2017 on light-related issues had not yet been held as of summer 2017.

Two international organizations, the International Dark Sky Association (IDA) and Loss of the Night Network (LoNNe) have published extensive information on the detrimental effects of bright artificial light at night, advocate for reducing it, and manage the Artificial Light at Night (ALAN) Research Literature Database, which links to hundreds of scientific articles on negative effects on humans and wildlife to include birds (mortality, migration, feeding, etc.), insects, bats, aquatic invertebrates, and reptiles. Dark Virginia Sky, the Virginia Section of the IDA, is dedicated to “preserving and restoring Virginia’s dark night skies, for public and natural welfare, with thoughtful regard for security and visibility.” \textsuperscript{212}

**Existing Conditions**

Current County and Reston guidelines do not address artificial lighting’s effect on human health, wildlife, and maintaining a dark sky. Although the County’s zoning ordinance addresses over-lighting and glare by requiring photometric drawings based on foot-candles, none of the ordinances or Reston covenants address the measurement of illumination on private residential property or roadways. The Fairfax County Public Facilities Manual is used in the design of most public spaces, where the issue is partially addressed by specifying pole heights and spacing, but this does not account for the differences in fixtures or spaces that are lit. \textsuperscript{213}

The EAC defines “environmentally sound” in terms of human safety, human health, energy savings, and as recognizing the extensive natural environment that sets Reston apart from other developed areas.

In both local and regional context, the level of light in Reston at night is very bright, with areas near the Toll Road nearly as bright as downtown Washington. The maps in Exhibits VIII-1-3 are based on National Oceanic and Atmospheric Administration data and are zoomed versions of the worldwide map that may be viewed at https://www.lightpollutionmap.info. \textsuperscript{214}
Exhibit VIII-2: Washington, D.C. and Environs
To address residential concerns expressed after a school installed new outdoor lighting, the EAC in 2016 discussed the potential environmental impact of the actual and pending lighting changes and developed an explanation and a list of recommendations for lighting along residential streets or pedestrian paths where poles are used. The principles regarding pole-based lighting also apply to other lighting situations. Lowering poles reduces conflict with vegetation, requires fewer lumens, and causes less glare. More poles often have to be placed if they are lower, although adjusting lenses and bulbs can be helpful.

See also Chapter VI.A Birds for information on how nighttime lighting negatively affects birds and a related recommendation.
Conclusions

The current status of light pollution in Reston is Fair. Although some portions of Reston are quite dark at night, in both local and regional context the overall level of light in Reston at night is very bright, with areas near the Toll Road nearly as bright as downtown Washington.

The 2016 EQAC Report contains a comprehensive section on light pollution with which EAC is in accord. It describes current efforts to expand County codes/ordinances to address lighting issues, noting adherence to these four principles will do much to mitigate or eliminate lighting problems:

- Always illuminate with properly shielded fixtures that prevent the light source, and the resultant glare, from being directly visible.
- Never use more illumination than needed for the task at hand.
- Always aim lighting downward, keeping its distribution within property lines and below the horizontal plane so it is not a source of glare.
- Do not burn lighting all night long to provide security. Instead, use motion detector lighting, which burns only for motion in the designated area.

Recommendations

RA should:

- Develop and, via the Design Review Board, implement new lighting guidance to make Reston a model for environmentally sound lighting practices. The new guidance should combine recommendations from the RA Pedestrian Lighting Task Force on placement of lighting and from EAC on the environmental impacts and intensity of lighting. This guidance should specify:
  - That all Reston lighting be 2700 Kelvin or lower for LED lighting used in outdoor installations (including signage),
  - *That night lighting only be used where it will aid human safety, recognizing that lighting alone does not decrease crime,
  - *That all outdoor lighting fixtures should be full cutoff fixtures as described in the Illuminating Engineer Society of North America (IESNA) classifications and on poles sized to pedestrian scale,
  - That fixtures are dimmed or on a timer to go off during off-peak periods,
  - *That IESNA standards be adopted as maximum lighting standards,
  - That Reston adopt Institution of Lighting Engineers limits as maximum limits for sky glow, light trespass, and glare,
  - That consideration be given to leaving unlit spaces when possible,
  - That preferred fixtures or spacing be suggested, accommodating future technological advances.
• Contract with a lighting specialist to advise the Board, DRB, EAC, and the Task Force during formulation of new guidelines.
• Work with Fairfax Board of Supervisors, VDOT, and Virginia's elected officials to eliminate unnecessary roadway lighting, to accelerate replacement of existing poorly designed fixtures under the control of VDOT with full cut-off fixtures, and to modify existing requirements where necessary to limit illumination.

*Recommended and briefed to RA Board in March 2017
IX. Environmental Education and Outreach

Environmental education and outreach promote the effective use, understanding, and enjoyment of Reston’s natural areas. Education is the key to environmental stewardship of Reston’s natural resources. Since Reston’s founding, there has been a strong commitment to environmental education and natural history interpretation.

Background

RA owns and operates the Walker Nature Center (WNC), which serves as the home base for environmental education in Reston (Exhibit IX-1). It is the heart of Reston’s open space and a community treasure for people, plants, and wildlife. The Nature Center’s history dates back to the original 1962 Master Plan for Reston created by its founder, Robert E. Simon, Jr. In 1967, Vernon J. Walker was hired as the Center’s first director. Walker was a science educator, camp director, environmentalist, and naturalist who believed in the healthy coexistence of nature and people. The Nature Center program was launched with funding provided by the Reston Foundation for Community Programs, a non-profit corporation established by the developer for instituting innovative programs within the community. From its earliest days, the vision for the Nature Center was more than a place—it was an active program that would encompass the entire 7,400-acre environment of Reston and engage residents in caring for the common land. Since Walker’s death in 1982, WNC carries on a tradition of using environmental education and citizen engagement as a key natural resource management tool.

Exhibit IX-1: Walker Nature Center

©Doug Britt
With its 72 acres of woodlands connecting with more than 250 additional acres of open space, WNC provides a valuable wildlife corridor and a wonderful place to explore habitats such as the forest, stream, and lake. WNC features include a mile of loop trails, a picnic pavilion, a fire ring, a pond, demonstration native plant gardens, a memorial sundial, The Glade stream, and Snakeden Branch’s entrance to 44-acre Lake Audubon. A year-round education building known as Nature House was gifted to RA in November of 2009 by Friends of Reston. Leadership in Energy and Environmental Design (LEED) is an internationally recognized rating system for high performance green buildings. Nature House is LEED Gold certified by the U.S. Green Building Council and open for public visitation six days a week. It is a model of sustainable design and construction.

Through direct experiences and interpretive media, the WNC’s mission is to foster good environmental stewardship in the community. To this end, RA employs a professional interpretive staff based at WNC. Interpretation is a mission-based communication process that forges emotional and intellectual connections between people and the natural/cultural resources they encounter. Good interpretation is more than mere information: It is building connections and creating memorable experiences. The Nature Center enhances people’s awareness, appreciation, knowledge, and enjoyment of Reston’s natural environment. These building blocks of environmental learning lead residents to take positive actions to conserve and protect Reston’s natural resources.

**Existing Conditions**

WNC offers a variety of educational programs and resources to the community. Its programs touch the lives of thousands of people each year through on-site and outreach experiences. In 2016, more than 23,500 contacts were made with program participants and visitors to Nature House. This figure does not include casual use of the WNC property by walkers, cyclists, and others or by those reached by its media services, informal contacts, and virtual engagement via telephone and computer. Staff assist with environmental program planning and natural history questions as well as member questions about plants, wildlife, ecofriendly living, and the local environment.

Environmental programs exist for people of all ages. Trained, interpretive staff conduct preschool programs, school programs, scout/youth group programs, family programs, adult programs, special events, summer camps, and service projects. The staff also provides interpretive media services that help on-site and virtual visitors engage with Reston’s natural resources. Examples include publications (brochures, newsletters, and checklists), interpretive signs, displays/exhibits, and a collection of printed materials are available for self-guided learners. Activity packs and “Nature Trunks” filled with environmental education materials and equipment are available for loan to teachers and youth group leaders.

Program topics include watershed conservation, stream and lake life, ecology, native plants, wildlife, and sustainable living. Programs are advertised in RA’s printed publications such as Reston magazine and the Nature Center newsletter *Branching Out*, as well as in electronic media such as the RA webpage, *RA News*, Facebook, and Twitter. The WNC also has its own Facebook page with over 1,600 followers as well as a newer Twitter page with 121 followers, a Pinterest page, and an Instagram page.
The following is a summary of its 2016 Programs:

**Youth Programs (232 programs with 4,784 participants)**

School Programs:
- Preschool Programs: 45-minute programs at the Nature Center and at schools during spring, fall and winter
- Elementary School Fieldtrips: One-and-a-half to two-hour programs for grades K-7 at the Nature Center and adjacent RA natural areas during spring and fall
- Elementary School Classroom Visits: One hour programs for grades K-6 at the schools during winter
- Special Request School Programs: Various lengths and topics for elementary and secondary school classes and for school-based environmental clubs

General Youth Programs:
- Public Children’s Programs: One to two-hour programs throughout the year on a variety of themes for ages five to 12
- Birthday Parties: 45 minute programs for ages three to 10. Public Preschool Programs: One-hour programs throughout the year for ages one-and-a-half to five.
- Special Request Youth Group Programs: Various lengths and topics for scout groups, camps, and child care centers

WNC Summer Day Camps:
- Nature Tots: Nature specialty camp for ages three to five at the Nature Center
- Walkers Rangers: Nature specialty camp for ages six to nine at the Nature Center

RA conducts some additional camps with environmental education components at locations other than the WNC, not included in the youth program figures above. They are:
- Junior Day Camp: General camp with nature activities for ages five to seven
- Day Camp: General camp with nature activities for ages seven to 11
- Science Camp: Camp provided in partnership with the U.S. Geological Survey for ages eight to 12.
- Teen Camp: General camp with nature activities for ages 11 to 14
- Counselor-in-Training Program: Leadership program with nature activities for ages 14 to 16
- Wilderness Camp: Specialty camp for ages 11 to 14

**Adult Programs (45 programs with 778 participants)**

- Interpretive Programs: One- to two-hour indoor/outdoor programs and presentations
- Workshops: One- to two-hour hands-on DIY programs
- Environmental Film Series
All Ages Programs (40 programs with 2,809 participants)

- Special Events: Community festivals, holiday celebrations, open houses
- Campfire Programs
- Public Programs: Interpretive hikes and workshops

Service Learning

RA has an extensive volunteer program that offers a wide variety of environmental volunteer opportunities. These activities provide hands-on engagement and empower participants to employ and share their knowledge and skills beyond the volunteer experience. Many of these programs and projects occur at the WNC (10 with 189 participants in 2016) as well as throughout Reston’s natural areas also facilitated by RA Environmental Resource Management staff. In 2016, 794 volunteers contributed more than 13,669 hours of service to environmental activities (Exhibit IX-2), which include:

- Citizen Science: Stream Monitoring, Nest Box Monitoring, Project FeederWatch, Wildlife Counts
- Group Service Projects for Youth: Projects such as planting natives, removing invasives, wood chipping trails, and litter pick-ups on open space for youth groups for scout, camp groups, etc.
- Individual Service Projects for Youth: ex. Eagle Scout and Girl Scout Gold projects
- Community Workdays: ex. Habitat Heroes, Reston’s Arbor Day, Earth Day
- Corporate Workdays: day of service projects
- Volunteer Program Opportunities: ex. at special events
### Exhibit IX-2: 2016 Environmental Volunteer Activities

<table>
<thead>
<tr>
<th>Event</th>
<th>Volunteers</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reston Winter Bird Count</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>Stream Monitoring</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td>Kids Trout Fishing Day</td>
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<td>20</td>
</tr>
<tr>
<td>Habitat Heroes</td>
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<td>Arbor Day</td>
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<td>75</td>
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<td>Nature House 5K</td>
<td>30</td>
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<td>CA Technologies - Garlic Mustard Challenge</td>
<td>8</td>
<td>16</td>
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<td>Potomac River Watershed Cleanup</td>
<td>113</td>
<td>339</td>
</tr>
<tr>
<td>Earth Day at the Nature Center (Leidos &amp; Merritt Group)</td>
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</tr>
<tr>
<td>Habitat Heroes - Deer Forest Recreation Area</td>
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<td>22</td>
</tr>
<tr>
<td>Bechtel Spring Cleanup</td>
<td>20</td>
<td>60</td>
</tr>
<tr>
<td>Spring Festival at the Nature House</td>
<td>41</td>
<td>123</td>
</tr>
<tr>
<td>Invasive Plant Removal Day</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Habitat Heroes</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Girl Scouts Troop 6917 - Bronze Award Project - Litter Clean</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Lake Cleanup</td>
<td>36</td>
<td>72</td>
</tr>
<tr>
<td>Summer Bird Count</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>Deloitte Impact Day at Browns Chapel Park</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Nautilus Aquatics Cleanup at Cedar Ridge Apts.</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>RA CITs - Service Project - Habitat Heroes</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>Butterfly Count</td>
<td>17</td>
<td>51</td>
</tr>
<tr>
<td>Mission Possible camp at St. Anne’s, Reston</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Habitat Heroes - Stones Throw Drive</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Dragonfly Count</td>
<td>17</td>
<td>51</td>
</tr>
<tr>
<td>PASS Stream &amp; Natural Area Cleanup at HW</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>Stream Monitoring</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td>Plant Save - Nicki</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>Dimension Data Day of Service - Lake Newport Soccer Field</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>Habitat Heroes</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Fall Stream Cleanup</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Habitat Heroes</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>Stream Monitoring -</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Halloween House</td>
<td>51</td>
<td>204</td>
</tr>
<tr>
<td>Halloween House</td>
<td>47</td>
<td>212</td>
</tr>
<tr>
<td>Habitat Heroes</td>
<td>29</td>
<td>58</td>
</tr>
<tr>
<td>Adopt-a-Spot</td>
<td>10</td>
<td>240</td>
</tr>
<tr>
<td>Nature House Welcome Desk Attendants</td>
<td>17</td>
<td>11,129</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>794</strong></td>
<td><strong>13,669</strong></td>
</tr>
</tbody>
</table>
Exhibit IX-3 summarizes WNC Education and Outreach programs:

<table>
<thead>
<tr>
<th>Type of Program</th>
<th>2018 Programs</th>
<th>2018 Participants</th>
<th>Average Participants</th>
<th>Average Participants**</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELF-GUIDED (inc. Nature Trunks, Scout Packs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>6</td>
<td>402</td>
<td>8</td>
<td>580</td>
</tr>
<tr>
<td>ADULT (inc. interpretive programs, workshops, speakers, films)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>48</td>
<td>765</td>
<td>45</td>
<td>778</td>
</tr>
<tr>
<td>ALL AGES (interpretive programs, workshops, campfires, special events)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>40</td>
<td>3,348</td>
<td>40</td>
<td>2,809</td>
</tr>
<tr>
<td>CHILDREN’S (inc. interpretive programs, workshops, field trips, classroom visits, camps)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preschool</td>
<td>95</td>
<td>1,413</td>
<td>97</td>
<td>1,410</td>
</tr>
<tr>
<td>Elementary</td>
<td>138</td>
<td>3,184</td>
<td>126</td>
<td>2,869</td>
</tr>
<tr>
<td>Secondary</td>
<td>12</td>
<td>672</td>
<td>9</td>
<td>515</td>
</tr>
<tr>
<td>Subtotal</td>
<td>246</td>
<td>5,269</td>
<td>232</td>
<td>4,784</td>
</tr>
<tr>
<td>WORK/LEARN with WNC (Earth Day, Arbor Day, Wildlife Counts)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>7</td>
<td>106</td>
<td>10</td>
<td>189</td>
</tr>
<tr>
<td><strong>TOTAL Programs</strong></td>
<td>347</td>
<td>9,890</td>
<td>335</td>
<td>9,141</td>
</tr>
<tr>
<td>OTHER</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaperones</td>
<td>2,084</td>
<td>1,845</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Rentals</td>
<td>6,837</td>
<td>6,088</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Meetings</td>
<td>1,268</td>
<td>863</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NH Drop-In Visitors</td>
<td>6,552</td>
<td>6,387</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>16,746</td>
<td>14,392</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL REACH</strong></td>
<td>26,636</td>
<td>23,533</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Total reach includes program participants, chaperones, rental attendees, meeting attendees, Nature House visitors. It does not include visitors to the 72-acre property who only come to walk/run, observe wildlife/plant life, fish, etc.

**Average based on complete years since the opening of Nature House in November 2005.

Additional RA Education & Outreach

Education and outreach activities by RA Environmental Resource Staff (not included above)

<table>
<thead>
<tr>
<th>Program</th>
<th>2018 Programs</th>
<th>2018 Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHILDREN’S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preschool/Elementary (Kids Trout Fishing Day, Invasive Program)</td>
<td>2</td>
<td>237</td>
</tr>
<tr>
<td>Secondary (Invasive Program)</td>
<td>3</td>
<td>54</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>5</td>
<td>291</td>
</tr>
</tbody>
</table>
Conclusions

The state of environmental education and outreach in Reston is good.

Reston has a well-established environmental education and outreach program, distinct from most community associations. Reston’s commitment to engaging its residents in the conservation of its natural areas distinguishes it from other communities in the United States and has helped Reston become recognized for many of the environmental and community honors it has received.

The Reston population is responsive to RA’s investments in environmental education and outreach. Since the opening of Nature House in November of 2009, there has been an approximate 20 percent increase in overall reach as well as program participation. As the Reston population grows, this is a trend that should be encouraged and facilitated. An educated and concerned public is the best safeguard to developing and sustaining a healthy environment.

Recommendations

RA should:

- Engage more people not only as program participants but also as volunteers to help with land and trail management, programs, special events, and visitor services by:
  - Increasing marketing activities to engage new audiences through traditional and social media outlets, possibly creating a WNC marketing intern position, and better positioning WNC activities in RA marketing materials.
  - Fostering partnerships with compatible organizations in the Reston and greater Reston area to benefit from cross-promotion activities.
- Revise and print trail maps and interpretive trail guides as well as other materials such as a Butterfly Checklist.
- Create Activity Packs to be available at WNC containing tools and information for self-guided learning on trails.
- Increase efforts to rent Nature House so that related income can further help to offset operating expenses.
- Develop education and outreach programs based on Recommendations in Chapters III, IV, V, VI, and VII as attendance and interest continues its upward trend.
Postscript: What Does This Mean for Reston?

Finally, a few words about Reston’s character as one of the nation’s earliest biophilic communities and why such a legacy should be preserved and extended. Many years after Reston’s founding, the famous Harvard ecologist, E.O. Wilson, in his book, Biophilia, popularized the premise that humans inherently need contact with nature and that we are hard wired genetically for this attraction. In recent years the benefits of human interaction with natural systems are gaining more attention from the scientific community. The physiological, psychological and behavioral benefits are proving substantial, including lowered blood pressure and stress hormone levels, enhanced immune systems, improved cognitive abilities, less aggressive behavior, more empathy, and less depression.

Building on the concept of biophilia, Tim Beatley (Teresa Heinz Professor of Sustainable Communities, School of Architecture, University of Virginia), suggests that to sustain ourselves as an urban species requires increasing the density and compactness of urban centers, thus reducing our energy use and carbon footprint while also keeping in close contact with nature. To do this is a challenge that Beatley argues calls for a different approach to urban design, underway in many progressive large cities, through creatively incorporating nature into the daily lives of their residents. He has spearheaded a project that attempts to link such cities together to help them share their experiences and to become even healthier and more resilient communities. The resulting Biophilic Cities Network (www.biophiliccities.org) currently has 15 participants around the world with many more in the application stage to join.

It has become apparent to the authors of this first RASER, that Reston is indeed a biophilic community by design and intent of its founding principles. Reston’s state of the environment, for many, is defined by how Reston connects its residents to the natural environment. Although RASER recommends improvements for some aspects of Reston’s environment, the overall easy accessibility and wide exposure that Reston residents have to a natural environment is of potential benefit to their health. Reston’s unique way of connecting natural areas to its residents through its many walking paths, trails, Nature Center, golf courses, other recreation areas, and numerous education/outreach programs maximizes such connectivity and promotes interactions that are more frequent, of longer duration, and more immersive. In Reston, you don’t have to travel to get to nature: You just have to step out of your home. Reston’s preservation of green space creates healthy viewscapes from much of the built environment. This connectivity, the ubiquitous interleaving of natural and man-made environment throughout this community, also sets Reston apart from most other communities.

Unfortunately, the development and re-development pressures currently facing Reston have the potential to impact Reston’s land uses and to disrupt its existing connections to the natural environment. Consequently, we believe RA (and when appropriate, in cooperation with Fairfax County and others) should develop guidelines, policies, and programs that not only protect the unique, environmentally sensitive nature of Reston but also act to preserve and to enhance the many ways its residents are connected to nature: Creating a biophilic urban core that continues Reston’s legacy as a “Model Community” far into the 21st Century. Tapping into the emerging Biophilic Cities Network also should be explored as a means to identify and to share urban development strategies and projects that may be applicable to Reston’s growth while benefitting the environmental health of its residents where they work, play, and live.

The RASER Working Group
Appendix: Reston’s Environmental Awards and Certifications

Tree City USA Designation, 1994 -2015
*National Arbor Day Foundation*
To qualify as a Tree City, a community must have the following four items: a tree board or department, a tree care ordinance, a community forest program, and an Arbor Day observance and proclamation. See [http://www.arborday.org/programs/treeCityUSA/index.cfm](http://www.arborday.org/programs/treeCityUSA/index.cfm)

Community Wildlife Habitat Certification, 2000-2015
*National Wildlife Federation*
A community wildlife habitat is a community that provides a place for people, flora and fauna to thrive. To be certified, more than 100 single family homes, 12 clusters, 3 apartment buildings or condominiums, 3 school or day care centers and 7 workplaces, churches, or other community locations were certified by NWF as Wildlife Habitats. See [http://www.nwf.org/](http://www.nwf.org/) for more information.

Money Magazine, 2012
Voted best small city in America

Land Conservation and Tree Preservation Award, 2012
*Fairfax County*
Reston Association’s Walker Nature Center was recognized for its exceptional environmental stewardship efforts during the construction of Nature House. This commendation was further recognized in the Congressional Record, Proceedings and Debates of the 112th Congress, Second Session by the Honorable Gerald E. Connolly, U.S. House of Representatives.

Best New Program, 2012
*Virginia Recreation and Park Society*
Reston Association’s Walker Nature Center and its partner, Reston Community Center, received this award for its Green Living series of programs developed with Sustainable Reston, in support of the Sustainable Reston initiative.

Reston Sustainability Award, 2010
*Sustainable Reston and Reston Citizen’s Association*
Friends of Reston was recognized in the non-profit category for contributing to making Reston a sustainable community by partnering with Reston Association to design and construct Nature House. Friends of Reston is Reston Association’s 501c3 support organization. It led an 8-year capital campaign to raise funds for the project.

Certificate of Recognition, 2010
*Fairfax County*
Friends of Reston was recognized for its initiative and commitment in constructing Reston Association’s Nature House, Reston’s first LEED certified building.
Honor Award, 2010  
*Community Appearance Alliance of Northern Virginia*  
Reston’s Nature House was recognized for enhancing community appearance by having an ecologically friendly education center designed as a handsome residential structure, aesthetically integrated into the existing residential community and site.

Nature House LEED Gold Certification, 2010  
*U.S. Green Building Council*  
Located at Reston Association’s Walker Nature Center, Nature House is a model of sustainable design and the home base for environmental education in Reston. It was the first new construction project in the Huntermill District of Fairfax County to achieve LEED Gold Certification and one of only 17 new LEED Gold buildings in the state. LEED (Leadership in Energy and Environmental Design) is an internationally recognized rating system for high performance green buildings.

Gold Leaf Award, 2008  
*International Society of Arboriculture, Mid-Atlantic Chapter*  
Reston Association has received this award twice for its activities to promote Reston’s Arbor Day and to educate people in our community on the importance of trees. See [http://www.mac-isa.org/index.html](http://www.mac-isa.org/index.html) for more information.

International Communities in Bloom Award, 2004  
*Communities in Bloom*  
Reston won this prestigious International Communities in Bloom competition for civic beautification. Competition in its population category came from around the globe, including England, Scotland, and Canada. The competition judges: floral displays, turf, community involvement, environmental awareness, landscape, urban forestry, heritage conservation, and tidiness. Reston received special recognition, with a perfect 5-Bloom rating, for its accomplishments in Natural Heritage Conservation. See [http://www.communitiesinbloom.ca/](http://www.communitiesinbloom.ca/) for more information.

Certificate of Recognition, Environmental Excellence Award Organization Category, 2004  
*County of Fairfax*  
The award recognized advancement or support of Fairfax County’s environmental goals and policy statements; dedication of personal time and expertise beyond normal fiscal or civic responsibilities; and leadership as a role model for others. Reston Association received the award for progressive and comprehensive watershed planning, protection and restoration efforts and association efforts to educate and involve the community. See [http://www.fairfaxcounty.gov/living/environment/](http://www.fairfaxcounty.gov/living/environment/) for more information.

America in Bloom Award, 2003  
*America in Bloom*  
Reston won this prominent nationwide beautification contest for its commitment to the natural environment and for the dedicated involvement of the community in these efforts. Reston was
a winner in its population category of 50,001-100,000, and was also given special recognition for its community involvement. See http://www.americainbloom.org/ for more information.

Environmental Stewardship Certificate of Recognition, 2003  
*County of Fairfax*  
Reston Association was recognized for outstanding initiatives in environmental stewardship resulting in collaboration with Fairfax County Board of Supervisors and the Reston Watershed Action Group for the improvement of the water quality in Reston and Fairfax County. See http://www.fairfaxcounty.gov for more information.

Urban Wildlife Sanctuary Designation, 2000  
*The Humane Society of the United States*  
This sanctuary designation is given to those who agree to nurture the land to provide safe habitat for wildlife and use humane stewardship practices in the management of the land. See http://www.hsus.org/wildlife/wildlife_and_habitat_protection_programs/urban_wildlife_sanctuary_program.html for more information.

Two Thousand Trees by the Year 2000 Award  
*Fairfax County Tree Commission*  
Each of Fairfax County's nine magisterial districts were challenged to plant 2,000 trees by year 2000. Reston Association met this challenge. See http://www.fairfaxcounty.gov/bacs/fairfax_board.asp?lookup=23331 for more information.

Urban Wildlife Sanctuary Certification, 2000  
*Humane Society of the United States*  
The Walker Nature Center was recognized for nurturing the land to provide safe habitat for wildlife, and for using humane stewardship practices.

Certificate of Exceptional Merit, 1999  
*National Wildlife Federation*  
The Walker Nature Center was recognized for taking exceptional action in preserving, enhancing and restoring wildlife habitat and in communicating the importance of habitat stewardship to the public. The Walker Nature Center achieved wildlife habitat certification in the community location/workplace category.

Friends of Trees Award, 1999  
*Fairfax County Tree Commission*  
This award was presented Reston Association for its demonstrated superior actions in preserving, protecting or planting trees. See http://www.fairfaxcounty.gov/dpwes/environmental/trees.htm for more information.
Best Operated and Maintained Dam by a Homeowner’s Association in Virginia, 1997
Virginia Lakes and Watershed Association

Certificate of Commendation for the protection of Difficult Run Watershed, 1997

Virginia Green Community
VA Dept of Forestry
See http://www.dof.virginia.gov/index.shtml for more information


6. UV Index Scale Sun Safety. [https://www.epa.gov/sunsafety](https://www.epa.gov/sunsafety), 2014


20 Personal communications, 16 April 2017; Colin Davis, MSW; Division Director, Emergency and Supportive Housing Programs, Cornerstones

21 Cornerstones. [https://www.cornerstonesva.org/](https://www.cornerstonesva.org/).

22 Table compiled by Faheem Darab, Senior Planner, Fairfax County Department of Planning & Zoning


29 Personal communications, 31 May 2017; Doris McCloud, VA Department of Environmental Quality


34 CH2M-Hill, 2005, Fairfax County Stream Physical Assessment, Fairfax County Department of Public Works and Environmental Services


36 Fairfax County, Difficult Run Watershed Management Plan, adopted by the Fairfax County Board of Supervisors on Feb. 26, 2007


Personal communications, Will Peterson, RA Staff; 2017.

https://water.usgs.gov/nawqa/urban/html/faq.html#findings


Data provided by Sarah M. Wills, Geographic Information Systems Manager, Wetland Studies and Solutions, Inc., April, 2017


Data compiled by Doug Britt, 2017; source: 2016 Fairfax County Stormwater Status Report, Fairfax County Dept. of Public Works and Environmental Services, 54 pp.


Personal communications, April, 2017; Marty Gurtz, retired officer, U.S. Geological Survey

Personal Communication, June 8, 2017, Charles Smith, Branch Chief, Fairfax County Stormwater Planning Division, Watershed Projects Implementation Branch – Central.

Idalina Walker, Lakes of Reston, Branching Out, Vol.18, Summer 2016

GYK & Assoc., Dam Break Inundation Study and Mapping, 2013


Reston Association, Reston Lakes Dredging Spreadsheet provided by Nicki Bellezza, RA Watershed Manager, 2017

Personal communication, Nicki Bellezza, RA Watershed Manager, 2017

Personal communications, 2017; Nicki Bellezza, RA Watershed Coordinator

Aquatic Environment Consultants, 2007, Fish Population Study, Reston Association

Olem & Associates and Brocksen and Brand, Inc., 1991;1990 Fish Tissue Analysis for Selected Game Fish from Reston Lakes Anne, Thoreau, and Audubon

Personal Communications, Doug Britt, 2017

Rice, K.C; K.M. Conko; and G.M. Hornberger; 2002; Anthropogenic Sources of Arsenic and Copper to Sediments in a Suburban Lake, Northern Virginia; Environ. Sci. Technol., 2002, 36: 4626 – 4967

Van Metre, P.C. and B.J. Mahler; 2010; Contributions of PAHs from Coal-tar Pavement Sealant and Other Sources to 40 US Urban Lakes; Sci. Total Environ., v 409: 334 – 344


Internet Center for Wildlife Damage Management – icwdm.org

Swallow, Matthew; Jane Huffman; Kyle Van Why; and Gino D’Angelo; 2010, The Effects of Goose Management on Water Quality; Proceedings of the 24th Vertebrate Pest Management Conference


Laite, K., 2016, Annual Environmental Monitoring Program Lakes Anne, Thoreau, Audubon and Newport, Bright Pond and Butler Pond, Aquatic Ecology Consultants, Inc.


Laite, K., 2016, Annual Environmental Monitoring Program Lakes Anne, Thoreau, Audubon and Newport, Bright Pond and Butler Pond, Aquatic Ecology Consultants, Inc.

Aquatic Environment Consultants, 2007, Fish Population Study, Reston Association

Laite, K., 2016, Annual Environmental Monitoring Program Lakes Anne, Thoreau, Audubon and Newport, Bright Pond and Butler Pond, Aquatic Ecology Consultants, Inc.

Reston Lake Management Treatment Log.xlsx, 2017

Aquatic Environment Consultants, 2007, Fish Population Study, Reston Association

2011 Annual Environmental Monitoring Program Lake Report


Laite, K., 2016, Annual Environmental Monitoring Program Lakes Anne, Thoreau, Audubon and Newport, Bright Pond and Butler Pond, Aquatic Ecology Consultants, Inc.

Reston Lake Management Treatment Log.xlsx, 2017

Aquatic Environment Consultants, 2007, Fish Population Study, Reston Association

Laite, K., 2016, Annual Environmental Monitoring Program Lakes Anne, Thoreau, Audubon and Newport, Bright Pond and Butler Pond, Aquatic Ecology Consultants, Inc.

Personal communication, Doug Britt, 2017

Personal communications, 2017. Nicki Bellezza, RA Watershed Manager


Edem K. Ekpe, K. Elizabeth Becker, Jessica Lab, C. Ross Hinkle, and Francisco Escobedo. 2010, An Assessment of the Structure and Environmental Benefits of Urban Forests in Orlando, Florida; Orlando Parks Division, Families, Parks and Recreation Department, City of Orlando, Florida


Personal communication, 2017; Patricia Greenberg, Environmental Resource Supervisor, Reston Association


Personnel correspondence, 2017; Claudia Thompson-Deahl, Senior Environmental Resource Manager, Reston Association.


Personal communication with RASER Chair Doug Britt, May, 2017; Steve Potts, retired raptor biologist and currently monitoring the Town Center falcons for the Center for Conservation Biology

Reston land use map compiled for RA 2017


152 USGS, National Wildlife Health Center accessed 3 June 2017. Ranavirus, 
https://www.nwhc.usgs.gov/disease_information/other_diseases/ranavirus.jsp


158 WNC, Chart of ranavirus sampling May 2014, RASER Dropbox


161 Fact Sheet; 20 June 2014; The Economic Challenge Posed by Declining Pollinator Populations; White House, Office of the Press Secretary

162 Fairfax County Newsletter, 2017; What’s the Buzz on Bees?; Northern Virginia Soil and Water Conservation District.

163 Fearing, Sarah; 26 April, 2014; Bee Colony Decline a Concern; Tidewater Review.


165 Walker Nature Center, Butterfly Checklist Summary, Excel spreadsheet compiled by Abby Stocking using data from annual butterfly counts, Reston Association, December 2016

166 Op.Cit. NABA Butterfly Counts, 2013, p. 71


168 Environmental Advisory Committee, Dragonfly Count Summary, Excel spreadsheet compiled by Dr. Donald S. Coram from WNC dragonfly count data, 3 January 3, 2017.


171 Munroe, Kevin, FW Dragonfly data2.msg, email message to Claudia Thompson-Deahl, February 13, 2017


Reston Association Larval Mosquito Surveillance Summary, Lauren Lochstampfor, Regional Biologist, 21 June 2015, RASER Dropbox


Reston Association, Use and Maintenance Standards Resolution 13, Feeding Non-Domesticated Wild Animals, 22 May 2008 https://www.reston.org/LinkClick.aspx?fileticket=MVL_DbwXhj8%3d&tabid=209&portalid=3&mid=629


Personal Communication, April 6, 2017 Margaret Dix, Fairfax County Fire & Rescue Incident Report Line.


Personal Communication, May 9, 2017, Randy Chapman, Virginia Department of Environmental Quality

Personal Communication, May 1, 2017, Joseph Glassman, Virginia Department of Environmental Quality, Case Manager for CEDS Facility 200000851768.


Personal communication, June 11, 2017, Saiful Islam Ph.D., Industrial Waste Section, Fairfax County Wastewater Planning & Monitoring Division. (see https://www.epa.gov/rcra).


"Toxics Release Inventory (TRI) Program." U.S. Environmental Protection Agency. https://www.epa.gov/toxics-release-inventory-tri-program/learn-about-toxics-release-inventory#What is the Toxics Release Inventory?


International Dark-Sky Association.. http://www.darksky.org/.


WNC, Summary Spreadsheet on Education and Outreach 2010-2016, Katie Shaw, RASER Dropbox
