Natural Resources Management Plan

Great Parks of Hamilton County
10245 Winton Road
Cincinnati, OH 45231

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NATURAL RESOURCES MANAGEMENT PLAN
GREAT PARKS OF HAMILTON COUNTY

SIGNATURE PAGE

This Natural Resources Management Plan (NRMP) is a framework for natural resource management of Great Parks of Hamilton County (GPHC). It has been reviewed for effect and recommended for continued implementation, with an update to occur in 2026 (every 5 years).

Approving Officials:

Todd Palmeter
Chief Executive Officer

Bret Henninger
Chief Operating Officer

Jason Rahe
Chief of Conservation & Parks

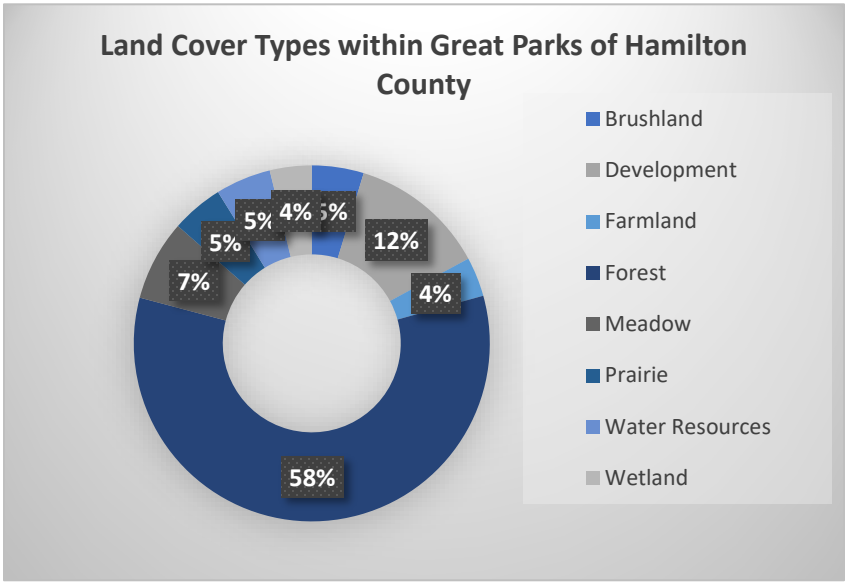
Jessica Spencer
Director of Natural Resources

EXECUTIVE SUMMARY

Great Parks of Hamilton County (GPHC or Great Parks) is home to a diverse array of plant and animal communities and many other natural resources unique to Southwest Ohio. GPHC's mission is to preserve and protect natural resources and to provide outdoor recreation and education in order to enhance the quality of life for present and future generations. The Natural Resource Management Plan (NRMP) supports this mission through the employment of ecologically sound land management practices. The NRMP is based on an adaptive management approach which allows for flexibility in the face of changing conditions.

While site-specific management plans and restoration projects have been implemented over time, new land acquisitions and ecological threats call for an updated and holistic document for Great Parks which outlines policies and approach. This first comprehensive NRMP will also help GPHC balance conservation measures with development of recreation and education facilities in pursuit of its mission, minimizing negative ecological impacts. Such an approach recognizes the need for conservation of natural areas as a precursor to achieving the mission's education and recreation components.

GPHC is located in the Southwest corner of Ohio, with the vast majority of property in Hamilton County and a few acres in Clermont County to the east. The 17,733 acres of Great Parks' managed property are comprised of 22 parks and preserves situated in suburban, rural and urban areas. More than 83% of lands are undeveloped and comprised of forests, wetlands, brushland, and prairie, as well as others including several high-quality rare communities. The remaining acreage, which includes lawns, buildings and pavement, is developed for educational and recreational purposes (see summary information below).



Brushland	5%
Development	12%
Farmland	4%
Forest	58%
Meadow	7%
Prairie	5%
Water Resources	5%
Wetland	4%

The overall management vision is to protect and restore resilient native ecosystems at GPHC, which provide abundant resources and services. This vision is supported in the NRMP by goals and management objectives, as well as best practices to achieve these goals.

Management objectives, metrics, and potential sources of funding and partnership are described in the NRMP by resource area. GPHC plans to improve and enhance its management of natural resources as it builds capacity, with plans to specify metrics and fill in data gaps and expertise.

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1.0 Introduction

Great Parks encompasses a wide variety of properties, including parks, nature preserves, and river corridors. These resources contain a wealth of natural and cultural resources that are preserved and managed for the citizens of Hamilton County, Ohio. Great Parks owns or manages a significant amount of the natural areas of Hamilton County. In total, 17,733 acres of land are managed by Great Parks, representing nearly one-third of the undeveloped areas of Hamilton County.

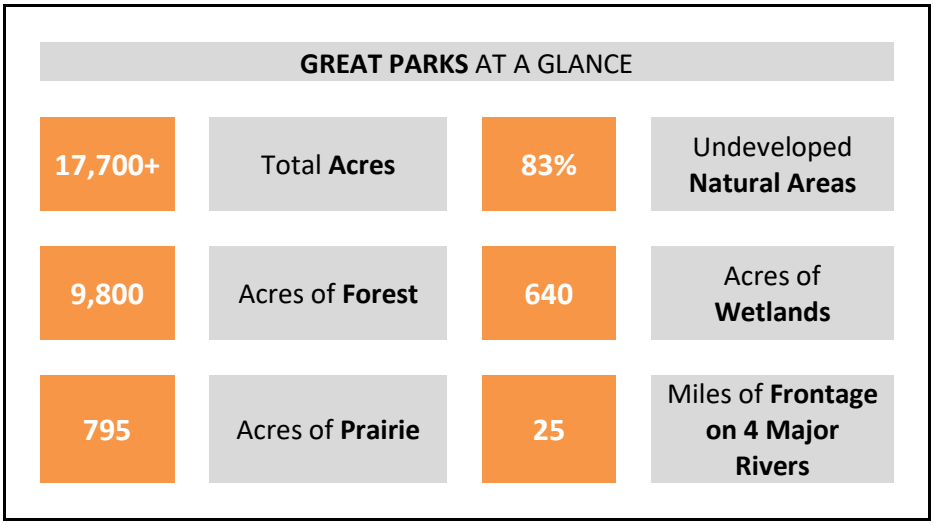

Figure 1. Great Parks Land Holdings At-A-Glance.

The majority of land managed by GPHC is directly owned by the GPHC, yet the park system also includes land leased from the Army Corps of Engineers, the City of Cincinnati, and non-profit organizations, in addition to managing several State Nature Preserves within its boundaries. Sharon Woods, Winton Woods, Newberry Wildlife Sanctuary, and Glenwood Gardens all have state nature preserves as part of their land holdings.

All GPHC properties are managed per the Ohio Revised Code Section 1545.11 and GPHC's bylaws, in coordination with partner agencies, regardless of ownership. In 1975, the Board of Park Commissioners adopted a Land Management Policy, which placed the highest value on land in its natural state and to ensure that this land is managed based on "sound ecological principles." This policy has guided the acquisition and management of park land in a way that has greatly benefitted the ecology of the region and increased the land holdings of GPHC.

At the recommendation of the Performance Audit issued by the Ohio Auditor of State in February 2016, the Director of Natural Resources at GHPC initiated a staff review of the Land Management Policy of 1975 to "...clearly establish overall preservation and conservation goals." Revisions to the policy, now called the Natural Resource Management Policy, were brought to the GPHC Board, and revisions were approved in December of 2016. Policy revisions reinforced the commitment of Great Parks to maintaining a minimum of 80% of park land in a natural state, managed for ecological benefits. Revisions also involved clarifying measurement of compliance to the 80/20 policy to include the entire land holdings, rather

than to track the 80/20 policy by each park. Lastly, the Land Management Policy revisions in 2016 incorporated a commitment to sustainability of natural resources in the agency's delivery of services.

Today, the GPHC park system includes 22 parks and preserves and a 78-mile trail system comprised of shared-use, nature, horse, mountain bike and fitness trails. Every park contains a river, creek, stream or lake, and Great Parks manages 25 miles of river frontage. Several parks and preserves also house nationally significant pieces of landscape and cultural history, including Shawnee Lookout, Woodland Mound, Sharon Woods and Miami Whitewater Forest.

1.1 Purpose

The Great Parks Comprehensive Master Plan (CMP) establishes an inspiring vision for the park system for 2019-2028 and includes a central goal for GPHC to "become a recognized leader in conservation". It further aspires to establish the lands that make up Great Parks of Hamilton County as a system of connected and ecologically resilient conservation areas, river corridors and parks (GPHC 2019). In order to achieve these goals, GPHC needed to create a guiding document which describes the general approach to conservation and natural resource management with ecological resilience at its core.

The purpose of this Natural Resources Management Plan (NRMP) is to describe the overarching adaptive management approach to natural resources protection that will be implemented to support ecologically resilient parks and preserves.

Additional park-specific natural resource management plans, currently being developed, will describe the state of natural resources at each park and provide a flexible 5-year plan for their management[1].

1.2 Natural Resource Management Philosophy

The goal of natural resources management at Great Parks is to protect and restore resilient native ecosystems, which is aligned with the mission of GPHC.

The mission of Great Parks of Hamilton County is to preserve and protect natural resources and to provide outdoor recreation and education in order to enhance the quality of life for present and future generations.

[1] Park-specific natural resource management plans will be rolled out evenly in the three regions (West, East, and Central) beginning in 2021.

In pursuing the mission of Great Parks to preserve and protect natural resources, the approach taken by GPHC has necessarily changed since the parks were established in 1930. The landscape, science, and tools available for conservation have changed with the urbanization of Hamilton County, and Great Parks has adapted as well. While previous efforts might have focused on preserving specific species or restoring individual areas, the number of current threats facing natural resources requires a more holistic and strategic approach to protecting and preserving these resources. Because the science of natural resource management has evolved, monitoring efforts to gauge the status of natural areas and the severity of threats is a more important focus now than in previous decades. Prioritizing areas for management within and among the parks and preserves has also become imperative in order to utilize limited resources wisely.

All staff at GPHC are responsible for supporting conservation efforts. The Conservation and Parks (C&P) Division is responsible for management and protection of natural resources on GPHC land. Direction and oversight of these efforts is the primary technical responsibility of C&P's Natural Resources (NR) team of biologists and specialists.

Natural resources are affected by a wide variety of activities, including water management, development of buildings and trails, and recreational uses such as golf and horseback riding. Preserving natural resource values alongside an array of uses of the parks and preserves is a core function of the team.

Modern challenges at Great Parks include unprecedented use of trail systems, urban forestry and tree pests, watershed health and aging infrastructure, wildlife management and young forest regeneration, and implementing sustainability across operations. Management of natural resources mitigates against harmful feedback loops that can occur in natural systems. Without consistent management towards desired outcomes, degradation and impairment of natural resources can result.

Ecosystem Services

Functioning ecological systems provide many tangible and intangible benefits.

Fresh water, food and wildlife, serene views, capturing stormwater and reducing local flood risk, cooling temperatures in urban heat islands, improving air quality and cycling nutrients for healthy soil are some of the essential things provided by natural systems when they are healthy and functioning.

Functional systems can recover from regular disturbances such as tree falls or flood events, whereas compromised systems are subject to rapid degradation and provide fewer services.

In order to protect natural resources amid constantly changing conditions, NR management efforts follow an adaptive management framework, which is a systematic and specific approach for improving management by learning from outcomes. Adaptive management allows for flexibility and collaboration while providing structure which allows for explicitly stating goals and including accountability in the process.

An adaptive management approach involves exploring alternative ways to meet natural resources management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to

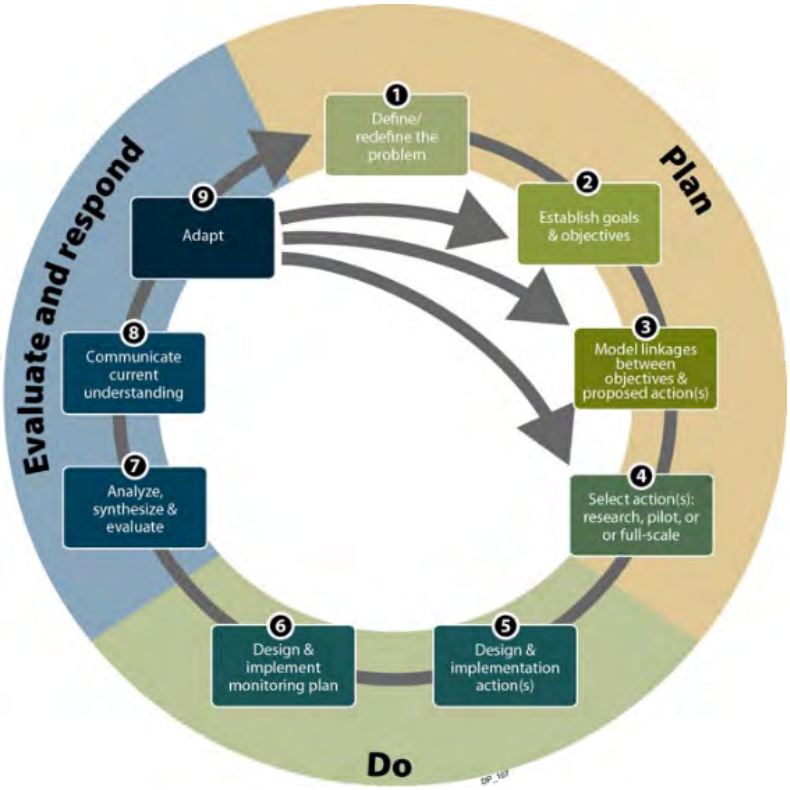

Figure 2. Adaptive Management diagram (From USFWS)

learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions (Murray and Marmorek 2003). This approach allows for responses to dynamic ecological systems and changing needs over time. Therefore, successful adaptive management requires an ongoing, long-term commitment to the iterative process (see example diagram in Figure 2). The goals and objectives developed in this document lay the foundation for natural resources management to occur across the properties managed by Great Parks of Hamilton County. Park-specific goals stem from the goals set forth in this NRMP.

Restoration is an integral part of the work that NR does to preserve natural areas. Land may be degraded or may be transitioning from one cover type (e.g. farm field) to another (e.g. prairie). NR works to identify the cover type that would have historically been in the area and balance that with the need to represent regionally rare ecosystems (e.g. prairie or wetlands). To this end, NR guides invasive plant management and the installation of native grasses, forbs, shrubs, and trees.

The Shaker Trace Nursery at Miami Whitewater Forest is a GPHC facility that specializes in preserving the ecological and genetic integrity of the region through native plant propagation of local genotypes. During the spring of 1992, this large native seed nursery was established from original seed stock gathered from relict natural areas within a 100-mile

radius of Hamilton County. This approach aims to preserve the regional genotype of each species so that plants grown from this seed stock are suited to the environmental conditions of southwest Ohio. Seeds processed at the nursery are used to restore prairies and wetlands on several hundred acres in the parks and preserves and is a resource for other conservation agencies in the region. Since 1992, over a quarter million seedlings have also been grown and transplanted. With the addition of uncommon woodland wildflowers, the nursery staff now works with more than 200 species of plants native to Hamilton County.

Severely altered or degraded parcels, and all of those currently in agricultural use, need restoration goals. Selecting management and restoration goals for a given parcel requires an understanding of the hierarchical relationships among geomorphology, soil characteristics, and plant communities (Palik et al 2000). Analyses from nearby forest (Zimmerman and Runkle 2010) in the Lower Twin Creek Watershed found that landform, soil drainage, aspect, curvature, and percent slope were the strongest factors in determining vegetation, and these can be used in conjunction with historical records to establish goals for the desired vegetation community. Restoration goals may vary between rehabilitation and reconstruction depending on the initial conditions of the site (Stanturf et al 2014).

Because Hamilton County was densely forested according to the earliest records that have been found, the restoration goal for most park district properties will be to return altered or agricultural land to forest cover. The most frequent exception to this rule is our interest in finding and maximizing opportunities for wetland restoration, which is based on the severity of wetland loss in our region. In most areas, NR follows this general process:

1. Identify the types and extent of cover that represent this region's natural heritage.
2. Establish a plan to restore cover types to minimize discrepancy between current distribution cover and regionally representative plant community cover, through acquisitions and conversion.
3. Increase connectivity between vegetation types within GPHC and surrounding natural areas

In adaptive management, a comprehensive understanding of what is present (i.e., baseline monitoring) is necessary before managers can begin to identify emerging issues and existing challenges, create a plan to address them, set performance standards, track project or program results, and adjust management strategies accordingly (**Figure 3**). Because this is a data-driven approach, it requires a collaborative effort among park employees, with guidance from NR, to collect information and use it to improve natural resources. This process will allow for gaining experience and knowledge while at the same time implementing goal-oriented strategies. This document, the Natural Resources Management Plan for Great Parks of Hamilton County, will provide an overview of this process for all properties, with will then inform the park-specific natural resource plans to be developed in the future at each park.

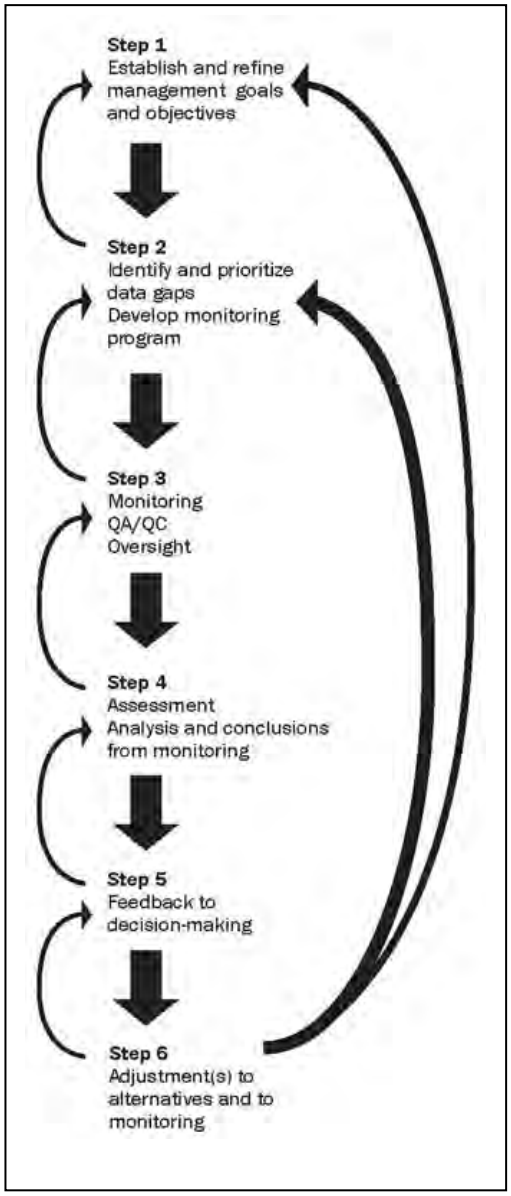

Figure 3. Example process diagram for Adaptive Management. *Biohabitats 2019*

1.3 AUTHORIZATION

This NRMP is authorized under GPHC's Comprehensive Master Plan following a 2016 audit. Great Parks is a political subdivision of the State of Ohio, whose enabling legislation is found in Ohio Revised Code Chapter 1545. The state code describes a park district's purpose is to acquire lands for preservation purposes and to conserve natural resources of the state such as native flora and fauna, soil, clean air and water which are essential to healthy functioning ecosystems which provide humanity various benefits.

For a full listing of federal, state, and local regulations and landholding agreements that dictate how GPHC manages the natural resources of public lands, please refer to **Appendix C.**

1.3.1 Review & Revision Process

The NRMP for Great Parks of Hamilton County will be reviewed every 5 years in order to ensure that the document remains current and up-to-date with best management practices, landscape changes, land holdings, and agency goals and structure.

1.3.2 Integration with Other Plans

The application of natural resources management is necessarily interdisciplinary, and the NR team integrates team members from other divisions and disciplines when addressing natural resource management at Great Parks.

Other plans help to guide GPHC when responding to natural resource challenges and conservation efforts. These associated documents are listed below and can be found in **Appendix B**.

- Trail Guidelines and Maintenance
- Tree Risk Management Plan
- Water Resource Management Plans
    - Harmful Algal Bloom Plan
    - Stormwater Management Plan (MS4)
- Wildlife Management Plans
    - White-tailed Deer Management Plan
    - Goose Management Plan
    - Herpetofauna Monitoring Manual
    - Wildlife Feeding Action Plan
- Sustainability Action Plan (Draft)
- Shaker Trace Nursery Business Plan
- Review process for creating access paths to natural areas for management
- Best practices for mowing and bushogging natural areas
- Herbicide use policy (Draft)
- Prescribed Fire Plans for multiple parks

1.4 BACKGROUND

Hamilton County is located in the Ohio River Valley in the southwest corner of Ohio. The Cincinnati metropolitan area is situated in the south central portion of the county. Land cover in Hamilton County (**Figure 4**) is predominantly developed urban and suburban areas and farmland. In contrast, the GPHC parks are dominated by forest cover, as shown in plant surveys over the years. Hamilton County has experienced an 11.6% increase in urban land between 1982 and 1997. Specifically, forests, cropland, and pastures have decreased 18.6%, 32%, and 47.2%, respectively (HCRPC 2004).

The backbone of Great Parks' mission is conservation, which depends on the integrity of the ecological systems found at Great Parks. Therefore, managing lands for conservation and the integrity of the ecological system is the foremost concern of GPHC.

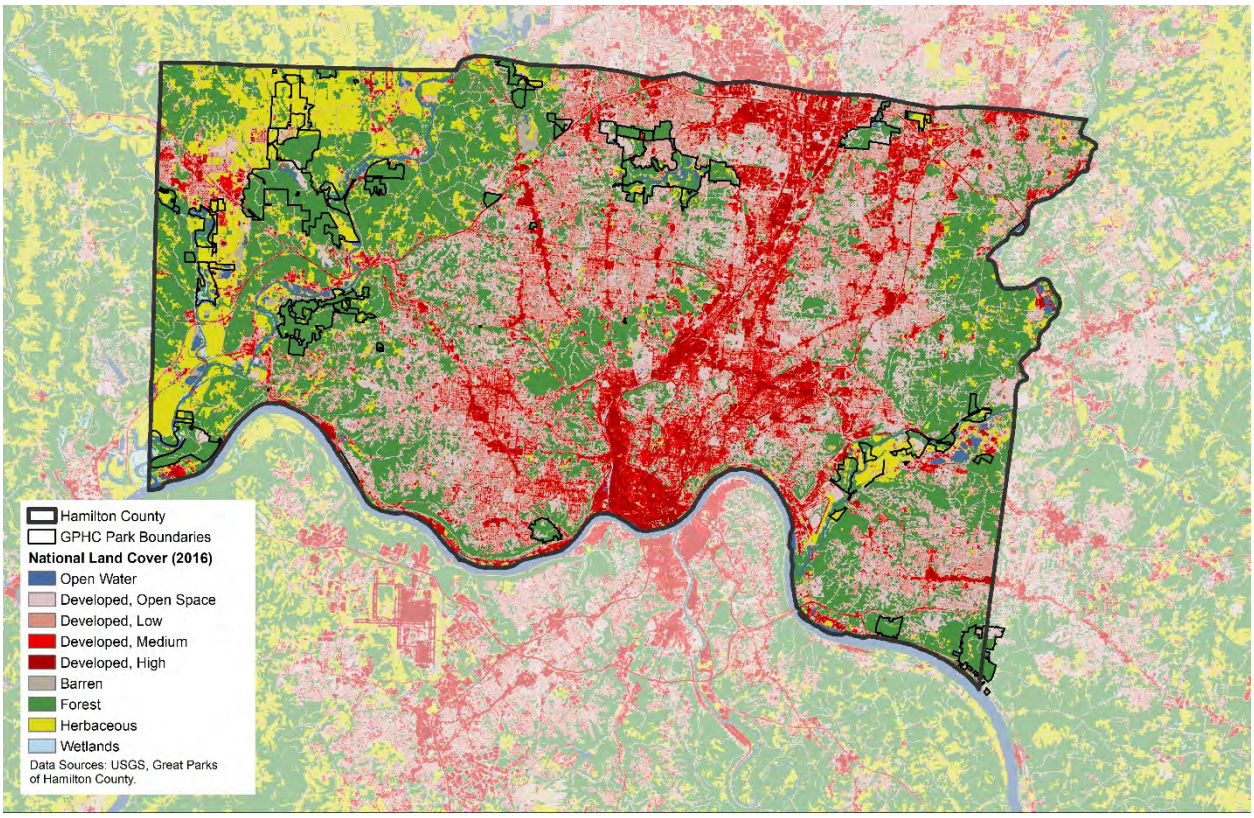

Figure 4. Land Cover Types for Great Parks of Hamilton County and Hamilton County and Surrounding Regions.

The natural resources of Great Parks provide benefits to the people of Hamilton County, such as wildlife habitat, native seeds, restorative natural settings, and a place to recreate and connect with their community. GPHC contains unique and disproportionate amounts of natural areas in Hamilton County, including forest resources and habitat types such as wetlands that are rare on the landscape. Natural resources management at Great Parks is impacted by regional conditions, and the agency's management impacts the region in turn. It is important to note that GPHC owned and managed natural resources have a larger function in the region.

The natural resources of Great Parks provide benefits to the people of Hamilton County such as wildlife habitat, native seeds, restorative natural settings, and a place to recreate and connect with their community.

Within the parks, preserves, and river corridors, natural systems adjust to and mitigate the effects of natural phenomena like climate, water, air and disease. Streams that are unimpaired and connected to their floodplains can accommodate the water from storm events and reduce local flood risk. Strong biological systems in our water ways can also filter out impurities and reduce water pollution. Closer to the urban core, forest cover has an important role in mitigating the effects of urban heat islands and trapping particulate air pollution. Supporting services include the core ecological cycles of photosynthesis, nutrient cycling, and the water cycle. The living soils throughout the parks

and preserves are an example of the supporting ecosystem services that create a foundation for functioning ecological systems, such as soil formation and nutrient cycling.

In addition to providing natural resources, non-material benefits provided by time spent in a natural environment is central to the visitor experience at GPHC. More research is showing that time spent in outdoor and natural environments can reduce stress, provide opportunities for increased physical activity, and boost academic performance in children (Children and Nature Network 2020). Time to interact with nature is a key resource enjoyed by the public. For example, the views and spectacular wilderness in Miami Whitewater Forest is a cultural resource to the entire region. In addition, GPHC protects nationally significant pieces of landscape and cultural history, such as the unique cultural resources that can only be found at Shawnee Lookout (Section 2.9).

In 2014, GPHC's expenditures dedicated to natural resources represented 2.5% of its total operating expenditures, which is slightly below the peer average of 3.0% and the peer park district median of 2.7% (State of Ohio, 2016). This comparison supports the concept that the cost to manage natural resources, a cornerstone of the purpose and mission of park districts, does not commonly make up a large portion of a park district's actual yearly financial responsibilities, yet yields valuable and vital ecosystem services.

2.0 Goals

The overall natural resources management vision is to protect and restore resilient native ecosystems. The NRMP strives towards this vision through four overarching goals.

1. *Monitor the state of natural resources and ecological structure and function*
2. *Establish priorities based on best management practices and available data*
3. *Protect and restore natural resources through conservation and sustainable practices*
4. *Engage the public and partners in regional collaborations to promote conservation of natural resources*

Each of these goals and existing activities currently conducted at Great Parks are described in more detail below. Park-specific goals, objections, and actions are contained in the natural resource management plans written for that particular park.

2.1 GOAL ONE: MONITOR THE STATE OF NATURAL RESOURCES AND ECOLOGICAL STRUCTURE AND FUNCTION

Obtaining information about natural resources through surveys and monitoring is essential. Surveys provide baseline information about the natural resources being evaluated. Monitoring is the foundation of adaptive management, as a source of data to measure progress toward accomplishing management objectives. The NR team at Great Parks is responsible for overseeing natural resource surveys and monitoring on park property and

accomplishes this in partnership with staff, volunteers, and contractors. These programs cover several groups of taxa as well as watershed health, as outlined in **Table 1**. Additional monitoring is undertaken by NR staff, researchers, and consultants as needed.

Table 1. Great Parks of Hamilton County Natural Resources Monitoring

System-wide Monitoring	Schedule	Indices	Description
Primary Headwater Streams	Annual	HHEI	Standardized rapid assessment of all headwater streams for habitat quality with physical characteristics. Used to detect emerging management issues such as invasive species or declines in habitat quality.
Headwater Streams	Annual	PTI	Volunteers assess a handful of streams from April-September using the Pollution Tolerance Index (PTI)
Wetland Delineation and Assessment	Variable	USACE Wetland Determination Data Form	Surveys to determine the extent and condition of wetlands within the parks and preserves. To confirm suspected wetlands and protect them accordingly. Sometimes in response to proposed management or construction projects.
Hazardous Tree Surveys	Annual	Tailored ISA Tree Risk Assessment Protocol	Evaluation of individual trees with targets by categorization of their likelihood of failure, impact and severity of their resulting consequences to determine risk.
Vegetation Surveys	Annual	FQAI	Plant surveys at 10m radius plots. Provides a quantitative measure of ecological integrity and can detect changes in habitat quality over time. Used to identify vegetation communities least disturbed by humans and prioritize their preservation and management.
		Cover mapping	Periodic effort to map the dominant vegetation communities present in natural areas so as to identify the management objectives for each area.
Small Nestbox Surveys*	Annual	Occupancy Rate	Eastern bluebird *(Sialia sialis)* nestbox surveys
Herpetofauna Surveys*	Annual	Species Diversity	Trained volunteers use multiple techniques, including dip net, cover board, leaf litter and visual surveys to assess these vulnerable and often overlooked animals
White-Tailed Deer (*Odocoileus virginianus)* Browse Impact Surveys	Annual	Population Index	Biologists quantify browse impacts to understory plants and young trees. Information is used to inform decisions in forest and deer management.
White-Tailed Deer Pellet Group and Aerial Infrared Surveys	Annual	Density estimate (index)	Biologists estimate populations by counting scat and analyzing infrared observations. Information is used to inform decisions in deer management.
Canada Goose *(Branta Canadensis)* Counts	Variable	Total numbers	Park managers use goose head counts to guide goose control and management.

Lakes Fish Survey	Each lake every 5 years	Population inventory	Contractual survey using electrofishing equipment
Lake Survey*	Annual	Secchi Disk Reading; Visual Survey	Volunteers visually assess lakes for algae blooms, pollution and turbidity to protect water quality and public health
Delisted Species: Running Buffalo Clover *(Trifolium stoloniferum)* Surveys	Annual[+]	Extent and population inventories	Coordinated with USFWS population counts for this formerly federally endangered species (delisted in 2021) to ensure populations are stable
Invasive Plant Mapping	Opportunistic	Invasive plant presence and intensity are mapped as encountered	
Opportunistic natural resource record-keeping	Opportunistic	Unusual, sensitive, or locally rare plants mapped as encountered, as well as notable wildlife	
Winter Bird Counts*	Annual	Citizen science effort to document winter-resident bird communities within parks	
* Volunteer-led efforts [+]Monitoring will continue for a 5-year period.			

Strategic planning in 2012 initiated baseline monitoring of streams and vegetation, and NR has continued to build on those gains. One of the goals of NR is to identify baseline surveys that are still needed and collaborate with researchers, volunteers and consultants to obtain that information. The NR team also utilizes contractual research to inform our adaptive management practices.

More information is needed to effectively evaluate natural resources at GPHC and determine if management activities are achieving the objectives set for particular properties. In addition, some baseline survey data is still needed, notably for some rare species (e.g. bats), invasive plant spread (e.g. honeysuckle control), and to gain more information on seldom-studied taxa (e.g. invertebrates). In addition to these, NR has discussed the possibility of leveraging partnerships in the region to complete citizen science-based surveys for particular taxa and cultural resource surveys, especially at parks with known or sensitive archaeological resources. Monitoring and surveys will be explored in more depth in each park's natural resource management plan.

2.2 GOAL TWO: ESTABLISH PRIORITIES BASED ON CURRENT BEST MANAGEMENT PRACTICES AND AVAILABLE DATA

Prioritization of natural area management is based on a comprehensive evaluation of natural resources for any given area. One tool employed to complete this evaluation is a spatial analysis developed by NR to identify sensitive areas and management priorities. The analysis combines 20 datasets to find the most ecologically important areas within Great Parks' boundaries, with more vulnerable areas being a higher conservation priority. The analysis can be adapted to identify priority management areas in accordance with defined criteria. The datasets are used in 13 themes that look at aspects of what makes an area vulnerable. The themes are below, and are listed from highest priority to lowest priority. More details on the themes can be found in **Appendix D**.

1) Canopy Height
2) Rarity
3) Streams 4-5
4) Wetlands
5) Headwater Streams
6) Floristic Quality
7) Rivers
8) Cover Type
9) Floodplains
10) Habitat Cores
11) Geophysical Setting
12) Slope
13) Erodability

The data in each theme are quantified across a scale of 1 to 10, where 10 is the most vulnerable and 1 is the least vulnerable. For example, steep slopes are more vulnerable to erosion when disturbed than relatively flat slopes. These scores are then weighted by the relative importance of each theme. Slopes, fall lower in the weighting as they are a less important resource to protect compared to wetlands, rare species and large tracts of habitat. The resulting metric indicates relative ecological sensitivity and importance combined. Park-specific natural resource plans are guided by the results of this process and can be updated as the data changes over time.

NR prioritizes natural areas using many datasets and ranks them in order of priority based on scores. High quality natural areas have a higher score, and targeted natural management activity is outlined for them in the park-specific natural resource plans.

NR is responsible for synthesizing current best practices in natural resource management and providing clear guidance for the annual work of C&P staff. The main way this is accomplished is through park-specific natural resource plans, which prioritize areas and provide goals, objectives, and activities for a 5-year period. As of the writing of this document, these plans are being updated. The bridge between these versions is an overarching implementation table associated with this NRMP, found in **Appendix F**. In addition to these plans, training sessions may be provided and challenges are discussed in check-in meetings held at park facilities and attended by that park's C&P staff and NR staff.

For management efforts not already identified and planned for in the park-specific natural resource plans, projects are outlined in standardized Project Plans as modifications to natural areas are proposed. Examples of these projects include tree plantings, innovative invasive species removal methods, and rain gardens. Project Plans are intended to provide NR the opportunity to give feedback on a needed project initiated by C&P staff that may not have been identified in long-term planning or that addresses a particular need. For recurring or chronic issues, Project Plans should be considered for incorporation into the park-specific natural resource management plan when they become due for revisions every 5 years.

NR also works closely with staff in all parks to review and implement natural resource management techniques such as prescribed burns, invasive species management, recreational fish stocking, and planning for more sustainable events. As part of this process, NR creates and maintains a library of internal best management practices, technical resource documents, and research reports that outline the scientific and practical considerations for special circumstances of natural resource management. These activities are incorporated into each property's park-specific natural resource management plan.

2.3 GOAL THREE: PROTECT AND RESTORE NATURAL RESOURCES AND ECOLOGICAL FUNCTION THROUGH CONSERVATION AND SUSTAINABLE RESOURCE MANAGEMENT

Based on the conditions of natural areas as described in GOAL 1 and the priorities as described in GOAL 2, GPHC undertakes management activities and specific projects in order to preserve and restore natural resources. These activities are varied, ranging from applying prescribed fire, rerouting recreational trails, managing overabundant wildlife populations, and converting agricultural fields to prairie or young forests. Evaluating results and adapting approaches per adaptive management principles are part of the annual reevaluation of objectives, goals, and activities. Management activities that are currently part of natural resource management at Great Parks are listed below in **Table 2**.

Table 2. Management Programs within Great Parks of Hamilton County

Management Programs	Frequency	Description
Tree Risk Management	Ongoing	Removal of trees that receive high risk ratings
Restoration	Ongoing	Includes reforestation, prairie planting, vernal pool creation, etc.
Native Plant propagation	Annual cycle	Collect, process and propagate seed for restoration projects
Raising hybrid bluegill *(Lepomis macrochirus* x *Lepomis cyanellus)*	Ongoing 2-year cycle	Production of adults from fingerlings
Prescribed Fire	Ongoing 3-year cycle	Burning prairies to prevent succession into forest

Wildlife Management	Ongoing	Protect, provide habitat, manage populations & help prevent conflict
Lake and Pond Management	As needed	Prevent pollution and coordinate clean ups
Invasive Plant Species Management	Ongoing	Promote biodiversity by removing invasive plants in sensitive areas first
Stew Crew Volunteer Program	Ongoing	Regularly engaging volunteers in management
Natural Surface Trail Maintenance	Ongoing	Remove water bars, improve drainage & reroute as needed
Bushhogging/Tree Thinning	Ongoing 2 or 3 year cycles	Prevent non-target and overabundant woody species from establishing
Stormwater Management/MS4	Ongoing	Includes training and prevention, public education and monitoring

As previously mentioned, a park-specific natural resource management plan is in development for each property held by GPHC. These plans specify a performance management framework that evaluates the results of each activity and informs long-term strategic decision making with the goal of effectively planning and prioritizing conservation efforts. Performance management strategies inform not only the way that GPHC approaches current resources and activities, but also future actions of NR.

GPHC undertakes a wide array of activities focused on terrestrial and aquatic systems. In addition, natural resources such as soil, water, air and cultural resources are protected from degradation or loss through conservation, restoration, and land acquisition.

2.4 GOAL FOUR: ENGAGE THE PUBLIC AND PARTNERS IN REGIONAL CONSERVATION AND SUSTAINABILITY

Many of the core management activities led by NR require a policy and regulatory structure to ensure consistent practice and to assist with public outreach and communication. For example, burning is a best practice in prairie management, but growing suburban developments near GPHC properties sometimes voice opposition to these practices because of smoke or traffic implications. Similarly, stormwater management on neighboring properties directly affects the quality of GPHC streams and waterways. GPHC has a special interest in explaining the significance of natural resource management practices to stakeholders, partners, and the public and offering technical support where feasible and appropriate. GPHC also has an obligation as a leader in conservation to partner with regional and state organizations to further work in conservation and natural resource management. **Table 3** outlines current partnerships and outreach programs that GPHC is involved in.

Table 3. Partnerships and Outreach Programs

Effort	Term	Description
Cincinnati Invasive Species Management Area	Ongoing	Cooperative partnering with multiple agencies to address invasive species in the region. Staff serving in advisory capacity towards common goals
Cincinnati Off-Road Alliance (CORA Partnership)	3-year	Memorandum of Understanding (MOU) regarding cooperative management of mountain bike trail at Mitchell Memorial Forest
City Nature Challenge 2021	1 year	Partnering with Cincinnati City Parks on a worldwide initiative organized by the California Academy of Science and LA Natural History Museum. Public bio blitz to collect biodiversity data in Hamilton Co. during April 30th-May 9th, 2021, using iNaturalist.
Groundwork Ohio River Valley	1-year	Internship and workforce development program in natural resources and other areas for local young people, most of whom are low-income and/or youth of color
Mill Creek Alliance	1-year	Litter Gitter management on the West Fork of Mill Creek
Ohio Bird Conservation Initiative	Ongoing	Collaboration of non-profit groups, businesses, state and federal government agencies, and citizens focused on ensuring the conservation and effective management of birds in Ohio.
Ohio Division of Natural Areas and Preserves	Ongoing	Coordination of management of the five State Nature Preserves within GPHS boundaries.
Ohio Community and Wildlife Cooperative	Ongoing	Staff serving in advisory capacity towards common goals
Ohio Prescribed Fire Council	Ongoing	Staff serving in advisory capacity towards common goals
Ohio River Foundation	1-year with possibility of extension	Native freshwater mussel storage at Lake Isabella
Monarch Joint Venture	Ongoing	Commitment to monarch and pollinator conservation through habitat restoration, conservation, education, research and monitoring.
Taking Root	Ongoing	Commitment to regional reforestation initiative; Collaboration on native tree plantings and community outreach
University of Cincinnati	15-year	Field Station lease at Miami Whitewater Forest

Waste Management and Recycling	Ongoing	Partnering with Hamilton Co. Solid Waste and Recycling District and Beyond 34. Conducted two physical waste sorts a WW and develop a plan to increase recycling in 2021.
2030 District Initiative	Ongoing	We commit to reducing 50% of the agency's emissions in energy, water, and transportation by 2030.

NR is also responsible for representing GPHC in professional organizations, supporting interpreter staff and outreach goals, and establishing research partnerships and priorities. Additionally, NR works with outside organizations on issues that extend beyond park boundaries and require holistic efforts to engage the community.

The state and federal regulations affecting our natural resources also create partnerships in stewardship. For water quality, endangered species management, and compliance with regulations, NR partners regularly and maintains communication with non-profit, state and federal agencies.

Great Parks plans to continue workforce development opportunities for local disadvantaged youth through summer partnerships with Groundwork Ohio River Valley. In addition, the agency will create more citizen science opportunities through research partnerships, will continue hosting regional natural resource workshops, visiting schools and regional programs, and collaborating with interpreters on programming and requests for media interviews.

3.0 Overview of Natural Resources

This section describes the natural resources that occur across properties stewarded by Great Parks. Threats to natural resources are mentioned briefly here. More detailed discussion of threats to natural resources at Great Parks is contained in **Appendix E**.

3.1 GEOLOGY AND SOILS

Hamilton County falls along some of the most important geological divisions in Ohio. One of the strongest drivers of Ohio vegetation is the glacial action of the Wisconsinan age. As these more recent glaciers retreated, they left rich "till" behind, the loamy, high-lime substrates that support much of Ohio's agricultural economy. The Southern Ohio Loamy Till Plain dips down just into the northern end of the county. Below it, glacial soils to the east are much older and more rugged. These steeper, less rich soils of the Illinoian Till Plain give way in the west to the Outer Bluegrass Region, which is characterized simply by the carbonate bedrock (Ordovincian limestone) rather than the deposits left behind by glaciers (ODGS 1998). Karst sink holes (areas where the underlying bedrock can be dissolved by water) are also scattered throughout the central part of the county. These geologic features correspond to ecoregions where the type, quality, and quantity of environmental resources are generally similar. In Hamilton County, the Northern Bluegrass Ecoregion of the Interior Plateau is at its

northernmost extent and meets the Eastern Corn Belt's Wisconsinan Drift Plains and High-lime till Plains.

Modern soils are strongly affected by the land use history. Wholesale clearing and logging reduced Ohio's forest cover to 10% in the late 19th century, and resulted in severe erosion in steep areas such as those of Hamilton County. This loss of soil is an issue that continues to affect the natural systems of GPHC, because natural forests only create about an inch of topsoil every 100 years. Once the forest was cleared, stabilization for the soil came in the form of agriculture, which strongly affects today's soils in terms of compaction and nutrient loads from fertilizer application, or through regrowth of forest cover.

3.2 Aquatic Resources

Wetlands and stream channels are complex ecological systems that are vitally important for clean drinking water and aquatic habitat. GPHC monitors and manages these systems for threats such as pollution, erosion and invasive plants through volunteer stream monitoring, Headwater Habitat Evaluation Index (HHEI) surveys, and dry weather outfall monitoring. Management includes removal of invasive plants like purple loosestrife (*Lythrum salicaria*), manipulation of water levels to increase habitat suitability, periodic mowing of cattails to encourage plant diversity, and the installation of green infrastructure.

In terms of land management and acquisition, GPHC strives to preserve riparian buffer zones along rivers and streams, where ephemeral off-channel wetlands are common. Buffers are particularly important for stream systems, where the effects of land development or agriculture can be compounded as water flows downstream. Runoff into streams drives the physical processes that shape the channel and drive biological processes. Unmanaged runoff can cause erosion and alter the function of these aquatic systems, which leads to reduced water quality and increased sedimentation of wetlands. Streambank stabilization and restoration of bottomland hardwood forests improves physical stability, an effect that adds valuable complexity to the food web and ultimately restores diversity in these habitat types. GPHC's management has improved water quality and habitat in the stream bank stabilization project along the Dry Fork Creek and through the wetland restoration and management of Shaker Trace Wetland, both at Miami Whitewater Forest. These efforts serve primarily to reduce the amount of sediment entering Dry Fork Creek while also adding plant diversity to improve habitat for birds and aquatic life.

The result is a corresponding increase in diversity that cascades through the food web which includes diversity of insects, waterfowl, mollusks, and fishes. This basis then provides habitat for predators such as bald eagles (*Haliaeetus leucocephalus*) and river otters (*Lontra canadensis*), which are increasing in numbers. Other management efforts in wetlands include manipulating water levels to mimic natural hydrologic cycles and occasionally mowing large swaths of cattails (*Typha* spp.) or reseeding to increase plant diversity.

3.2.1 Primary Headwaters and Buffers

Management Objective: Improve and protect headwater streams and priority habitat areas in order to preserve the biota of this niche habitat and the functioning of downstream systems.

GPHC's smallest streams are primary headwaters, which encompass the most upland tributaries in a watershed. Although the smallest, headwater streams often make up the majority of the stream length in a watershed. These streams tend to range in size from approximately 1.5 to 25 feet in width, and fall into the standard classification by hydrologists of first, second and third order streams, those at the tops of their watersheds. Headwater streams provide key ecosystem services to downstream water bodies including nutrient processing, sediment reduction, and flood control. And while they may not be perennial streams with year-round flow, many provide habitat for species that wouldn't necessarily be found in larger streams such as crayfish, salamanders and invertebrates.

Given the density and small size of headwater streams, these streams are particularly vulnerable to changes in land use and activities within the drainage area. Replacing native vegetation with developed land, including active recreation, can disrupt and fragment the forested stream buffer and alter the natural hydrology by increasing the volume and velocity of stormwater runoff coming to the streams. Changes in drainage patterns and land use often result in decreased water quality and a corresponding decline in benthic community health. These small streams may also be particularly vulnerable to increasing temperatures and changing precipitation patterns associated with climate change.

Ohio EPA classifies primary headwater streams in the state into three general types: ephemeral aquatic streams, small drainage warm water streams, and spring water streams. According to Ohio EPA, ephemeral streams occur where flow is temporary and in direct response to precipitation or snow melt. Otherwise, the channel in this type of stream is normally dry. Small drainage warm water streams occur where flow is primarily derived from surface runoff or, if perennial, derived from shallow groundwater such that the ambient stream temperature is warm in the summer. The thermal regime in this type of stream is more responsive to seasonal changes in ambient air temperatures. Spring water streams occur where flow is primarily derived from deeper groundwater and remains cool in the summer. The thermal regime of spring water streams is more resistant to seasonal changes in ambient air temperature (Ohio EPA, 2018).

Great Parks utilizes the Ohio EPA's Headwater Habitat Evaluation Index (HHEI) Level 1 Assessment to predict the biological potential of primary headwater streams and to classify each stream into one of the three types identified by Ohio EPA described above. There are approximately 1,000 primary headwater streams under Great Parks management.

Great Parks strives to maintain and/or restore an unfragmented forested buffer of 100 feet from primary headwater stream edges (100' both sides of stream) to filter runoff and provide detritus, shading and bank stability. Primary headwater streams should exhibit well-defined riffles and pools in sequence, heterogeneous substrate including boulders, bedrock and cobble, stream channel sinuosity, varied water depths and flow velocities, natural stream banks without abnormal bank erosion, and clean substrates with adequate interstitial spaces between individual pieces.

Ecological Targets

- Maintain and/or restore an unfragmented forested buffer of 100 feet from stream edges (100' both sides of stream) to filter runoff and provide detritus, shading and bank stability (**Figure 5**).
    - Wider buffers should be considered where possible.
    - Where honeysuckle control or other management severely reduces the vegetation cover near a stream, spicebush, *viburnum*, dogwood or other riparian species should be used to replace the lost plant cover.
- Minimal streambank erosion
- Control and treat stormwater runoff discharging to headwater streams
- Minimize or prevent development and intense recreational activities within the stream buffer (**Figures 5 and 6**)

Figure 5. Buffered Stream in Winton Woods (Source: Google Earth)

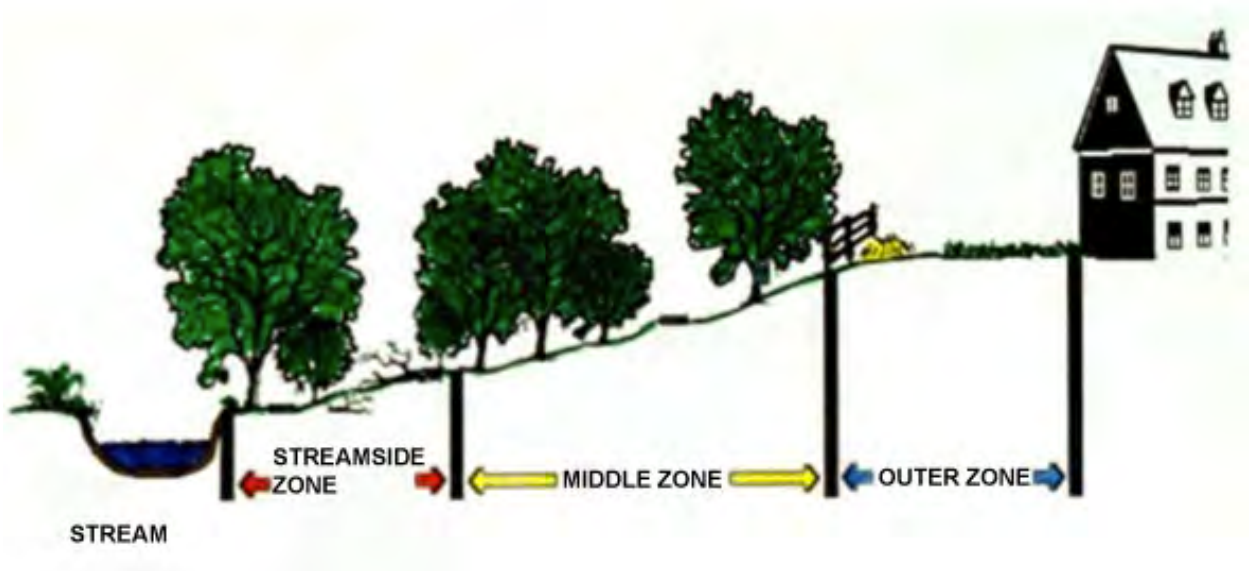

Figure 6. Buffer Management Zones (Source: Center for Watershed Protection)

Metrics and Milestones

- HHEI
- At least 75% of stream buffer (100' on either side of stream) is forested
- At least 75% of the stream buffer is connected, forested (unfragmented stream buffer)
- No mowing to the edge of streams or piling of wood and yard debris within buffers
- Less than 25% of the stream reach classified as severe to high streambank erosion
- Provide stormwater controls for 30% of uncontrolled stormwater outfalls

Management Activities and Prioritization

Where GPHC streams have wide, uninterrupted, forested buffers and are not receiving large quantities of warm, contaminated stormwater runoff, management might be minimal or limited to biannual monitoring. However, in many of the system's urban streams, stormwater runoff causes a cascading effect through the system, impairing habitat, damaging stream channels and infrastructure through erosion as well as deepening and disconnection from the floodplain, creating flood and safety hazards. This is exasperated by high-density and hilltop development. Stream management activities and prioritization items include those listed below.

1. Continue to map utilities and liabilities, including stormwater management facilities, along all stream corridors and nearby septic systems. Maintaining points of contact for notification in emergency, such as a crack in the sewer line or other source of pollution.
2. Identify stormwater outfalls that have no stormwater management control and find opportunities to detain and treat uncontrolled stormwater runoff (quantity and quality).
3. Maintain 100 foot buffer of native vegetation around stream corridor.
4. Revegetate with woody species, where necessary, to expand buffer width and reduce fragmentation of the stream buffer.
5. Prohibit development and intense recreational activities within the stream buffer.
6. Trails and passive recreational activities should be at least 25 feet away from the stream bank and avoid wetland impacts. Boardwalks may be an option to reduce the impacts within the stream buffer and wetlands.
7. Prohibit maintenance activities, such as mowing and disposal of waste (including lawn and landscape clippings) within the stream buffer.
8. Restore impaired streams, beginning with drainages that flow into otherwise resilient park land. Specific restoration techniques will vary by reach, but where possible eroded reaches should be restored using natural channel design techniques to reconnect streams to the floodplain and enhance aquatic and terrestrial habitat. Streambank armoring should be limited but may be warranted to protect exposed utilities (e.g., sanitary sewer line).

Potential Funding and Partnerships

GPHC should work with maintenance crews to limit activities within the stream buffer and protect and restore forested buffers where possible. Restoration and reforestation work may be funded through mitigation banking or fee-in-lieu programs. Projects such as stream

restoration may be best prioritized in the context of a watershed action plan developed with local partners.

3.2.2 Streams

Management Objective: Improve and protect stream habitat and stream flows to support native fish, macroinvertebrates, and insects.

This category describes the mid-sized streams of the system, which are neither large lowland rivers like the Ohio River, nor pristine forested headwaters. These streams tend to range in size from approximately 25 to 200 feet in width. These larger streams tend to have more variety of habitat niches and therefore support a greater diversity of aquatic life.

Similar to headwater streams, mid-sized streams are also susceptible to uncontrolled stormwater runoff. Development and intense recreational activities can increase the volume and velocity of stormwater runoff causing streambank erosion, loss of habitat, and poor water quality. Streambank erosion and channel alteration can prevent a stream from overflowing its streambanks and accessing the floodplain during storm events, where the floodplain provides important ecological functions such as slowing down and filtering stormwater runoff. Invasive terrestrial plants such as Amur honeysuckle *(Lonicera maackii)* may also threaten small streams. For instance, the leaf litter produced by Amur Honeysuckle may decrease a stream's dissolved oxygen content resulting in hypoxic conditions (Hayes et al., 2011). Removal of this plant has been shown to increase macroinvertebrate density and allow for greater functional richness in the stream (Cipollini 2006; Cipollini et al. 2009; McNeish et al. 2017; McEwan et. al. 2018). Additionally, a stream that is disconnected from the floodplain will also be disconnected from adjacent wetlands and potentially the water table. The loss of these functions can exacerbate flooding and water quality issues downstream as well as diminishing important wildlife habitat.

Great Parks monitors the health of selected streams utilizing the Pollution Tolerance Index (PTI), an index designed to score streams based on the diversity and composition of their benthic macroinvertebrate communities. Great Parks' volunteers assess streams annually from April through September. Great Parks is continuing to assess other indices, including QHEI, IBI, and MIWB, to set future benchmarks for streams.

Great Parks strives to maintain and/or restore an unfragmented forested buffer of 200 feet from stream edges (200' both sides of stream) to filter runoff and provide detritus, shading and bank stability. In order to maintain a diverse aquatic community, streams should exhibit well-defined riffles and pools in sequence, heterogeneous substrate including boulders, bedrock and cobble, stream channel sinuosity, varied water depths and flow velocities, natural stream banks without abnormal bank erosion, and clean substrates devoid of embeddedness and interstitial spaces between individual pieces.

Ecological Targets

- Aim for maintaining or restoring an unfragmented forested buffer of 200 feet from stream edge (200' both sides of stream) to filter runoff and provide detritus, shading and bank stability

- Maintain a diversity of in-stream habitat such as riffles, runs and pools and diverse aquatic community
- Minimal streambank erosion
- Streams can access floodplain during significant rain events
- Reduce pollutants associated with stream impairments such as suspended solids
- Control and treat stormwater runoff discharging to headwater streams

Metrics and Milestones

- The Qualitative Habitat Evaluation Index (QHEI) for stream habitat or other scores can offer a snapshot of the stream habitat quality or the integrity of macroinvertebrate (IBI), fish (MIWB), and invertebrate (ICI) populations. Increasing these scores for certain target streams is a long-term goal.
- Maintain good and excellent stream health ratings (IBI, MIWB, etc.)
- At least 75% of stream buffer (200' on either side of stream) is forested or vegetated
- Less than 75% of the stream reach classified as low stability according to the QHEI Channel Morphology metric
- Provide stormwater controls such sand seepage, step pools or raingardens for 30% of uncontrolled stormwater outfalls

Management Activities and Prioritization

Where GPHC streams have wide, uninterrupted, forested buffers and are not receiving large quantities of warm, contaminated stormwater runoff, management might be minimal or limited to biannual monitoring. However, in many of the system's hardworking urban streams, stormwater runoff causes a cascading effect through the system, impairing habitat, damaging infrastructure through erosion and downcutting and creating flood and safety hazards.

1. Continue to map utilities, including stormwater management facilities, along all stream corridors. Establish point of contact for notification in emergency, such as a crack in the sewer line.
2. Maintain 200 foot buffer of native vegetation around stream corridor.
3. Several stream rating indices are widely used, including ones for macroinvertebrate (IBI), fish (MIWB), invertebrates (ICI), and stream habitat (QHEI). GPHC can examine the utility of these indices and set some benchmarks according to their baseline values in the future. Selecting certain streams or incorporating such information and exploration in project design (e.g., as for before and after a bank stabilization) might be a way to initiate such an approach.
4. Restore streams with poor stream health ratings, beginning with drainages that flow into otherwise resilient park land. Specific restoration techniques will vary by reach, but where possible eroded reaches should be restored using natural channel design techniques to reconnect streams to the floodplain and enhance aquatic and terrestrial habitat. Streambank armoring should limited but may be warranted to protect exposed utilities (e.g., sanitary sewer line).
5. Identify opportunities to detain and treat uncontrolled stormwater runoff (quantity and quality).

6. Review park activities that may contribute to nutrients and bacteria, such as fertilizer application, dog parks and public bathroom facilities. Fertilizers should be used as directed on labels and should not be applied within 24 hours of forecasted rain, on hard surfaces where it could runoff or within 15 feet of water bodies. Dog parks should have adequate dog waste stations and disposal signage and be retrofitted with stormwater management facilities (e.g., bioretention) where possible to capture and treat runoff. Septic systems should be assessed, maintained and upgraded where necessary. Staff training should include how to identify and report sanitary sewer overflows or leaks.
7. Prohibit development and intense recreational activities within the stream buffer.

Potential Funding and Partnerships

GPHC should work with maintenance and construction crews to limit activities within the stream buffer and protect and restore vegetative buffers where possible. Restoration and reforestation work may be funded through the mitigation banking or in-lieu-fee programs. Projects such as stream restoration and reforestation may be best prioritized in the context of a watershed action plan developed with local partners.

3.2.3 Rivers and Riparian Corridors

Management Objective: Improve dynamic and resilient floodplain connectivity and native plant communities to support riparian health and diverse native plant, bird, and wildlife populations.

Rivers in this region are generally larger perennial water bodies flowing through a channel. They flow more slowly than the streams that feed them and connect smaller watersheds to their eventual outflow at the Gulf of Mexico. A river corridor's width also varies greatly but includes the adjacent floodplain of a river. At this scale, large river systems provide aquatic habitat, drinking water, fishing, and recreational activities. River dimensions can vary greatly, but they are approximately 200 feet or greater. A river corridor's width also varies greatly and includes the adjacent floodplain. Large river systems can provide aquatic habitat, drinking water, fishing, and recreational activities.

River health is in part dictated by the health and condition of the upstream tributaries, feeder streams, and associated drainage areas. Uncontrolled runoff and development increase the amount of water and pollutants draining into rivers. Dams, which can provide useful services such as flood control, energy, water supply and recreation, can also prevent fish migration, degrade river habitat and water quality and increase downstream water temperatures. Lastly, another potential threat to rivers are invasive species such as common carp, or zebra mussels, which outcompete their natural counterparts, restricting other species' ability to flourish and reducing biodiversity.

The U.S. Geological Survey developed a hierarchical system of hydrologic units and assigned each unit a Hydrologic Unit Code (HUC). Five 8-digit HUC watersheds extend into Hamilton County. These five watersheds include the Lower Great Miami River, Middle Ohio-Laughery (of which the Mill Creek and Southern Ohio River Tributary watersheds are part), Little Miami

River, Whitewater River and the Ohio Brush-White Oak watersheds (of which the Southern Ohio Tributary watersheds are part) (Figure 7).

Section 303(d) of the Clean Water Act requires states to provide a list of impaired waters to the US EPA. The primary purpose of the 303(d) list is to identify impairments for which a total maximum daily load (TMDL) study is needed. The TMDL study will identify the maximum amount of pollutant that a waterbody can receive and still meet water quality standards. Waters within Hamilton County have been identified as impaired and are included on the Section 303(d) list. These impairments include the following:

- The Great Miami River is impaired for aquatic life, recreational use and fish tissue. A Total Maximum Daily Load (TMDL) document is underway to address the pollutant loads contributing to these impairments.
- The Mill Creek is impaired for aquatic life, recreational use, and fish tissue. While an established TMDL addresses load reductions for nutrients, it also acknowledges that in order to remove impairments, further TMDLs are needed identify load reductions for additional pollutants.
- The Little Miami River includes aquatic life and recreational use impairments. A TMDL document was prepared and identifies load reductions for the following pollutants: E. coli, total phosphorus, chemical oxygen demand, total suspended solids, and sedimentation.
- The Whitewater River is impaired for aquatic life, recreational use and fish tissue. A TMDL is underway to address the pollutant loads contributing to these impairments.
- Ohio River Tributaries (Southern) is impaired for aquatic life and recreational use. A TMDL document is underway to address the pollutant loads contributing to these impairments.

Likely causes of impairments are sediments and urban pollutants carried by stormwater runoff as well as stream channelization and disconnection from the floodplain. Great Parks strives to maintain and/or restore an unfragmented forested buffer of 300 feet from river edges (300' both sides of river) to filter runoff and provide detritus, shading and bank stability.

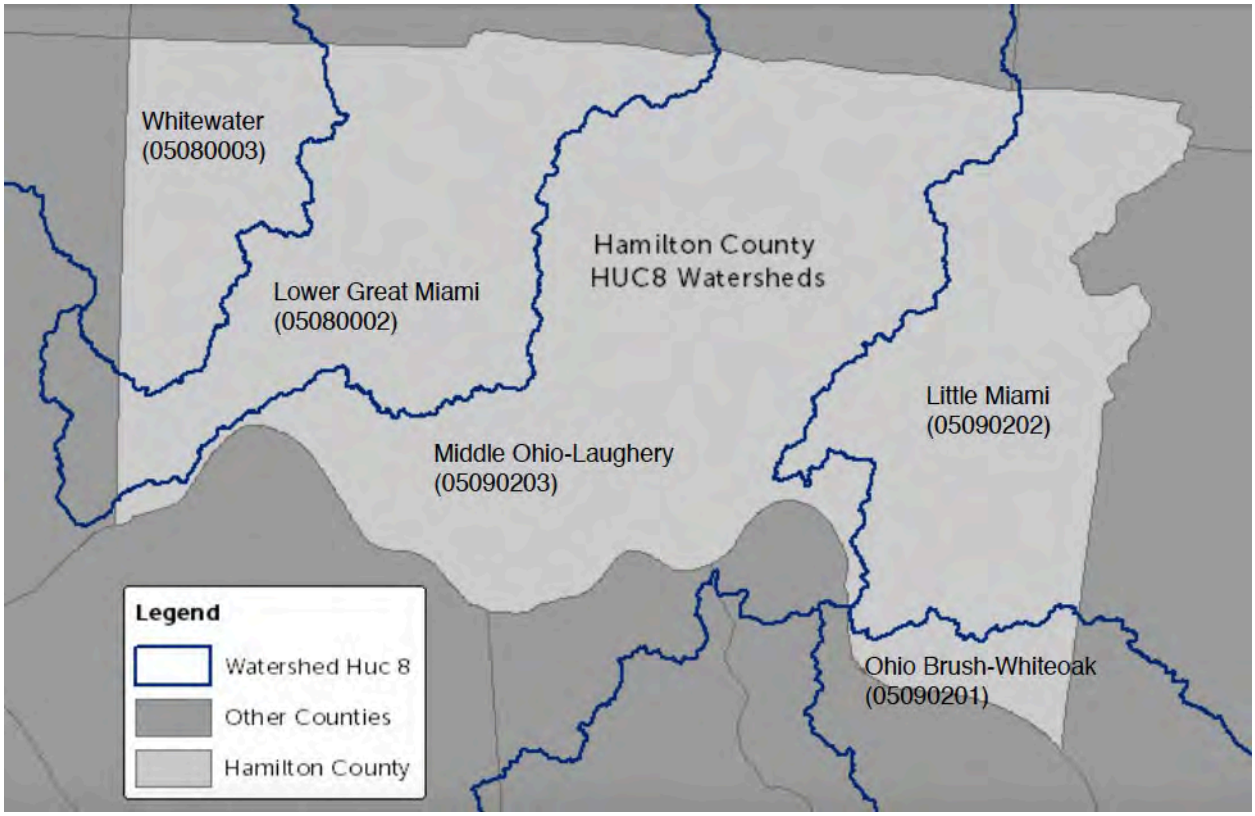

Figure 7. The Five Watersheds in Hamilton County

Ecological Targets

- Maintain and/or restore an undisturbed vegetated buffer of 300 feet from river's edge (300' both sides) in order to promote wildlife habitat, provide flood attenuation and filter runoff
- Maintain a diversity of in-stream habitat and diverse aquatic community
- Minimal streambank erosion
- Rivers are able to access floodplain during significant rain events
- Control and treat stormwater runoff discharging to headwater streams

Management Activities and Prioritization

Where rivers adjacent to GPHC ownership have access to the floodplain, have wide, uninterrupted, forested buffers and are not receiving large quantities of warm, contaminated stormwater runoff, management might be minimal or limited to biannual monitoring. However, there are areas where a more proactive and aggressive management strategy is needed to improve river conditions.

1. Maintain 300 foot undisturbed buffer from river edge (both sides).
2. Restore rivers with poor stream health ratings, beginning with drainages that flow into otherwise resilient park land. Specific restoration techniques will vary by reach, but where possible eroded reaches should be restored using natural channel design techniques to reconnect streams to the floodplain and enhance aquatic and terrestrial

habitat. Streambank armoring should limited but may be warranted to protect exposed utilities (e.g. sanitary sewer line).

3. Review park activities that may contribute to nutrients and bacteria, such as fertilizer application, dog parks and public bathroom facilities. Actions include:
    a. Fertilizers should not be applied within 24 hours of forecasted rain, on hard surfaces where it could runoff, or within 15 feet of water bodies.
    b. Dog parks should have adequate dog waste stations and disposal signage and be retrofitted with stormwater management facilities (e.g., bioretention), where possible to capture and treat runoff.
    c. Septic systems should be assessed, maintained and upgraded where necessary.
    d. Illicit discharges detected and eliminated: Staff training should include how to identify and report any sanitary sewer overflows or leaks.
4. Prohibit development and intense recreational activities within the stream buffer.
5. Look for land acquisition opportunities to provide buffer continuity along river corridors.
6. Control riparian invasive species within the river corridor.
7. Control invasive fish species. GPHC should provide incentives to increase their harvest via recreational fishing. This could be accompanied by reintroduction of native aquatic species as appropriate.

Potential Funding and Partnerships

GPHC should work with staff to identify and remove invasive species. Restoration and reforestation work may be funded through mitigation banking or fee-in-lieu programs. Projects such as stream restoration may be best prioritized in the context of a watershed action plan developed with local partners.

3.2.4 Wetlands

Management Objective: Prevent further loss of wetlands and restore habitat for amphibians and other life dependent on wetlands.

The National Wetlands Inventory (NWI) identifies 134 acres of emergent wetlands and 338 acres of forested and shrub wetlands within GPHC boundaries. This makes up approximately 40% of the emergent and 50% of the forested and shrub wetlands identified within Hamilton County. In addition, wetland delineation surveys have identified an additional 302 acres of wetlands within the parks, bringing the total managed by Great Parks up to 640 acres. GPHC manages almost 40% acres of wetland in Hamilton County as well as almost half of the county's 844 acres of forested and shrub wetlands (excluding rivers, ponds and lakes).

Wetlands are found at the transitional areas between the upland and aquatic ecosystems where the water table is at or near the surface or the land is covered by shallow water. Wetlands are among the most productive ecosystems in the world and provide numerous benefits including flood storage, wildlife habitat, and improved water quality. The latter benefit is why they are often referred to as the kidneys of the landscape.

The significant majority of wetlands and vernal pools have been lost due to development and agricultural activities that have filled in and drained wetlands. Additionally, as a side effect of development and agricultural activities, streams erode and become incised, disconnecting floodplain wetlands. Uncontrolled runoff can further degrade wetlands and vernal pools by contributing pollutants such as nutrients, sediments, and bacteria. Wetlands and vernal pools may also be particularly vulnerable to increasing temperatures and changing precipitation patterns associated with climate change.

Historic Wetlands

The historic extent of wetlands across Ohio are difficult to determine but estimates have calculated approximately 90% of the wetlands in the state were lost between the 1780's and 1980's (Dahl et al 1990). The percentage of surface area of Ohio covered by wetlands around 1780 would have been approximately 19% compared to about 1.8% remaining in 1980. While this statewide percentage likely does not apply equally to all counties, it tells a story of wetland loss from which Hamilton County is not exempt. Modern National Wetland Inventory Maps estimate the total acres of emergent and forested wetlands remaining within Hamilton County to be approximately 1,182 acres, or 0.4% of county acreage. Nearly half of those wetland acres can be found within GPHC boundaries. However, these wetlands make up only about 0.3% of GPHC property, a far cry from the state's historic proportion of 19%. This underscores how critical GPHC's commitment to wetland preservation and restoration is for future generations; especially as further development of land continues in the county.

Ecological Targets

- Protect existing wetlands and vernal pools
- Expand and continue wetland restoration efforts
- Incorporate floodplain wetland restoration/enhancement into stream restoration efforts
- Manage wetlands and vernal pools to reduce invasive species

Metrics and Milestones

- Increase wetland acreage as much as possible where conditions allow
    - Use hydric soils and current cover type to ID restoration potential
    - Locate drainage tiles that need to be broken
- Reduce invasive plant species
- Protect vernal pools and wetlands with 200 foot buffer

Management Activities and Prioritization

Often GPHC wetlands and vernal pools require monitoring of invasive plants, disturbance to keep aggressive native plants at bay and occasional debris removal.

1. Maintain an inventory of vernal pools and wetlands.
2. Maintain 200 foot undisturbed, natural buffer around the edge of wetlands and vernal pools.
3. Prohibit development and vehicular traffic in vernal pool and wetland areas.
4. Manage and monitor invasive species in wetlands and vernal pools. Invasive plant species removal from vernal pools should only be conducted when the pool basin is

dry using manual methods. Control purple loosetrife, invasive grasses and cattails within wetlands. Cattails may be mowed while other invasive species should be removed using manual or mechanical control on an annual basis.

5. Vernal pools should not be disturbed. Leaves, branches and naturally fallen logs should be left undisturbed as they provide food and habitat for vernal pool aquatic life.
6. Create and restore wetlands and vernal pools. Prioritize restoration in areas that will create habitat for species of concern and create wetlands where supporting conditions exist.
7. Integrate wetland restoration into stream restoration projects.

Potential Funding and Partnerships

GPHC should work with staff to identify and remove invasive species and limit activities within the wetlands, vernal pools, and associated buffers. Restoration work may be funded through a Consent Decree compliance budget, mitigation banking or fee-in-lieu programs. Projects, such as wetland restoration, may be best prioritized in the context of a watershed action plan developed with local partners.

3.2.5 Lakes and Ponds

Management Objective: Diversify vegetation and habitats while also addressing specific water quality challenges in high use locations where fishing or other activities occur.

Both lakes and ponds are slow-moving or standing bodies of water with varying depths, and most of them in this region are human-made rather than natural systems. Lakes, and their smaller counterpart, ponds, provide numerous habitat and recreation opportunities through the Great Parks system. Waterfowl, turtles, fish and mammals like the North American beaver (*Castor canadensis*) and muskrats (*Ondatra zibethicus*) *can* be found in lakes and ponds. Some research indicates that ponds are also a good carbon sink that may help address climate change (Taylor et al., 2019).

The biggest threat to lakes and ponds at GPHC is uncontrolled runoff and sediment from nearby developed urban areas, sewer overflows, and agricultural activities. Nutrient inputs from runoff and wildlife populations, such as geese, can degrade water quality and have additional side-effects such as increased algae growth. Algae and duckweed do not necessarily pose an ecological threat, though the public might require education on this topic. Harmful algae blooms (HABs) can also occur as a result of excess nutrients, producing toxins that can cause illness in humans and animals under certain exposure. GPHC has a HAB plan and has informational signs near lakes and ponds to inform the public of these water quality issues. Additional water quality impacts include sedimentation from streambank erosion and surrounding land uses filling in the basin of the water body, as well as establishment of invasive species that reduce habitat diversity.

Great Parks manages three manmade reservoirs: Winton Lake, Miami Whitewater Forest Lake, and Sharon Lake. Great Parks also manages several quarry lakes including Lake Isabella and several others along the Whitewater River, including Campbell Lakes. Several GPHC lakes are monitored annually by volunteers for pollution, algal blooms and transparency. Fish

Western Mixed Mesophytic Forests	Light Green
Beech Forest	Blue
Mixed Oak Forest	Yellow
Bottomland Hardwood Forests	Dark Green
Forested Wetlands	Purple

community surveys are conducted on the larger lakes on a 5-year cycle. Many of the lakes and ponds in Hamilton County were created for flood control or recreation. Because their hydrological systems have been constructed and do not behave as natural systems, they cannot be managed as natural systems.

3.3 VEGETATION

There are two original records of forest types and land cover before Europeans arrived, both derived from foresters' assessments (Braun 1950, Gordon 1980). According to the widely used map created by Gordon (1966), the 18th century forests of Hamilton County were broadly divided into four vegetation types (**Figure 8**). Western Mixed Mesophytic Forests were the dominant forest type, with throughways of beech (*Fagus* spp.*)* forest and a small patch of mixed oak (*Quercus* spp.) forest to the southeast of Cincinnati. Bottomland hardwood forests appeared along the major rivers, and other forested wetlands occurred in two small patches of elm (*Ulmus* spp.*)*-ash (*Fraxinus* spp.) swamp forest. Western Mixed Mesophytic forests offer rich resources for wildlife, and though they are characterized by little endemism, they have strikingly high overall diversity; the variability is at such a fine scale that many species are represented at a low density across the landscape. In general, Beech and beech-maple (*Acer* spp.) forests tend to occur on the better-drained Wisconsinan till. Mixed Mesophytic is not a particularly informative vegetation type, but it underscores the local diversity of the forest that made it difficult for early foresters to describe with greater precision.

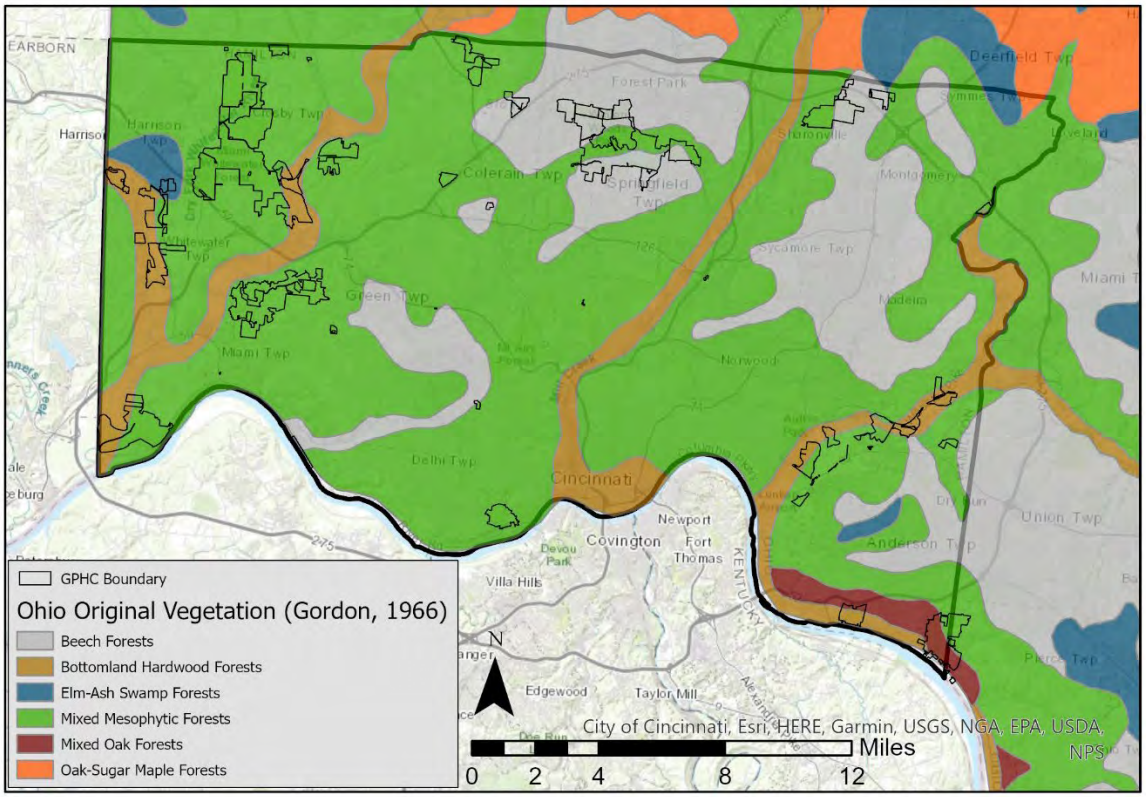

Figure 8. Approximation of historic vegetation of Hamilton County around the 15th century. OH GS 1998.

These features persist today and explain some of the forest distribution throughout the GPHC system. Stream dissection that created steep-sided valleys results in drier, cooler ridges and slopes that are prone to erosion. Because those steep slopes also make the land unsuitable for farming, a disproportionate amount of this habitat type and the regions older forests are preserved in GPHC parks and preserves. An analysis that uses the landmark trees from early land surveys to examine species composition, suggests that modern Ohio forests have weaker spatial structure and are more homogenous across the state than historic ones, and that modern forest composition is driven primarily by land use (Deines et al, 2016).

The types of vegetation present on lands within GPHC have been categorized during FQAI surveys and are updated by NR (see GOAL 1). NR is responsible for reporting on the agency's commitment to maintaining Great Parks as 80% natural area, as discussed in Section 1.0.

Climate is changing and is impacting forests in many ways. Strategies to maintain healthy and productive forests are needed given the continued accelerated change. Anticipating how plants and wildlife may respond to climate change will help GPHC manage healthy forest ecosystems. An important consideration is collaboration in research and management partnerships.

Forests

Because of Hamilton County's diverse topography, geology and glaciation history, much of the forested lands within the GPHC system fall into a broad category of mixed forest, where small-scale variation in soil characteristics, moisture, and slope create pockets characterized by dominant species that may be less common just a few hundred yards away. Previous ecologists (Braun 1950) have labeled large areas to be "Mixed Mesophytic" forest, which can characterize a diverse landscape with local pockets of more uniform species assemblages (Bryant 1987). For planning and management purposes, we describe most of the forests managed by GPHC in this category, including early successional forests.

Because mixed forest types comprise so much of GPHC land, the relevant threats include many factors, such as fragmentation, invasive species, and climate change. Threats that are most likely to trigger GPHC management actions include invasive plant species spread and establishment, white-tailed deer population increases which inhibit young forest regeneration, and overcrowding in early successional vegetation types.

3.3.1 Oak Hickory & Oak Maple Forest

Management Objective: Intensive focus to prioritize oak/hardwood recruitment and regeneration alongside structural diversity.

Oak-Hickory (*Carya* spp.) and Oak-Maple forests are currently found at the lower end of the moisture gradient on exposed hillsides with steeper slopes, though the disturbance history plays a strong role in their current distribution (Bryant and Held 2004). Oak and hickory shape the dynamics of the forest around them. They are shade-intolerant keystone species that require disturbance or management to persist (Spetich 2004) and compete with shade-

tolerant mesophytic hardwoods. Among native trees, most of the region's oak forests are fire-dependent and perhaps foremost in wildlife and habitat values. Oak ranks first in the ability to support native butterfly and moth (*Lepidoptera*) species (Tallamy and Shropshire 2009). Their leaves, by supporting these insects and caterpillars, are the foundation of a wide web of resources in mature oak forest, and acorn crops represent huge amounts of biomass that is readily converted into forage for animals.

Succession into stands of maple is a serious threat to these forest types. Where forested areas are too densely populated by woody vegetation (trees and shrubs), shading greatly reduces recruitment. Additionally, high densities of deer put a large amount of browsing pressure on young forests, posing challenges to forest regeneration and diversity (Nuttle et al. 2013). In central Illinois, oak forests managed by Native Americans are estimated to have had low densities of only about 65 trees/hectare (Anderson and Anderson 1975). Sunlight in undisturbed oak stands is often < 5%of full sunlight, so mid-story canopies dominated by shade-tolerant species develop and prevent recruitment of oak seedlings. The combined threats of browse pressure from deer and lack of disturbances (e.g., fire) pose a threat to oak and hickory forest regeneration in southwest Ohio. The species that comprise these forest types do not readily establish even in canopy gaps and open areas where sunlight is sufficient. Deer browse impact surveys within the park have demonstrated this (GPHC 2017). Additional threats to oak-hickory and oak-maple forests include invasive trees, shrubs, and vines, as well as pests, disease and uprooting which may be associated with changes in precipitation patterns.

Ecological Targets for Oak Hickory & Oak Maple Forest

- Control of invasives
- Attention to pathogens and disease
- Seedling recruitment levels at sustainable levels

Metrics and Milestones

- As of this writing, GPHC uses FQAI data to quantify forest system health
- Quantify forest regeneration through age class analysis

Management Activities and Prioritization

- Priority sites include Bowles Woods and Oak Glen Nature Preserve, both classified as oak hickory (red) and oak sugar maple (orange) seen in Figure 9.
- Prescribed burn management, deer control, invasive species control, enhancement seeding and planting, and restoration monitoring via vegetation inventories and management plan summaries.

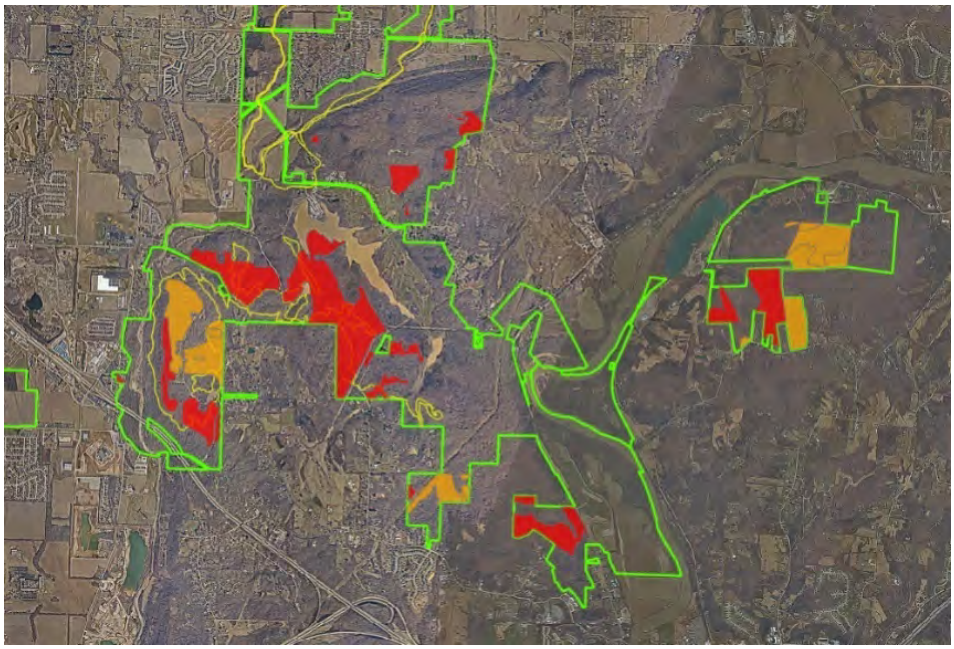

Figure 9. Oak hickory (red) and oak sugar maple (orange) forests of Miami Whitewater Forest and Oak Glen

3.3.2 Beech-Maple Forest

Management Objectives: Maintain and monitor important stands of beech-maple forest.

This upland forest community of Hamilton County's rolling flats and terraces is part of a larger forest region whose southern boundary follows the southern limit of Wisconsin drift, along which it frequently connects with (Western) Mesophytic Forest. It is characterized by a canopy typically dominated by beech trees and an understory dominated by sugar maple. This forest has a denser canopy of deciduous trees and an absent-to-sparse shrub layer. It is typically found on flat to rolling uplands to steep slopes with rich loam soils over glacial till. Tulip poplars (*Liriodendron tulipifera*) are also often common in the canopy of this community (Braun 1950).

The forest also has thick leaf litter providing habitat for several small mammals and salamanders. This forest type supplies beech nuts, which serve as forage for a wide range of wildlife. Cavities found in beech trees offer dens for mammals, such as squirrels and raccoons (*Procyon lotor*). Numerous bird species can be found in these forests - especially in tracts of 100 acres or more – including wood thrush (*Hylocichla mustelina*), pileated woodpecker (*Dryocopus pileatus*) and scarlet tanagers (*Piranga olivacea)*.

Significant areas of Hamilton County are listed as beech-maple forests in the original vegetation map of Ohio. The LandFire models of "potential vegetation" and "biophysical settings" indicate that large portions of GPHC land was or has the potential to be beech-maple forest, however current conditions pose challenges to this forest's current and future extent (LandFire 2020). In fragmented landscapes with high deer populations, beech-maple forests have a tendency to shift species composition in favor of fast-growing species. In nearby Hueston Woods, Beech is slowly declining in canopy dominance (Runkle 2013). The

lack of remnant beech forests to act as seed sources, their slow growth rate and predicted climate shifts to hotter and dryer conditions may not support beech-maple forest into the future without management.

Ecological Targets for Beech-Maple Forest

- GPHC seeks to maintain our current extent of beech-maple forest and manage important stands to maintain their species composition and structural diversity.

Metrics and Milestones

- The metric to quantify forest system health is generally FQAI
- Monitoring annual ingrowth and mortality, which averages <1% to 3% in old-growth forests may help pinpoint vulnerabilities.

Management Activities and Prioritization

- General management strategies include encouraging recruitment of beech, since it is very slow-growing.
- Fencing seedlings where practical

3.3.3 Floodplain Forest

Management Objective: Recognize inherent dynamism of this forest system type and support regeneration and recovery from disturbance.

Floodplain forests are found in wet soils near waterways. Dominated by black willow (*Salix nigra*), cottonwood (*Populus* spp.) and green ash (*Fraxinus pennsylvanica*), or by pin oak (*Quercus palustris*) and red maple (*Acer rubrum*) in depressions, these forests are among those most likely to have been destroyed or seriously disturbed by changes to hydrology such as drainage for agricultural purposes. In the face of hydrological alterations, the dynamics that support a diverse floodplain forest may be compromised. Intact floodplain forests provide important habitat for migrating Neotropical birds (Knutson et al 1996).Because they are an edge habitat that is regularly disturbed, floodplain forests are particularly susceptible to invasion by non-native plants. Floods present a regular source of invasive seeds.

Ecological Targets for Floodplain Forest

- Increase the resilience of native floodplain forest to invasive species following flood events.
- Reconnect floodplain habitats to the channel level as possible.

Metrics and Milestones

- The metric to quantify forest system health is generally FQAI.
- Seedling recruitment provides an important indicator of future forest composition

Management Activities and Prioritization

- Monitor frequently for new invasives arriving during flood events
- Identify canopy gaps and whether regeneration is occurring

- Large, contiguous tracts of floodplain and upland forests should be maintained where they exist and restored in other locations.

3.3.4 Urban Forest

Management Objective: Urban Forests should provide a safe environment for people to congregate and enjoy the benefit of trees. Urban Forests should also function such that they provide ecosystem services that allow for improved quality of life in our community.

Urban forests are generally comprised of mixed Mesophytic species, but their land use history often leads to more unusual assemblages of species which often include non-native trees & shrubs. Urban forest tracts at Great Parks provide an immediate benefit to guests and residents of the county. Although these forests may not be native assemblages, they provide important ecosystem services, such as mitigating urban heat islands, trapping particulate pollution, protecting water quality, and reducing flood risk. These services are key to our understanding of the value of the urban forest. Urban forests also provide some wildlife value through the provision of food and cover.

Trees provide numerous benefits even outside of forests, which is why GPHC focuses on protecting existing trees and planting new ones in order to maintain a healthy urban forest with diverse species and ages. Activities include regular pruning, applying treatments to support tree health, and planning tree plantings. In addition, GPHC's arbor team advises on projects to prevent impacts to trees and conducts tree risk assessment and removal of hazard trees in recreational and operational areas. GPHC follows arboriculture industry standards in its tree risk management program with a written tree risk management plan, specialized training for all tree inspectors, systematic inspections of park trees, and appropriate risk management action and tree care (ISA 2017).

Urban forests endure regular stress due to their proximity to development. Threats include soil compaction of the root zone due to construction and maintenance, trunk damage from mowers and vehicles, improper pruning from maintenance of utilities, reduced access to moisture from surrounding pavement, improper mulching, and disease.

Ecological Targets for Urban Forest

- Maintain existing forest species diversity and structural diversity. Include no more than 30% of any family, 20% of any genus or 10% of any species in a given area.
- Maintain at least 45% canopy cover in developed areas of the parks
- Preserve old and large trees such that the age distribution of the urban forest is statistically normal
- Replace invasive tree species with species that will not pose a threat to surrounding natural areas.

Metrics and Milestones

- Trees along boundaries and within developed areas are assessed using the ISA's tree risk assessment program.

Management Activities and Prioritization

- Conduct an Urban Tree Canopy assessment and create a 5 or 10-year planting plan
- Monitor hazard trees annually and Legacy trees regularly for risk and health condition respectively
- Follow guidelines in Tree Risk Management Plan
- Develop a regular pruning cycle which would include overlooks
- Support tree health with preventative measures
- Develop guidelines for mitigation and tree protect trees and root zones mitigation during construction, projects and maintenance
- Establish best practices for tree planting, care and maintenance
- Develop maintenance agreements with utility companies that ensure proper pruning and protection practices for trees within easements
- Increase no/low-mow areas to include trees where possible to reduce soil compaction, trunk damage and herbicide damage, otherwise mulch if possible

Potential Funding and Partnerships

- Local municipalities, utilities and non-profits, extension agents, and state agencies

3.3.5 Mixed Forest

Management Objective: Preserve or enhance the diversity of the existing forest in term of species assemblage, age classes, and vertical structure (e.g., groundcover and understory).

Because of Hamilton County's diverse topography and geologic/glaciation history, much of the forested lands within the parks system falls into a broad category of mixed forest, where small-scale variation in soil characteristics, moisture, and slope create pockets characterized by dominant species that may be less common just a few hundred yards away. Previous foresters have labeled large areas to be "Mixed Mesophytic" forest, which can characterize a diverse landscape with local pockets of more uniform species assemblages (Bryant 1987). For planning and management purposes, we describe most of the forests managed by GPHC in this category, including early successional forests.

This forest type covers much of GPHC land. Therefore, threats to this forest type include many factors, including fragmentation, invasive species, and climate change. GPHC management actions are typically triggered by invasive plant species spread, high deer populations that inhibit seedling recruitment, and overcrowding in early successional habitats.

Ecological Targets for Mixed Forest

- Track FQAI values within stands
- Quantify forest regeneration through age class analysis
- Measure light penetration in regenerating forest

Metrics and Milestones

- Maintain forests such that there is a diversity of species and stand age with trees like basswood as an indicator, and no species comprising more than 25% of the total

Management Activities and Prioritization

- Minimize additional stress via soil compaction and disturbance
- Management of invasive species such as honeysuckle to reduce competition with native plants that are more beneficial to wildlife.
- Reforestation opportunities
    - Take advantage of reforestation opportunities in canopy gaps where light is available. Undertake supplemental interior planting to increase diversity and jumpstart understory development by installing plants that have grown above the browse height of white-tailed deer or protecting them with fencing.
    - Use care with soil in planting pits during reforestation to facilitate establishment of native vegetation.
    - Deer exclusion and management to allow natural regeneration to occur and support greater forest structure and diversity in age classes.
- Thinning – the removal of trees that provide little habitat value or that are overabundant in a given species or age class within a stand to further promote diversity. OH DNR provides guidance on timber management for wildlife benefits (OH DNR 2016).
- Supplemental edge planting to provide transitional habitat that supports increased wildlife diversity while improving the quality of forest interior. This is particularly important in the wake of invasive species control.

Openlands

3.3.6 Prairie

Management Objectives: Prairie within GPHC should consist of native and rare prairie plants, support a diverse assemblage of pollinators and wildlife, and build soil carbon and soil biota.

Prairie is a temperate ecosystem found in relatively flat areas with moderate rainfall and is composed of grasses, forbs and shrubs with few, if any, trees. Conditions can include extremes in temperature and moisture such as drought and frigid winds. In general, prairies thrive in areas too arid to support forests, yet with too much precipitation to be a desert. Prairies, while not strongly represented in historical records of Hamilton County, are able to exist here due to regular disturbance. Historic disturbance regimes of prairies would have included grazing by large herds of bison or fire. It is believed that prairies were regularly burned for maintenance and hunting by Native Americans. The importance and rarity of prairie is not be understated. A very small fraction of the 400,000 square miles of historic North American prairie remains. Only 5% of Ohio was originally in prairie, and of that, only 1% remains so; the rest has been converted to agriculture, development, or become woodland due to fire suppression.

Prairies have intrinsic value. Prairies can serve as important habitat for pollinators and certain species of birds. Grasslands seem to be particularly important in light of climate change because they are resilient in the face of rising temperatures, drought, and fire, and they sequester carbon into the soil through their roots, creating belowground sinks that help prevent it from reentering the atmosphere (Dass et al, 2018). Since they are a system adapted

to disturbance and drought, prairie plants have large amounts of belowground biomass, and therefore serve to enrich soil, reduce compaction, and restore soil biota.

The key decision for our land management is how much of this important system to maintain. There are some clear benefits provided by the resource, but maintenance cost and ecological integrity are important considerations. Because prairies in Hamilton County are fire-dependent, their ideal management involves repeated burning (Bowles and Jones 2013); fire frequency return intervals at Great Parks is typically 3-5 years for prairie.

Prairies were not common historically in Hamilton County. They do not appear on the earliest vegetation maps, which were used to assess forest resources and therefore focus on trees (**Figure 8**). However, the original land surveyors of the Symmes Purchase[2], which included most of Hamilton County, report encountering at least one prairie (Bryant 1987). Additional areas had likely been maintained in prairie by Native Americans who used fire as a landscape management technique. While the majority of prairies in Ohio are found farther north in the state, there were likely pockets of open areas that functioned as prairies.

Threats to this ecosystem are lack of diversity and GPHC's ability to manage prairies with prescribed fire due to increases in development around the parks and concerns about smoke. Fire management requires specific weather conditions, and the window to carry out prescribed burns varies each year. Even in years with favorable weather conditions, the window can be too short to burn each prairie that requires it. Other threats to this habitat type are forest succession, pollinator declines, invasive plants, and soil erosion. GPHC is utilizing alternative methods of management as needed and providing seed to other conservation agencies engaging in prairie restoration through production efforts at Shaker Trace Nursery.

Prairies and certain types of forest are fire-adapted ecosystems which thrive with regular disturbance. Without fire or other management, prairie quickly transitions to shrubland and early successional forest, then eventually mature forest. In order to sustain habitat for species that require large open areas, GPHC conducts prescribed fires on each prairie approximately every three years in compliance with the guidelines set forth by the Ohio Division of Forestry, the Ohio EPA, and Ohio Prescribed Fire Managers who have that certification on staff. The prairies at Miami Whitewater Forest have been managed with prescribed fire for multiple decades and continue to support dozens of fire-adapted plant species.

Prairie should be maintained using multiple methods including prescribed fire, mowing, selective spraying, or grazing when possible. Locations of rare plant species should be increased within prairies to buffer the effects of climate change and development.

Ecological Targets for Prairie

- Prairie should represent rare plant communities and meet habitat requirements for species of concern like grassland birds.

[2] https://recordersoffice.hamilton-co.org/about_the_recorder/history_of_our_land.html

- Large, contiguous blocks of prairie should be created and maintained, as opposed to smaller parcels. This allows for habitat for area-sensitive species while maximizing the acres of prairie habitat that can be maintained
- Belowground carbon accumulation begins to slow around 7-10 years after prairie restoration (Hungate et al 2017), at which point succession into shrubland, then mature forest may be beneficial for wildlife habitat (especially birds) and young forest regeneration goals.
- Prairie habitat should be prioritized where wet prairie is possible to restore
- Although GPHC strives to establish and maintain larger tracts of prairie for ecosystem goals and management efficiency, small pollinator lots should be established when feasible. These help enhance public awareness and understanding of the ecosystem type and can be maintained without fire. An example of such a prairie is present at Farbach-Warner Nature Preserve, which is regularly featured in interpretive activities.

Metrics and Milestones

For optimal prairie restoration outcomes, benchmarked metrics such as Floristic Quality Index are the right starting place, but a full picture of ecological function can help document additional benefits of the system (Hansen and Gibson 2013). Additional indicators such as royal catchfly, soil characteristics, arthropod abundance and diversity, small mammal or bird richness can help tell managers how well the prairie is meeting its ecological targets. The structure of the prairie is also a consideration with examples being the percent cover of desired plants or proportion of woody plants warm-season grasses and forbs.

Management Activities and Prioritization

GPHC staff has been actively managing all prairie landscapes for several decades, since the oldest prairies were planted after the spring of 1992. In general, management activities include: disturbance at regular intervals, such as prescribed fire approximately every three years; invasive species control; woody plant removal; enhancement seeding or planting; and monitoring. With regard to establishing new tracts of prairie, initial clearing and seeding is followed by control of weeds and invasive species.

Potential Funding and Partnerships

The Eastern Tallgrass Prairie Landscape Conservation Cooperative is a clearing house for resources on management. Working with organizations like the Ohio Prescribed Fire Council, The Nature Conservancy and other conservation organizations to share resources during the burn season will increase effectiveness. Similarly, sponsorship of prairies that covers management and monitoring costs should be pursued.

3.3.7 Meadow

Management Objective: Maintain as a transitional zone between developed areas and forest or other natural areas, as habitat for wildlife such as small mammals and grassland nesting birds.

Meadow is typically dominated by cool-season grasses that are maintained in an herbaceous state through mowing every 1-3 years, though meadows vary in composition and wildlife

value according to hydrology. Often, meadows at Great Parks are transitional zones where mowing has been reduced or where right-of-way areas associated with infrastructure are present (e.g., underground gas pipelines and aboveground utility corridors). Upslope areas contain a mix of more drought-tolerant species, whereas lower areas and depressions contain species that require or tolerate more soil moisture. In an urban environment, some meadows are also managed for stormwater and drainage systems with many located along rights-of-way or around ponds. Although the forage quality is lower than native plant prairies, meadows provide cover and opportunities for grassland birds and animals to forage.

Threats to this system include mowing that disrupts ground nesting birds and decreases the diversity and abundance of high-quality forage plants that reproduce from seed. Other threats include succession into woodland if mowing is lacking. Properly timed mowing, spot treating with herbicides, or other management methods can discourage non-native invasive species that may outcompete native species.

Ecological Targets for Meadows

At the highest level of function, meadows should provide good forage, protect seepage wetlands, and offer adequate cover for nesting birds or hunting grounds for raptors. Target species such as monarch butterflies, eastern meadowlark and the common yellowthroat should be present.

Metrics and Milestones

Typical meadow plants are introduced species of grass. Therefore, the presence of target wildlife species is the most informative milestone.

Management Activities and Prioritization

- Mowing will not occur from April to July during bird nesting season (to allow for at least one nesting cycle).
- Avoid annual mowing, if possible, in favor of semi-annual bush hogging outside of the nesting season in up to 3 year intervals.
- Reduce mower speed, especially where nests have been documented, and avoid mowing at dark when birds will not flush.
- Rather than managing an invasive species problem with mowing, consider spot spraying in early spring as an alternative.
- Allow at least 65 days between management disturbance activities for birds to recover. For example, if mowing occurs in August, do not mow again until November.

Potential Funding and Partnerships

Partnerships with organizations like Pheasants Forever (pheasantsforever.org) should be explored as well as the Audubon Society (cincinnatiaudubon.org) and local chapters. Sponsorship of meadow management and monitoring should be explored as well.

3.3.8 Brushland

Management Objective: Maintain breeding populations of neotropical birds and short-distance migrants by creating areas with dense native vegetation up to 5' in height.

Brushlands are dense, early-successional areas dominated by shrubs and sapling-stage trees. Brushlands in this region of Ohio are not necessarily permanent; rather, they are a temporary stage between disturbance that sets back established forest and the eventual return to a forest. In other scenarios they are areas of stunted vegetation limited by soil depth or quality. Such areas occur throughout Ohio at regenerating forest cuts, or in large canopy gaps caused by fire or wind storms.

GPHC manages for this habitat type, primarily along forest edges, because of the rich resources it provides for wildlife species, especially birds that specifically require brushland. Threats to brushland include reduction of size due to lack of management and establishment of invasive plants.

Ecological Targets for Brushland

The ecological targets for brushland are primarily the bird species that thrive there. The year-round presence of American woodcock and summer breeding by the neotropical migrants, willow flycatcher, gray catbird, and yellow-breasted chat and Eastern cottontail indicate that a brushland habitat is meeting its management goals. Less likely inhabitants, such as blue-winged warbler and ruffed grouse would also indicate successful management.

Metrics and Milestones

- Monitoring Avian Productivity and Survivorship (MAPS)[3] and bird monitoring data are the most readily available metric for brushland management

Management Activities and Prioritization

- Maintain existing brushlands by preventing reduction in size and succession to forest through regular mowing.
- Create new brushland in previous meadows, old farm fields or acquired land
- Replace invasive species such as amur honeysuckle, burning bush and autumn olive with native seed producing plants.
- Maintain a minimum of 50% native shrub cover in these areas
- To the extent possible incorporate both larger tracts of brushland as well as opportunistic patches throughout the landscape.

Potential Funding and Partnerships

Wildlife agencies, conservation organizations, and conservation-minded agricultural opportunities should be explored. Sponsorship of brushland management and monitoring costs should be considered as well.

3.4 ANIMALS

Fish and wildlife management at Great Parks maintains and restores natural habitat for native fish and wildlife in a manner consistent with accepted scientific principles. Land management

[3] https://www.birdpop.org/pages/maps.php

practices influence wildlife numbers and species composition, particularly vegetation management and disturbances such as prescribed fire.

The primary approach to wildlife conservation is providing suitable habitat for a variety of fauna native to this area.

The approach to managing animals at GPHC is to maintain the overall integrity and diversity of existing habitats and to reduce overabundant or nuisance populations of wildlife through habitat modification, hunting, and other methods. In addition, Great Parks has a robust and long-running aquaculture program that provides hybrid bluegill to our fishing ponds and lakes for recreational purposes. Volunteer-run wildlife management activities, such as controlled bow hunting and bluebird (*Colaptes auratus*) nest box monitoring, are ongoing. Fish communities in the large lakes at Great Parks are surveyed on an approximately 5-year cycle.

The primary approach to wildlife conservation is providing suitable habitat for a variety of fauna native to this area, including rare species. Vegetation management programs at Great Parks aim to improve wildlife habitat, maintain or alter habitat types, and bolster diversity. In many cases, this means keeping large sections of habitat intact and preventing fragmentation by roads and certain amenities. Leaving standing dead trees that are safely pruned near developed areas also provides habitat for wildlife like wood ducks, woodpeckers, raccoons, owls and squirrels. As a more active example, prescribed burns have resulted in plant community changes that maintain prairie and provide improved habitat conditions for several bird and insect species. Throughout GHPC, some species may require management to increase their numbers (e.g., rare plants and animals), while other over-abundant animals (e.g., white-tailed deer and Canada geese) need to be controlled due to negative ecological impacts or impacts to recreation.

Climate changes over the next several decades are likely to result in changes in animal distributions, especially in migratory animals. There have already been documented shifts in bird distributions that shows a shift northward. Phenological changes in plants (e.g. earlier emergence) can and do have impacts on wildlife such as migratory birds (USFS 2020). How climate change impacts flora will be different from how it impacts fauna due to abilities to move and adapt. The changes in climate (weather patterns and temperature) functions together with the composition of forests (forest conditions) which impacts birds and other wildlife (Ohio Bird Conservation Initiative 2020).

Data from regular surveys will be valuable in tracking changes, both for species shifting out of the region to the north and those shifting into the region from the south. These changes may also result in changes to non-native animal distribution and abundance.

3.5.2 Birds

Natural areas such as park property are vital stopover habitat for migratory birds in Hamilton County, which is urban and continues to see further development. The large amount of forest owned and protected by Great Parks, in addition to the important migratory bird corridors protected by GPHC holdings on the Great Miami, Whitewater, and Little Miami Rivers, mean that GPHC plays a major role in meeting the habitat needs for migratory birds in

southwest Ohio. This large forest canopy and undeveloped riparian areas are important refuges in highly-developed Hamilton County.

Monitoring of migratory birds has been conducted through collaboration with the University of Cincinnati under the guidance of Dr. Ron Canterbury. Annual mist netting is undertaken at several locations including Miami Whitewater Forest which is a Monitoring Avian Productivity and Survivorship (MAPS) site. Information on the species present and their condition help determine whether objectives for the surrounding natural area are being met and inform future management decisions. Volunteer monitoring is likely to play a role in future years to expand the number of locations being surveyed by sight or sound through point counts.

Resident birds are just as dependent on local resources as they inhabit the region throughout the year. In addition to backyard birds like robins, blue jays and cardinals, natural areas are home to birds with more specific habitat requirements. Several of these species have been identified as highest priority species by the Ohio Bird Conservation Initiative due to immediate threats. Examples include American woodcock (*Scolopax minor*), cerulean warbler (*Setophaga cerulea*), and wood thrush (*Hylocichla mustelina*). The primary approach for conserving these species is protecting and improving habitats to meet their specific needs as well as those of other wildlife.

Monitoring for resident birds has been ongoing since at least 1972 when the annual Winter Bird Count began at Great Parks. This effort, involving local birders and staff has identified 146 species present in December over the past 4 decades. Long term monitoring efforts are important for detecting trends over time and implementing changes in management accordingly.

3.5.1 Herpetofauna, Mammals and Invertebrates

Globally, amphibians and reptiles are some of the most threatened animals, so preserving habitat for these species and monitoring for them in particular, is essential to their conservation locally. Salamanders, tree frogs and snakes are an important part of the food web helping to control insect populations and serving as a food source for other animals. Monitoring for herpetofauna is primarily undertaken by volunteers through coverboard surveys and similar methods at multiple sites throughout the year (**Figure 10**). Additional efforts include opportunistic collection of box turtle data when encountered and collaborations with local universities on amphibian population health and threats.

Figure 10. PVC pipe installed at monitoring sites to monitor tree frogs.

Mammals are some of the most well-known wildlife, and Hamilton County is home to several animals that were previously extirpated from the state including the white-tailed deer (*Odocoileus virginianus*), beaver (*Castor canadensis*), and even bobcats (*Lynx rufus*) which have made a comeback. These animals find homes in a variety of habits and depend on everything from rivers, meadows and wetlands to forests, brushland and rocky crevices. Despite previous declines, species like deer seem to be thriving, and in some cases over-abundant. Other animals however, such as many bats are species of concern or even federally endangered. Monitoring of mammals is focused on certain species and done through collaborations with entities like the Ohio Department of Natural Resources which surveys for river otters, as well as contractors and researchers. Other wildlife including invertebrates are noted as individual projects arise or as ongoing volunteer projects are approved. Lepidopterists gather at Winton Woods, Sharon Woods, and Farbach Warner Nature Center to identify species each August.

3.5.1 Fish and Aquatic Organisms

Hamilton County has an abundance of streams and rivers that provide habitat to fish and other aquatic organisms such as macroinvertebrates and mussels. As there are no naturally occurring lakes on GPHC property, the most common native fish are fish suited to stream (lotic) environments. In smaller streams, species including the rainbow darter (*Etheostoma caeruleum*) and the creek chub (*Semotilus atromaculatus*) are present, while the longnose gar (*Lepisosteus osseus*) and shovelnose sturgeon (*Scaphirhynchus platorynchus*) are present in rivers. Monitoring of these aquatic habitats is accomplished through surveys and sampling

activities. For instance, the stream health is monitored at Great Parks by volunteers using benthic macroinvertebrates as indicator species.

Lakes and ponds provide additional habitat for fish, amphibians and other aquatic wildlife. Many of the lakes are stocked annually for recreation with native and sport fish species such as trout and channel catfish. In 2009, three aquaculture ponds were constructed at the Shaker Trace Nursery to raise hybrid bluegill for the Park District. A fourth and fifth pond were added in 2010 which accompanied the arrival of the first small fry fish. Best practices for aquaculture are followed in the production of these fish. Fish from this facility have been stocked in various Great Parks fishing lakes every year starting in 2011 with special emphasis on the annual Children's Fishing Derby at Triple Creek Park. Volunteers coordinate the daily feeding and water quality checks while staff coordinate transport and rotation between the ponds.

Electrofishing surveys have been completed at Great Parks lakes over the last several decades, providing baseline data on fish communities. Species such as bluegill, channel catfish, and largemouth bass are common per these reports. Nuisance species including gizzard shad and common carp are also prevalent, as they thrive in the hypereutrophic condition of many Great Parks lakes. Most recently, in 2020, GPHC partnered with the University of Cincinnati (UC) to survey the fish species present at the chain of quarry lakes that make up Campbell Lakes. Campbell Lakes have historically been stocked with sport fish, but this practice was stopped in 2020. Since 2010, the Campbell Lakes system has been breached by the Whitewater River, resulting in a shift of its fish community toward more riverine species, as described in the electrofishing survey conducted by UC. Similar inventories will continue so that GPHC can provide natural resources management, fisheries management, and work toward balancing ecosystem health with recreational goals.

3.5 Rare, Threatened, and Endangered Species

Rare, threatened, and endangered (RTE) species and their habitats are protected and managed at Great Parks as required by state and federal law and as written in GPHC by-laws. When possible, GPHC cooperates in studies, programs, plans, and experiments designed to protect and enhance populations of RTE species, in partnership with USFWS, OEPA, and ODNR.

Great Parks staff must ensure that any work performed is in compliance with the requirements of the Endangered Species Act (ESA) and Chapter 1518 of the Ohio Revised Code, as all Great Parks lands are subject to these regulations. GPHC strives to balance its mission and the conservation of listed species through effective long-term planning.

Known listed species at Great Parks are closely monitored and protected. Populations actively managed by GPHC are located at several parks, including Shawnee Lookout, Richardson Forest Preserve, Miami Whitewater Forest, and Woodland Mound, to name a few. General management guidelines are available for each species, and individual park natural resource plans are in development to provide specific direction on management of natural areas and any RTE species they may contain.

Great Parks provides habitat for over 100 potentially-occurring RTE species (29 plants and 83 animals), including:

- Over a dozen state listed plants, with several in cultivation at Shaker Trace Nursery, and one (1) federally listed plant;
- Eight (8) state listed birds;
- One (1) federally listed amphibian; and
- Two (2) federally listed mussel species located in the Little Miami River Corridor.

Comprehensive surveys of every taxa across the 17,733 acres managed by GPHC is not feasible; however, Great Parks continually monitors its vegetation, coordinates long- and short-term monitoring programs with volunteers and staff, and engages with researchers and community partners to investigate and protect rare, threatened, and endangered species (**Section 2.1**). Great Parks has investigated public records managed by state and federal agencies to determine potentially-occurring RTE species occurring in Hamilton County. This information is further broken down for park-specific natural resource management plans, which will allow managers at Great Parks to evaluate potential impacts to RTE species when conducting maintenance and planning activities across the county. **Table 4** provides an overview of the rare, threatened, and endangered species at Great Parks.

Table 4. Rare, Threatened, and Endangered Species at Great Parks of Hamilton County

Common Name	Scientific Name	Status	Documented at GPHC (Y/N)	Source
Plants (29 species)				
Ashy sunflower*	*Helianthus mollis*	ST	Y	(Osborne 2020)
Arbor vitae	*Thuja occidentalis*	SP	Y	(GPHC 2021)
Bicknell's sedge	*Carex bicknellii*	ST	Y	(GPHC 2021)
Brittle fern	*Cystopteris fragilis*	SX	Y	(GPHC 2021)
Buffalo clover*	*Trifolium reflexum*	SE	Y	(Osborne 2020)
Butterfly-pea	*Clitoria mariana*	SP	Y	(GPHC 2021)
Blue false indigo*	*Baptisia australis*	SE	Y	(Osborne 2020; GPHC 2021)
Compass-plant*	*Silphium laciniatum*	SE	Y	(Osborne 2020; GPHC 2021)
Flattened sedge	*Carex complanata*	ST	Y	(GPHC 2021)
June grass*	*Koeleria macrantha*	SE	Y	(Osborne 2020)
Missouri gooseberry	*Ribes missouriense*	ST	Y	(Kovar 2021)
Necklace sedge	*Carex projecta*	SE	Y	(GPHC 2021)
Prairie false indigo	*Baptisia lactea*	SP	Y	(GPHC 2021)
Prairie ironweed*	*Vernonia fasciculata*	ST	Y	(GPHC 2021)
Prairie tick-trefoil	*Desmodium illinoense*	SX	Y	(GPHC 2021)
Prairie wake-robin	*Trillium recurvatum*	SP	Y	(GPHC 2021; Kovar 2021)
Prairie wedge grass	*Sphenopholis obtusata var. obtusata*	SE	Y	(Osborne 2020)
Purple virgin-bower	*Clematis occidentalis*	SX	Y	(GPHC 2021)
Rattlesnake-master*	*Eryngium yuccifolium*	SP	Y	(GPHC 2021)
Royal catchfly*	*Silene regia*	ST	Y	(Osborne 2020; GPHC 2021)
Running buffalo clover	*Trifolium stoloniferum*	FE, SE	Y	(Bartgis 1989; Becus 1989, 1990, 1992, 1995, 1996, 2000, 2001,

				2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013; Conover 1993, 2015; Hamilton County Park District 1995; Osborne 2020)
Showy goldenrod*	*Solidago speciose*	ST	Y	(Osborne 2020)
Smooth rose	*Rosa blanda*	SP	Y	(Conover 1991)
Spathulate-leaved sundew	*Drosera intermedia*	SE	Y	(GPHC 2021)
Spring coral-root	*Corallorhiza wisteriana*	SP	Y	(GPHC 2021)
Tall larkspur*	*Delphinium exaltatum*	SP	Y	(GPHC 2021)
Three-flowered melic	*Melica nitens*	ST	Y	(GPHC 2021)
Umbrella magnolia	*Magnolia tripetala*	SP	Y	(GPHC 2021)
Virginia meadow-beauty*	*Rhexia virginica*	SP	Y	(Osborne 2020)
Birds (55 species)				
American black duck	*Anas rubripes*	SI	Y	(Whitney Jr. 1948; Klein 1996)
American bittern	*Botaurus lentiginosus*	SE, BCC	Y	(Whitney Jr. 1948; Klein 1996)
American coot	*Fulica americana*	SI	Y	(Whitney Jr. 1948)
American golden-plover	*Pluvialis dominica*	BCC	N	-
Bald eagle	*Haliaeetus leucocephalus*	BCC	Y	(Whitney Jr. 1948; Klein 1996)
Black-billed cuckoo	*Coccyzus erythropthalmus*	SC, BCC	Y	(Whitney Jr. 1948)
Black tern	*Chlidonias niger*	SE	Y	(Whitney Jr. 1948; Klein 1996)
Black-crowned night-heron	*Nycticorax nycticorax*	BC	Y	(Klein 1996)
Black-throated blue warbler	*Setophaga caerulescens*	SI	Y	(Whitney Jr. 1948)
Blue-winged warbler	*Vermivora pinus*	BCC	N	-
Blackburnian warbler	*Setophaga fusca*	SI	Y	(Whitney Jr. 1948; Pennington 2005)
Blue-headed vireo	*Vireo solitaries*	SI	Y	(Pennington 2005)
Bobolink	*Dolichonqy oryzivorus*	SC, BCC	Y	(Whitney Jr. 1948; Pennington 2005)
Brown creeper	*Certhia americana*	SI	Y	(Styer 1998; Saunders 1999; Pennington 2005)
Canada warbler	*Cardellina canadensis*	SI	Y	(Pennington 2005)
Cattle egret	*Bubulcus ibis*	SE	Y	(Klein 1996)
Cerulean warbler	*Dendroica cerulean*	SC, BCC	Y	(Wauligman 1994; Pennington 2005)
Common tern	*Sterna hirundo*	SE	Y	(Klein 1996)
Dark-eyed junco	*Junco hyemalis*	SI	Y	(H.C.P.D. 1982; Styer 1998; Saunders 1999)
Dunlin	*Calidris alpine arcticola*	BCC	N	-
Eastern Whip-poor-will	*Antrostomus vociferus*	SC, BCC	N	-

Golden-crowned kinglet	*Regulus satrapa*	SI	Y	(H.C.P.D. 1982; Whitney Jr. 1948; Styer 1998; Saunders 1999)
Golden Eagle	*Aquila chrysaetos*	BCC	N	-
Great egret	*Ardea alba*	SC	Y	(Wauligman 1994; Klein 1996)
Green-winged teal	*Anas crecca*	SI	Y	(Klein 1996) (Whitney Jr. 1948)
Henslow's sparrow	*Centronyx henslowii*	SI	Y	(Whitney Jr. 1948)
Hermit thrush	*Catharus guttatus*	SI	Y	(Pennington 2005)
Kentucky warbler	*Oporonis formosus*	BCC	Y	(Klein 1989)
Lark sparrow	*Chondestes grammacus*	SE	Y	(Hamilton County Park District 2001a)
Le Conte's Sparrow	*Ammodramus leconteii*	BCC	N	-
Lesser yellowlegs	*Tringa flavipes*	BCC	N	-
Least flycatcher	*Empidonax minimus*	SI	Y	(Whitney Jr. 1948; Pennington 2005)
Least bittern	*Lxobrychus exilis*	ST, BCC	Y	(Klein 1996)
Long-eared owl	*Asio otus*	SI	Y	(HCPD 1982)
Magnolia warbler	*Dendroica magnolia*	SI	Y	(Whitney Jr. 1948; Pennington 2005)
Northern shoveler	*Spatula clypeata*	SI	Y	(Klein 1996)
Northern waterthrush	*Parkesia noveboracensis*	SI	Y	(Wauligman 1994; Pennington 2005)
Nashville warbler	*Leiothlypis ruficapilla*	SI	Y	(Whitney Jr. 1948; Wauligman 1994; Pennington 2005)
Northern saw-whet owl	*Aegolius acadicus*	SI	Y	(HCPD 1982)
Prairie warbler	*Dendroica discolor*	BCC	N	-
Prothonotary warbler	*Protonotaria citrea*	SC, BCC	Y	(Wauligman 1994)
Red-breasted nuthatch	*Sitta canadensis*	SI	Y	(Whitney Jr. 1948)
Redhead	*Aythya*	SI	Y	(Whitney Jr. 1948; Klein 1996)
Red-headed woodpecker	*Melanerpes erythrocephalus*	SC, BCC	Y	(Whitney Jr. 1948; Wauligman 1994)
Ruddy duck	*Oxyura jamaicensis*	SI	Y	(Whitney Jr. 1948; Klein 1996)
Rusty blackbird	*Euphagus carolinus*	BCC	N	-
Sandhill crane	*Antigone canadensis*	ST	Y	(Klein 1996)
Short-billed dowitcher	*Limnodromus griseus*	BCC	N	-
Semipalmated Sandpiper	*Calidris pusilla*	BCC	N	-
Upland sandpiper	*Bartramia lonicauda*	SE	Y	(Klein 1996)
Veery	*Catharus fuscescens*	SI	Y	(Pennington 2005)
Virginia rail	*Rallus limicola*	SC	Y	(Wauligman 1994)
Wilson's snipe	*Gallinago delicate*	SI	Y	(Whitney Jr. 1948)
Winter wren	*Troglodytes hiemalis*	SI	Y	(Whitney Jr. 1948; Styer 1998; Pennington 2005)
Wood thrush	*Hylocichla mustelina*	BCC	N	-
Reptiles & Amphibians (3 species)				
Cave salamander	*Eurycea lucifuga*	FE, SE	Y	(Juterbock 1986, 1987; Davis and Krusling 1990, 1991, 1993, 1993; Davis et al. 1991; Rubin 1992;

				Hamilton County Park District 2001b; Wayne Wauligman et al. 2002)
Blanchard's cricket frog	*Trifolium stoloniferum*	SC	Y	(Simon and Krusling 1988; Johnston 2006)
Woodland box turtle (Eastern box turtle)	*Terrapene carolina carolina*	SC	Y	(Simon and Krusling 1988; Rubin 1989) (Klein, 1989)
Mammals (6 species)				
Big brown bat	*Eptesicus fuscus*	SC	Y	(Edelen 2003a, 2003b, 2005, 2006, 2008)
Gray bat	*Myotis grisescens*	FE	N	-
Indiana bat	*Myotis sodalist*	FE, SE	N	-
Little brown bat	*Myotis lucifigus*	SC	Y	(Edelen 2005, 2006, 2008)
Northern long-eared bat	*Myotis septentrionalis*	FT, ST	Y	(Edelen 2005, 2008)
Red bat	*Lasiurus borealis*	SC	Y	(Edelen 2003a, 2003b, 2005)
Mussels (9 species)				
Deertoe	*Truncilla truncate*	SC	Y	(Hoggarth 1998)
Fanshell	*Cyprogenia stegaria*	FE, SE	N	-
Fawnsfoot	*Truncilla donaciformis*	ST	Y	(Hoggarth 1996, 2004a)
Pink mucket (pearlymussel)	*Lampsilis abrupta*	FE, SE	N	-
Purple wartyback	*Cyclonaias tuberculate*	SC	Y	(Hoggarth 1996)
Rayed bean	*Villosa fabalis*	FE, SE	Y	(Hoggarth 1996)
Sheepnose mussel	*Plethobasus cyphyus*	FE, SE	N	-
Snuffbox mussel	*Epioblasma triquetra*	FE, SE	Y	(Hoggarth 1996)
Threehorn wartyback	*Obliquaria reflexa*	ST	Y	(Hoggarth 1996, 2004b)

FE = Federally Endangered; FT = Federally Threatened; SE = State Endangered; ST = State Threatened; SX = Presumed Extirpated Species (State); PT = Potentially Threatened (State); SC = Special Concern; SI = Special Interest; BCC = USFWS Birds of Conservation Concern
*species cultivated at GPHC Shaker Trace Nursery
Sources: IPaC; USFWS Midwest Region Endangered Species, Ohio; ODNR – Rare Native Ohio Plants. 2020-21 Status List; USDA Natural Resources Conservation Service

3.6 Recreation and Education

The mission of Great Parks, as previously stated, is to preserve and protect natural resources and to provide outdoor recreation and education in order to enhance the quality of life for present and future generations. The main task in natural resources management is to preserve and protect the natural resources, yet management also considers the two other portions of the mission: recreation and education.

Educating the public about natural resources present at Great Parks and their importance is vital to conservation efforts. This is a key focus of the Guest Experiences staff. This team draws connections between public health and well-being and the health of the environment through innovative programming both in-person and online. Partnerships with surrounding communities, and schools allow for a broader educational reach, improves public health, and increases environmental awareness.

A critical component of building awareness is getting the public out in nature. Recreation is a key factor when considering how Hamilton County residents and visitors utilize the parks. A

key goal as outlined in the Master Plan is to increase trails and connectivity. Good stewardship requires that increased access to natural areas is balanced with conservation and protection of sensitive areas. Certain areas within the parks are less tolerant to increased visitation, traffic and development than others; for reasons such as the presence of rare species, erodible soils and steep topography, or sensitive water resources (GOAL 2).

Reviewing protocols regularly for inclusion of conservation best practices facilitates mission-based thought and action. Examples include multi-divisional contributions towards making decisions about land acquisition and the encroachment resolution process. The NR team also works with staff to facilitate low-impact infrastructure maintenance and new developments as well as to undertake cultural resource reviews or recommend archeological surveys when warranted. This allows GPHC to anticipate impacts that might have a detrimental effect on the environment, come up with alternatives in partnership with stakeholders, and problem-solve agency-wide to mitigate any potential negative impacts. Great Parks has a strong track record of soliciting and incorporating public input when establishing recreational projects and educational programming, and conservation and natural resource management is built into those tasks

Great Parks' staff also collaborate on guidelines for the management of active recreation sites such as golf courses and on public interactions. Although the management goals for active recreation sites are different from natural areas, their management and operation still affect natural resources, both directly and indirectly. Naturalized spaces, trees and sensitive resources such as wetland buffers within recreation sites are managed in collaboration with NR. Trail placement and design, which is an important function of NR, is undertaken through close collaboration with park staff, interpreters and rangers. Also, decisions and plans related to natural resources management may affect park staff and guests or invite questions regarding practices. Therefore, NR supports the Guest Experience Division's messaging and on-going communication with staff and guests to communicate about current and planned projects.

The talented and experienced staff of GPHC have the skills and tools necessary to inspire cooperative action in the region for the benefit of our natural heritage and future generations.

3.7 Cultural Resources

Great Parks is fortunate to inherit to a wealth of cultural heritage and is committed to protecting and interpreting cultural resources. The lands that today make up Great Parks of Hamilton County have been inhabited for over 12,000 years, by a series of distinct groups of people. Seventeen of our parks house nationally significant pieces of landscape and cultural history, including the Shawnee Lookout Archeological District. Archeological sites are present within the parks from pre-history and include evidence of the Archaic, Adena, and Hopewell people (Knepper 2002). Historic people, including the indigenous Great Lakes and Algonquin-speaking Tribes as well as Irish and German immigrants, also left their marks on the land. The signs these groups left behind are invaluable cultural resources that tell the history of the park system and the region as a whole. Heritage sites, such as the Shawnee Lookout Springhouse School, Shaker Village, cultural landscapes, and cultural artifacts

represent the wide variety of cultural resources in need of maintenance and protection within GPHC's purview. These resources are finite and nonrenewable.

Cultural resources have often been interpreted and studied by GPHC and partners in the region, but a formal cultural resources program has yet to be established at Great Parks. GPHC regularly coordinates with Ohio History Connection and the Cincinnati Museum Center on matters related to cultural resources. As recommended in the CMP, Great Parks will maintain natural resources in a way that protects cultural resources within the parks, embracing the cultural heritage of each of our unique park properties. The objective is to preserve the diverse cultural heritage of Hamilton County, protect significant and historic infrastructure and landscapes, and facilitate historic preservation programs and educational opportunities for the public.

As the number of visitors to the park system grows and as recreational opportunities are enhanced GPHC will need to address the potential for increased visitor impacts – including pollution, vandalism, and theft – to prevent site degradation, destruction, or alteration. To reduce impact from human activities, whether accidental or purposeful, GPHC will need to produce explicit signage, enlist the cooperation of GPHC Rangers for enforcement, and engage the public with supporting education to raise awareness on the significance of sites. Properly maintaining these assets so as not to allow expedited degradation will be a primary concern of GPHC. Preventing weathering, deterioration of materials, and establishment of unwanted plants will also be crucial to protecting the integrity of heritage structures and landscapes.

GPHC will continue to work with Ohio History Connection and will follow guidelines described in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation, Historic American Buildings Survey (HABS), Historic American Landscapes Survey (HALS).

Management Activities and Prioritization

Cultural resource management involves research, planning, and stewardship of archival information, historic structures, landscapes, and corresponding features of human activity and history. In order to steward these cultural resources, GPHC will:

- Establish dialogue with relevant tribes through Ohio History Connection or similar liaison and invite them to discussions on the following topics in meaningful ways that would benefit them as well as GPHC.
- Develop a Cultural Resources Management Plan.
- Establish internal work flow and responsible parties for projects associated with cultural resources.
- Minimize damage to earthworks and burial mounds due to unnecessary mowing or digging through implementation of park-wide policy that exhibits respect for relevant parties
- Partner with qualified researchers and historians to conduct desktop analysis of archival research, analysis of cultural landscapes, and archeological data recovery and to understand historic resource surveys.

- For proposed infrastructure improvements, conduct archeological/architectural site survey, resource identification and evaluation, assessment of project effects, and mitigation of adverse effects.

Potential Funding and Partnerships

The National Park Service is integral in preserving the diversity of American history through laws and guidelines, financial assistance, and technical assistance. Federal and state funding is also available for heritage programs and preservation. Partnering with the Ohio History Connection, Ohio State Parks and the Cincinnati Museum Center can facilitate GPHC preservation initiatives. GPHC will continue to develop more robust plans for addressing, preserving and interpreting cultural resources at Great Parks.

4.0 Implementation

This management document will be implemented across properties managed by Great Parks, overseen by the Director of Natural Resources. It serves as a guidepost for natural resource management activities at Great Parks. Park-specific management plans will be developed for each park property and will correspond to the structure set forth in this document.

Great Parks supports its ability to uphold the three main parts of its mission – education, recreation, and conservation – through the natural resources management practices outlined herein. Long-term management effectiveness is also evaluated through periodic inventories of species populations, habitat quantity and quality, and other variables, through ongoing and new surveys. Trends can be used to indicate the degree of success. Great Parks will evaluate these recurring data as they become available.

This Natural Resource Management Plan will be implemented by executing the various metrics and programs described throughout the document and by accomplishing the goals and objectives as described in **Sections 2 & 3**. The implementation schedule, project and activity lists, and how the projects relate to NRMP implementation are detailed in **Appendix F**.

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Appendix A – Acronyms

ATV – All Terrain Vehicle

C&P – Conservation and Parks

CMP – Comprehensive Master Plan

EAB – Emerald Ash Borer

EPA – Environmental Protection Agency

ESA – Endangered Species Act

FQAI – Floristic Quality Assessment Index (Andreas et al, 2004)

GIS – Geographic Information System

GPHC – Great Parks of Hamilton County

HAB – Harmful Algal Blooms

HHEI – Headwater Habitat Evaluation Index (Ohio EPA, 2012)

LED – Light-emitting Diode

MOU – Memorandum of Understanding

NR – Natural Resources

NRMP – Natural Resource Management Plan

ODNR – Ohio Department of Natural Resources

OEPA – Ohio Environmental Protection Agency

PTI – Permit-to-Install

RTE – Rare Threatened and Endangered

SOC – Standards of Care

UC – University of Cincinnati

USFWS – US Fish and Wildlife Service

Appendix B – List of Associated Documents for the Natural Resource Management Plan

1. Great Parks of Hamilton County Stormwater Management Program (2014)
2. Great Parks of Hamilton County Natural Resource Management Policy (2016)
3. Tree Risk Management Plan (2018)
4. Harmful Algal Bloom (HAB) Response Plan for Great Parks Lakes (2020)
5. Great Parks of Hamilton County Trail Guidelines and Maintenance (Draft 2020)
6. Shaker Trace Nursery Business Plan (Draft 2020)
7. US Army Corps of Engineers West Fork Lake[1] Master Plan Update (2020)
8. Forestry Management Plan (Draft 2021)
9. Sustainability Guidelines (Draft anticipated 2021)

[1] Also known as Winton Lake

Appendix C – Regulatory Drivers and Land Use Agreements

The Great Parks of Hamilton County (GPHC) is comprised of over 17,700 acres, which is owned by multiple agencies. Although the majority of Great Parks land is owned by GPHC, itself, some property is leased from the Army Corps of Engineers, the City of Cincinnati, and the Ohio Department of Natural Resources. Regardless of ownership, GPHC manages land and natural resources per the Ohio Revised Code Section 1545.11 and the GPHC Natural Resource Management Policy in coordination with the partner agencies. The Conservation and Parks Division of GPHC is responsible for overseeing management of natural resources on park land. The following sections outline laws and regulations governing natural resource management at GPHC.

1. Ohio Revised Code § 1545.11

Board of park commissioners - power to acquire lands

Effective Date: 10-20-1972.

The board of park commissioners may acquire lands either within or without the park district for conversion into forest reserves and for the conservation of the natural resources of the state, including streams, lakes, submerged lands, and swamplands, and to those ends may create parks, parkways, forest reservations, and other reservations and afforest, develop, improve, protect, and promote the use of the same in such manner as the board deems conducive to the general welfare. Such lands may be acquired by such board, on behalf of said district, (1) by gift or devise, (2) by purchase for cash, by purchase by installment payments with or without a mortgage, by entering into lease-purchase agreements, by lease with or without option to purchase, or, (3) by appropriation. In furtherance of the use and enjoyment of the lands controlled by it, the board may accept donations of money or other property, or may act as trustees of land, money, or other property, and use and administer the same as stipulated by the donor, or as provided in the trust agreement. The terms of each such donation or trust shall first be approved by the probate court before acceptance by the board.

In case of appropriation, the proceedings shall be instituted in the name of the board, and shall be conducted in the manner provided in sections 163.01 to 163.22, inclusive, of the Revised Code.

This section applies to districts created prior to April 16, 1920.

2. GPHC Natural Resource Management Policy (December 15, 2016)

WHEREAS, Ohio Revised Code Section 1545.11 authorizes park district Boards of Park Commissioners to, "...acquire lands either within or without the park district for conversion into forest reserves and for the conservation of the natural resources of the state..." and,

WHEREAS, the Board of Park Commissioners of Great Parks of Hamilton County (then, Hamilton County Park District) was formed in 1930, and later adopted a Land Management Policy on May 15, 1975, which directed that 80% of its land be kept in a natural state in the intervening 41 years until this date, and

WHEREAS, the Board of Park Commissioners wishes to affirm a commitment to conservation as the core purpose of Great Parks of Hamilton County, as enabled by Ohio Revised Code, and having embraced the importance its parks and preserves have in preserving habitat for native species in the region, protecting habitat for migratory species, and protecting water quality in streams, rivers, lakes and reservoirs, and

WHEREAS, sustainability of natural resources is necessary to ensure that the region's rich natural heritage is available for the enjoyment of future generations, as predecessors have enabled this generation. Therefore,

BE IT RESOLVED that the Board of Park Commissioners of Great Parks of Hamilton County establishes this resolution as its Natural Resources Management Policy for the operation of its parks and preserves, and

BE IT FURTHER RESOLVED that this policy amends and replaces the Land Management Policy, and that any policy that conflicts with it is hereby amended:

Natural Resources Management Policy

- The Board of Park Commissioners of Great Parks of Hamilton County recognizes that as plant and animal diversity has been impacted through land use changes in the region, there is need to preserve habitats which serve as reserves of the region's natural heritage, as well as wild places for public enjoyment.
- The highest priority of the park district will be in preserving land in its natural state. For this purpose, 80% of all park land will be kept in its natural state and managed for the conservation of habitats and species native to our region. Examples include forest, wetland, prairie, meadow, brushland and water resources.
- Development can comprise no more than 20% of all park land. Examples include recreational facilities and amenities, roads, buildings, paved trails, built infrastructure, turfgrass, and agriculture.
- Great Parks of Hamilton County is the steward with ultimate responsibility for some of the most significant remnants of habitat in southwest Ohio. Given the scarcity of these habitats, proposed development in parks and preserves that impact natural areas requires study of the impacts and approval of the Executive Director, or inclusion in an approved comprehensive master plan.

- Collection and/or removal of natural materials or wildlife from parks or preserves is prohibited, except in the cases of approved scientific research, vegetation management or wildlife management by staff or contractors of Great Parks of Hamilton County. Collection of plants or animals as part of a research project by an outside entity may be requested, and will be evaluated as part of a permit issued by the Executive Director, or designate.
- The principal of sustainability is a guiding value of Great Parks of Hamilton County. It creates and maintains conditions under which people and nature can exist in productive harmony. Great Parks will evaluate, test and implement proven methods and technologies to produce measurable ecological benefits. Areas of continuous improvement include, but are not limited, to reducing energy use, reducing waste and maximizing the ecological benefits of park land.

3. GPHC Bylaws

Sections 31.02, 90.01, 131.06 (including staff)

§ 131.06 PRESERVATION OF PROPERTY AND NATURAL FEATURES. (A) No person shall injure, deface, disturb, or befoul any part of the park district, nor any building, sign, equipment, or other property found therein. (B) No person shall remove, injure, or destroy any trees, shrubs, wildflowers or other plants, animals, fossils, or minerals within the park district. (C) Special exceptions to the above may be permitted for purposes of scientific research, if approved guidelines are followed and collecting of natural materials is authorized by written permit from the Chief Executive Officer. (D) Exceptions to the above could also be made for removal of non-native (alien or exotic) species by park personnel and for generally accepted land management practices. (Prior by-law § 1) Penalty, see § 130.99

4. Federal Laws

American Antiquities Act of 1906 (Public Law 59-209; 16 USC §431-433) – authorizes the President to designate historic and natural resources of national significance, located on federal lands, as National Monuments for the purpose of protecting items of archeological significance.

Archeological and Historical Preservation Act of 1974 (Public Law 95-96; 16 USC §469 *et seq*.) – provides for the preservation of historical and archeological data, including relics and specimens, threatened by federally funded or assisted construction projects.

Archeological Resources Protection Act of 1979 (16 USC §470 *et seq*.) – prohibits the excavation or removal from federal or Indian lands any archeological resources without a permit.

Bald Eagle Protection Act of 1940 (Public Law 87-884; 16 USC §668a-d) – prohibits the taking or harming (i.e. harassment, sale, or transportation) of bald eagles or golden eagles, including their eggs, nests, or young, without appropriate permit.

Clean Air Act of 1970 (42 USC §7401 *et seq*.) – regulates air emissions from stationary, area, and mobile sources. This law authorizes the US Environmental Protection Agency (USEPA) to

establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment.

Clean Water Act of 1972 (Public Law 92-500; 33 USC §1251 *et seq.*) – aims to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Under Section 401, states have authority to review federal permits that may result in a discharge to wetlands or water bodies under state jurisdiction. Under section 404, a program is established to regulate the discharge of dredged or fill material into the Nation's waters, including wetlands.

Emergency Wetlands Resources Act of 1986 (16 USC §3901-3932) – requires reporting of wetland loss by the Secretary to Congress; authorizes the purchase of wetlands; requires the Secretary to establish a National Wetlands Priority Conservation Plan; and requires states to include wetlands in their Comprehensive Outdoor Recreation Plans, among others.

Endangered Species Act of 1973, as amended (16 USC §1531 *et seq.*) – provides for the identification and protection of threatened and endangered plants and animals, including their critical habitats. Requires federal agencies to conserve threatened and endangered species and cooperate with state and local authorities to resolve water resources issues in concert with the conservation of threatened and endangered species. This law establishes a consultation process involving federal agencies to facilitate avoidance of agency action that would adversely affect species or habitat. Further, it prohibits all persons subject to US jurisdiction from taking, including any harm or harassment, endangered species.

Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (Public Law 92-516; 7 USC §136 *et seq.*) – governs the use and application of pesticides in natural resource management programs. This law provides the principal means for preventing environmental pollution from pesticides through product registration and applicator certification.

Fish and Wildlife Conservation Act of 1980 (Public Law 96-366; 16 USC §2901 *et seq.*) – encourages management of non-game species and provides for conservation, protection, restoration, and propagation of certain species, including migratory birds threatened with extinction.

Fish and Wildlife Coordination Act of 1934 (16 USC §661 *et seq.*) – provides a mechanism for wildlife conservation to receive equal consideration and coordinate with water-resource development programs.

Land and Water Conservation Act of 1965 (16 USC §4601 *et seq.*) – assists in preserving, developing, and assuring accessibility to outdoor recreation resources.

Migratory Bird Conservation Act of 1929 (16 USC §715 *et seq.*) – establishes a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds.

Migratory Bird Treaty Act of 1918 (Public Law 65-186; 16 USC §703 *et seq.*) – provides for regulations to control taking of migratory birds, their nests, eggs, parts, or products without the appropriate permit and provides enforcement authority and penalties for violations.

National Historic Preservation Act of 1966, as amended (PL 89-665; 16 USC §470 et seq.) – directs federal agencies to take into account the effect of any undertaking (a federally funded or assisted project) on historic properties.

Native American Graves Protection and Repatriation Act of 1990 (Public Law 101-601; 25 USC §3001-3013) – addresses the recovery, treatment, and repatriation of Native American and Native Hawaiian cultural items by federal agencies and museums. It includes provisions for data gathering, reporting, consultation, and issuance of permits.

Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 – created the Aquatic Nuisance Species Task Force which is committed to preventing and controlling aquatic nuisance species and implementing the act.

Noxious Plant Control Act (PL 90-583) – provides for the control and management of nonindigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.

Plant Protection Act of 2000[1] (7 USC §7701 et seq.) (replaces Federal Noxious Weed Act of 1973 [PL 93-629] – authorizes the USDA to prohibit or restrict the importation or interstate movement of any plant, plant product, biological control organism, noxious weed, article, or means of conveyance if the Secretary of Agriculture determines it is necessary to prevent introduction or spread of plant pests or noxious weeds.

Plant Quarantine Act (7 USC §151-167) – regulates the importation and interstate movement of nursery stock and other plants that may carry pests and diseases that are harmful to agriculture.

Resource Conservation and Recovery Act of 1976 (42 USC §6901 *et seq.*) – establishes a comprehensive program which manages solid and hazardous waste. Subtitle C, Hazardous Waste Management, sets up a framework for managing hazardous waste from its initial generation to its final disposal. Waste pesticides and equipment/containers contaminated by pesticides are included under hazardous waste management requirements.

Soil Conservation Act of 1935 (16 USC §590a *et seq.*) – provides for soil conservation practices on federal lands.

Watershed Protection and Flood Prevention Act (PL 84-566; 16 USC §1001-1009) – the Soil Conservation Service at the Department of Agriculture provides planning assistance and construction funding for projects constructed by local sponsors, often in the form of flood control districts.

<u>Federal Regulations</u>

32 Code of Federal Regulations (CFR 190) – Natural Resources Management Program

40 CFR 6 – USEPA Regulations on Implementation of NEPA Procedures

40 CFR 162 – USEPA Regulations on Insecticide, Fungicide, and Rodenticide Use

50 CFR 17 – USFWS list of Endangered and Threatened Wildlife

50 CFR 10.13 – List of Migratory Birds

[1] Replaces Federal Noxious Weed Act of 1974 (Public Law 93-629; 7 USC §2801).

APPENDIX D

Prioritization of Natural Areas Using Sensitivity Analysis

Wetlands: Two polygon layers were used to make up this theme. The first is the Wetlands Layer that is managed by GPHC, and the second is an export of the hydric soils from the SSURGO layer. The scores for this theme were calculated on whether or not these polygons were present or absent for an area.

Primary headwater streams: HHEI scores were spatially joined to a HUC-14 watershed polygon layer. If there were multiple scores per HUC, we captured the highest HHEI score for that polygon. Then we unioned the primary headwater stream buffers to the watershed layer, and any area that fell within the buffer would get a score boost for being in the riparian zone.

Medium streams: Medium-sized stream were buffered and had macroinvertebrates and attainment scores spatially joined to them. Where available, the score was calculated for macroinvertebrate points first, then attainment next.

Rarity: This theme is similar to the wetland theme. We had three polygon datasets that were compiled together to indicate where rare plants and animals were located. Score was assigned by presence or absence of the layer for the area in question.

Forest age: A raster dataset where the score was calculated by the natural breaks in the data. We did make a few changes to the data. We know that the original data was calculated on a national level, which reasonably means that there were some errors in the data. Because we know the area on a local scale we were able to improve on the quality of the data.

Floristic Quality: Point dataset with scores created for a 10 meter radius around the sampling area every 10 acres. Layer is managed by GPHC. Score for this theme was created by using the natural breaks in the data.

Habitat cores: This theme looked at habitat corridors within the park boundaries, and areas that extended outside of our boundaries. This layer was scored so that natural areas that were part of a corridor, or that were next to other natural areas outside of our parks, scored high. We also scored farmland within our boundaries as a half weight if it was located adjacent to other more natural areas.

Geophysical settings: This theme analysis used The Nature Conservancy's (TNC) Resilience Raster data. Raster was reclassified into the categories defined by TNC.

Soil Erodability: This Theme utilized the K Value (value used to analyze Soil erodability) located with the SSURGO Soil layer. The higher the K Value score, the higher the score for the theme was.

Slope: this was created from a Digital Elevation Model Raster, ran through the Slope Spatial Analysis tool. Data was scored based on the slope grade. The steeper the slope the higher the score.

Large Rivers: The largest rivers were buffered and assigned an attainment score. This layer is scored high if the river is fully attaining, compared to medium for partially attaining, or low for non-attaining.

Veg type: This theme looked at land cover classifications and scored based on the most sensitive cover type. This theme also looked at buffer zones around lakes, giving those areas a high score as well.

Floodplains: Score was assigned to the Flood zone and zone suitability in the FEMA Special Flood Hazard Area layer.

Appendix E – Threats to Natural Resources

This appendix provides an overview of the main threats and challenges to natural resources at Great Parks of Hamilton County (GPHC or Great Parks), identifies the resources at risk, and provides a brief overview of the management approach to addressing those threats and challenges. Several overarching issues affect many of the natural systems within GPHC parks and preserves.

Given the many and growing number of threats to natural resources, GPHC is committed to continually evaluating the source of each threat as well as the relative severity of its impact. Threats are categorized as either those that can be stopped and resolved through management, those that cannot be stopped but can be partially mitigated through management, or those that cannot be managed by GPHC staff alone and require further monitoring and outreach to educate the public on everyone's role in addressing the threat.

THREAT CATEGORIES

- Resolve
    - Examples include: sewer leaks (point-source pollution), encroachment, and damage to wildlife and plants from off trail activities
- Manage and mitigate
    - Examples include: invasive species, lack of forest regeneration, and increased visitation in sensitive areas
- Monitor and educate
    - Examples include: climate change, water quality issues, air quality issues, pollinator decline

Once a threat is identified, ongoing conversations among specialists and managers determine the course of action based on the potential severity of impact. For example, sewage leaks are typically in the resolve category and are reported, investigated and resolved through an established process in partnership with municipalities. This approach was also utilized during the response to the 2014 oil pipeline leak at Oak Glen Nature Preserve. The level of impacts related to the pipeline leak were high, warranting immediate action, communication, and collaboration with stakeholders. In the second category, mitigate, a lack of forest regeneration also has severe consequences, although the timeline is much longer. Multiple approaches carried out over many years of proactive management will be necessary to address this threat, including reduced browsing pressure through wildlife management, seedling protection, tree plantings, and fencing.

Below, we outline eight major threats to natural resources at GPHC, discuss the resources most at risk, and outline our approach to managing natural resources to weather the impacts of those threats using this tiered approach.

1.0 Climate Change

Climate change is a significant environmental stressor and a growing problem for everyone. The national climate change assessment (Pryor et al. 2014) suggests that major impacts in southwestern Ohio will include extreme rainfall events, increased flooding, and heat waves linked to more severe summer droughts, a longer frost-free season, and changing forest composition. This poses problems for our natural areas specifically, because it compounds existing threats. For example, bat populations that are in decline due to white nose syndrome might have decreased chances of survival if winters become less predictable and cause them to emerge from hibernation too early. Similarly, the conditions that allow the fungus causing white nose syndrome to thrive might improve with warmer temperatures.

Annual average temperature is a common metric for our changing climate, and over the contiguous US it has increased by 1.2°F (USGCRP 2018). The number of days over 86°F is likely to increase by the end of the century. In Hamilton County, days per year reaching a temperature of 86°F could increase to over 97, far more than the 47 days recorded in 2009 (www.nrs.fs.fed.us/pubs/55870). Climate change can act as a multiplier of existing threats that influence local forest ecosystems (landslides, drought, pests, and invasive plants), which can create negative feedback loops increasing the conditions that are posing threats.

1.1 Resources at Risk

The interconnectedness of ecosystems means that all natural resources are at risk from climate change. Changes in the ranges and distributions of plants and animals (Sections 3.4 and 3.5), which will tend to shift their range and migrate north as temperatures rise, will be something that GPHC will need to continually monitor. These communities can become vulnerable to invasive species as disturbances impact plant communities. For example, climate change may allow invasive plants to penetrate further into previously untouched areas and may compromise existing communities through increased drought and higher temperatures. These disturbances may stress native plant communities and result in decreased species richness in the region.

Sustainability is one practice that can help minimize risks to natural resources through activities that reduce development and demand for resources. Reducing the carbon footprint of GPHC will help mitigate effects of climate change that are adding stressors to natural resources in the form of shifting moisture and temperature regimes, severity of storms, air quality, and phenology of plant and animal species which have compounding effects.

1.2 Approach –Mitigate, Monitor and Educate

GPHC continues its commitment to reducing greenhouse gases with the guidance of our new Sustainability Coordinator (position established in 2019) and the Sustainability Task Force. This team is taking steps to establish Great Parks as a leading sustainability organization in the region, engaging and educating the public to participate in more sustainable practices.

Acting as a leader in sustainability requires ongoing action both internally and externally. Internal efforts focus on reducing the organization's carbon footprint and changing the agency's cultural behavior. The first step in this effort is to build a reliable, comprehensive database and action plan in line with common worldwide standards such as: green building certification, stormwater management, and design guidelines.

Below is a list of sustainability initiatives that GPHC has undertaken since 2000.

Energy Efficiency and Green renovation

- 2013: Zero net maintenance building at Winton Woods – The building is covered with solar panels that provide all the electricity needed. An online kiosk is available to track data.
- 2017: Winton Woods campground building – renovation was made based on green buildings methods including the material selection, efficient water systems, and appliances.
- 2019-2020: Replacing all lights at Great Parks' parking lots with LED lights and a smart lighting system.
- Hybrid vehicles have been purchased to replace conventional fleet (of 115 vehicles, 9 (6.5%) are hybrids).
- The campground office at Winton Woods utilizes geothermal energy.

Education programs and public engagement

- Leave No Trace: A comprehensive national initiative based on seven principles for minimizing impacts outdoors. Great Parks is an active member and has educated hundreds of participant and youth groups.
- Great Parks Volunteers: hundreds of long and short-term, adult and teen volunteers participate in natural resources management events annually
- Holiday Light Recycling Program: annual collection of holiday lights has diverted over 17,000 lbs. of decorative lights from the landfill.
- Lake Clean Up: An annual clean-up at Winton Woods Lake engages volunteers in an effort to pick up trash from watersheds to protect marine life, prevent pollution, and increase recycling.
- "Where our food comes from": Includes vegetable beds and an educational program about growing food and local food sources at Parky's Farm and Glenwood Gardens.

Stormwater management

- Rain Gardens: Established for stormwater management at the Winton Centre parking lot and Winton Woods campground, Sharon Woods visitor center, and Farbach-Werner Nature Center.
- Permeable pavers were utilized for a portion of the Winton Centre parking lot.

Tree Planting and Native Plants

- 2013-2016: The Taking Root program resulted in planting over 160,000 trees at Great Parks.
- Ongoing planting efforts to replace canopy lost due to the emerald ash borer (*Agrilus planipennis*) (EAB) and natural decline.

Golf Course and Facility Improvements

- Wastewater treatment plant ESD Waste2Water – water recycler treats and circulates water allowing for reuse of the same water for multiple equipment cleanings.
- Electric carts are part of the fleet at each golf courses.
- Zoysia grass, a more sustainable grass that requires less irrigation and is fungus resistant, is utilized.
- 2013: Sharon Woods Golf Course received Audubon Certification for enhanced natural areas and wildlife habitat.

In anticipation of likely direct impacts on natural resources, GPHC is also following recommendations specific to our region such as maintaining and promoting a diverse assemblage of tree and plant species that can survive a variety of scenarios including increased storm events, drought, and heat. Another approach to managing natural resources under climate change is through partnerships with researchers and fellow conservation organizations to assess the health of our changing ecosystems, better utilize resources, and apply a regional approach to management.

Climate change is a global challenge, and the direct impacts GPHC can make are limited. Therefore, efforts are also focused on educating the public about the changes happening locally and what individuals can do to help. At the external level, Great Parks provides opportunities for residents and guests to engage, learn, and adopt best practices of sustainability while promoting wonder, connection to nature, and conservation. GPHC aims to become a community-based environmental anchor for local initiatives in order to expand partnerships and coalitions for sustainability in Hamilton County. Great Parks is a member of the Cincinnati 2030 District[1] and future opportunities for involvement include community gardens, community composting, special events, and volunteering opportunities.

2.0 Habitat fragmentation, degradation, and loss

As cities expand, urban sprawl tends to fragment remaining tracts of natural communities. The resulting landscape offers less connectivity for movement of species and smaller areas in which species can exist. Habitat fragmentation results in a net loss of habitat. In forests, this results in less total forest cover and a higher ratio of forest edge to forest interior.

Forest edges, where the forest abuts open or developed space, are hotter, drier, and more prone to entry by invasive species (Cadenasso and Pickett 2001). Though some species including white-tailed deer thrive on forest edges, many native species, such as some

[1] https://www.2030districts.org/cincinnati

neotropical migrant songbirds, experience higher predation and parasitism or increased competition for resources near forest edges (Chalfoun et al. 2002).

The vast majority of GPHC property is situated adjacent to private land owners. Encroachments can change habitat types, provide inroads for activities such as illegal dumping, introduce pollutants to streams and soils, and increase the amount of litter and debris present in natural areas that can be harmful to wildlife. Identifying and addressing issues along the 248 miles of park boundaries in order to minimize and repair damage is one of the biggest conservation priorities.

Several parks and preserves have a very high ratio of border to interior space. In cases like this, encroachments by neighboring owners can have disproportionate impacts on natural areas. For instance, preserving wildlife corridors or contiguous greenspace at Winton Woods is difficult due to the shape of the park property and the many boundaries it shares with neighbors. When neighboring properties push beyond their legally-allowed property boundaries, they intensify the edge effects on the natural areas of Great Parks.

Table 1. Great Parks of Hamilton County Properties with Boundary Information.

Park Name	Miles of Boundary	Acres per Boundary Mile
Miami Whitewater Forest	43.3	108
Winton Woods	32.6	78
Mitchell Memorial Forest	27.6	60
Woodland Mound	14.5	74
Shawnee Lookout	13.8	146
Sharon Woods	8.7	84
Embshoff Woods	4.4	76
Otto Armleder	4.4	70
Triple Creek	4.3	42
Glenwood Gardens	3.8	89
Withrow Nature Preserve	3.5	76
Lake Isabella	2.9	26
Farbach-Werner Nature Preserve	0.9	27

2.1 Resources at Risk

Habitat fragmentation, loss, and degradation impact almost every natural resource listed in Section 3. Aquatic resources (Section 3.2) are degraded when intact forests are removed, and this directly impacts vegetation (Section 3.3). Invasive species (Section 3.4) benefit from disturbance, especially habitat fragmentation, and these impacts are likely to degrade habitat for fish, wildlife, and rare species (Sections 3.5 and 3.6). Recreation is likely to be negatively impacted in those areas where conserved lands (e.g., trails or viewsheds in less recreationally

developed areas) are degraded or divided (Section 3.7), and ecosystems overall will be less resilient to disturbances amplified by climate change when they become fragmented (Section 3.8).

Encroachments have the potential to impact all natural resources, and the specific impacts will depend on the location of the encroachment. Illegal discharges from sanitary sewers can impact streams (Section 3.2), and land use changes can impact soils (Section 3.1), vegetation and wildlife (3.3 and 3.4). Sensitive areas near park boundaries are at risk from neighboring activities including unauthorized trails and roadways that may disturb sensitive resources (Section 3.5).

2.2 Approach – Resolve, Mitigate, Monitor and Educate

GPHC is addressing the challenge of habitat fragmentation, degradation, and loss by addressing encroachments and acquiring properties to reduce edge effects when possible. For example, inholdings in Mitchell Memorial Forest have been prioritized for purchase by Great Parks, as have properties along riparian corridors (e.g., Whitewater River riverfront properties) and other regional lands with high conservation value (e.g., regionally rare habitats). Park Natural Resource Plans and Project Plans are reviewed with scrutiny whenever fragmenting projects are proposed on lands already owned and managed by Great Parks.

Large tracts of farmed land are also being replanted with trees and prairie species as an ongoing effort to create more contiguous blocks of habitat. Native species of seedlings, saplings and larger trees suitable for each location are planted to initiate natural succession. In each case, a nearby forest is identified as a reference ecosystem to be used as a restoration target. This has been successful in the Whitewater River Corridor properties along Kilby Road, where larger trees planted with a cover crop in 2017 are thriving, and volunteer trees have become well-established.

In addition, Great Parks is actively partnering with regional groups to conserve and protect habitats and educate county residents about their value and importance. For example, in the fall of 2020, GPHC became a partner in the Great Miami Riverway Coalition, the only National Water Trail in Ohio, with 99 miles of connected communities along the Great Miami River. Partnerships such as these leverage limited community resources to promote awareness of our natural resources and preserve them for future generations.

Conservation & Parks (C&P) is responsible for addressing encroachments with the help of the Rangers and Planning Department. In the past, boundary monitoring was performed by volunteers guided by the GPHC Surveyor. Staff and members of the public can report encroachment issues by sending an email to encroachments@greatparks.org. Once received, the issue is either resolved or the case is escalated, requiring a second letter, legal action and restitution.

3.0 Lack of Forest Regeneration

The establishment of the City of Cincinnati and the extensive agricultural practices occurring throughout Hamilton County have resulted in few old-growth tracts of forest remaining in Hamilton County. Forest regeneration is a major concern for Great Parks and the state of Ohio. Natural regeneration of forests no longer proceeds as it had in the past, and oak species were recently absent from the list of the ten most common tree species identified at survey points throughout GPHC. Historical surveys of this region reveal a slightly different forest composition (Braun 1950), indicating that oak trees are not regenerating as much as they once did.

One significant threat to the natural resources of Ohio is the overabundance of white-tailed deer, which affects forest composition by browsing. Ohio's deer population was extirpated a century ago, returned in the 1950s, and then increased from about 17,000 deer in the 1970s to an estimated 700,000 deer today (ODNR 2016). Deer consumption of seedling and sapling trees combines with other factors to create a dynamic wherein modern forests are less diverse and more homogenous across regions of Ohio than historic forests (Deines et al. 2016).

The lack of young forests negatively impacts reptiles, birds, and mammals, some of which are relatively rare on the landscape (The Young Forest Project 2020). This trend of an overabundance of mature forest and too little young forest will continue and likely intensify in the absence of active management. Forests are composed of more and more maple trees and invasive species than in the past, and without management intervention, our native oak-hickory forests will fail to regenerate in many areas. These changes will directly affect Hamilton County residents and visitors, impacting the quality and quantity of natural resources available to future generations.

3.1 Resources at Risk

Resources at risk in forest regeneration are the forests themselves (Section 3.3), the flora and fauna that depend on them (Sections 3.5 and 3.6), and park guests seeking recreational experiences in native forests (Section 3.7). Invasive species would benefit from a lack of forest regeneration (Section 3.4). Resiliency to climate change (Section 3.8) would be negatively impacted for a variety of reasons, from carbon storage to species range shifts.

3.2 Approach –Mitigate and Monitor

Great Parks manages a robust bow hunting and deer management program, which succeeds in reducing the impact of deer on park property. However, the unique challenges associated with urban park districts mean that there are many boundaries where the wide range for white-tailed deer combined with conflicting wildlife management practices lead to a constant influx and movement of deer on properties. Despite these challenges, GPHC has

successfully reduced the density of deer in the two decades since the program has been established.

In addition to reducing browse pressure in forests, Great Parks has partnered with community groups to experiment with fencing tree plantings. The fences prevent damage from deer browsing and promote the growth and establishment of species such as oaks that do not regenerate as readily as other species such as maple. Current data indicate that more work needs to be done in terms of young forest regeneration, and the NR team plans to focus efforts on continuing to minimize the impacts of deer while experimenting with cost-effective methods of regenerating native forest communities.

4.0 Invasive Species

Plants and animals that did not originate from this region and therefore lack natural predators can outcompete native plant and animal communities and decrease species richness. Invasive species are costly to manage and disrupt the supply of goods and services such as food crops, timber, and fishing, as well as ecosystem services such as provisioning clean air.

In managing for invasive species, GPHC identifies high-quality natural areas that are relatively intact and can be defended against invasive species (as opposed to those with established invasions or with lower quality plant communities). This approach allows GPHC to detect invasive species early before they become well-established. Surrounding areas of lower quality may be managed to a tolerable number of invasive plants until they can undergo more focused efforts after high-quality areas are sufficiently protected.

Invasive plant species

Invasive plants are major threats to native ecosystems, outcompeting native species and degrading the ecological services they provide. For instance, while birds readily eat bush honeysuckle berries, they provide less fat than typical native berries, making them less suitable for migrating birds with high energy demands. Unless managed, invasive plant species decrease the quality of our natural areas as habitat and reduce the number of species that can be supported. Invasive species management is increasingly time-consuming as the number of problematic species grows. This is evident in the management plans that C&P has been utilizing for the past several years. Prioritizing large-scale habitat management, minimizing "edge" and fragmentation of habitats, and early detection and elimination of new invasions is a key focus of NR's strategy for invasive plant management.

This region's most noticeable invasive plants include Amur honeysuckle (*Lonicera* spp.) seen as an unusually green shrub layer in the fall, lesser celandine (*Ficaria* verna) which creates thick green mats with yellow flowers in the spring, and Callery pear trees (*Pyrus calleryana*) which display a forest of white when in bloom. These plants also spread prolifically or emit allelopathic properties which facilitate spread within natural areas, decreasing the functional diversity upon which other fauna and flora rely.

Great Parks C&P staff spend significant time and effort working each year to slow the spread of invasive plant species, especially in open prairie and brushland areas. In 2020, Sharon Woods staff treated roughly 60 acres of bush honeysuckle over the course of two months using a foliar herbicide application method.

Management efforts for invasive plant species must be undertaken with care to avoid impacts to ecosystems, native plants and sensitive wildlife, such as fish and amphibian larvae. The objective is to protect the resources in the area, not simply to eliminate threats at all costs. Accomplishing these goals requires knowledge of plant identification, the ability to recognize invasive species, and an understanding of available control methods, among other things. Great Parks formed a Pesticide Committee in 2020, which works across disciplines in the park (e.g., Golf and Natural Resources) and is aimed at creating a formalized pesticide policy which emphasizes Integrated Pest Management.

Table 2. Invasive Plants and Typical Affected Areas at Great Parks of Hamilton County

Common Name	Scientific Name	Wetlands	Floodplains	Upland Forests	Open lands
Autumn olive	*Elaeagnus umbellata*			x	x
Asiatic bittersweet	*Celastrus orbiculatus*		x	x	x
Bush honeysuckle	*Lonicera spp.*			x	x
Callery pear	*Pyrus calleryana*		x		x
Chinese lespedeza	*Lespedeza cuneata*				x
Curlyleaf pondweed	*Potamogeton crispus*	x	x		
European buckthorn	*Rhamnus cathartica*	x			x
Garlic mustard	*Alliaria petiolata*			x	
Hydrilla	*Hydrilla certicillata*	x	x		
Japanese chaff flower	*Achyranthes japonica*		x	x	
Japanese knotweed	*Polygonum cuspidatum*	x	x		
Japanese stiltgrass	*Microstegium vimineum*		x	x	x
Johnson grass	*Sorghum halepense*				x
Lesser celandine	*Ficaria verna*	x	x	x	

Phragmites (giant reed)	*Arundo donax*	x			x
Poison hemlock	*Conium maculatum*	x			x
Porcelain berry vine	*Ampelopsis brevipedunculata*			x	x
Purple loosetrife	*Lythrum salicaria*	x	x		
Teasel	*Dipsacus fullonum*				x
Tree of heaven	*Ailanthus altissima*			x	
Wild parsnip	*Pastinaca sativa*	x			x
Winter creeper	*Euonymus fortunei*			x	

The three most commonly-detected native species in the FQAI data were Virginia creeper (*Parthenocisus quinquefolia*), box elder (*Acer negundo*), and white snakeroot (*Eupatorium rugosum*). These are early successional plants. Additionally, the three most commonly detected non-native species were each invasive plants: bush honeysuckle, garlic mustard, and multiflora rose. Bush honeysuckle was found at 79% of plots surveyed, underscoring the scale of the management challenge.

Invasive Insects & Pathogens

Invasive insects and introduced pathogens can cause considerable damage to forests, woodlands, and urban vegetation (Table 3), and some also affect wildlife. Many of the most devastating are introduced species originating outside the U.S. Since our native species evolved without these introduced species, they have few mechanisms of resistance to the introduced insects and disease-causing organisms, and these introduced species have fewer predators and environmental factors to keep their populations in check. Some of these pests spread on their own, while others are inadvertently introduced by people through activities such as moving infested firewood or bringing in infected hosts. Often, the most devastating invasive insects and diseases remove entire tree species from the landscape (e.g., hemlock wooly adelgid [*Adelges tsugae*]), entire genera (e.g., EAB), or even several groups of species (e.g., Asian longhorn beetles [*Anoplophora glabripennī*] [ALB]). In each case, gaps in the forest provide opportunities for establishment, often fillled by invasive plants. In other cases, invasive microbes can devastate host populations to the point of at least local extinction. Dutch elm disease and several emerging disease threats (e.g., beech bark disease) are caused by fungi transmitted by a beetle.

Table 3. Invasive insects, disease threats, and possible effects at GPHC

	Invasive Insect or Disease	Host	Effect
Past	Dutch elm disease	American elm (*Ulmus Americana*) trees	Fungus carried by beetles damages tissues under bark, trees plug nutrient transmitting vessels and die
	Emerald ash borer	Ash trees	Tree death within 3-5 years
Current	Elm yellows disease	Elm trees	Death 1-2 years after summer leaf yellowing due to phloem necrosis caused by bacteria carried by insect
	Chytrid fungus	Amphibians	Salamander and frog mortality
	West Nile, Lyme disease, encephalitis	Mosquitos, ticks & vertebrates	Flu-like symptoms, encephalitis, death
	White nose syndrome	Bats	Local extinction of several bat species
	Snake Fungal Disease	12+ snake species	Skin lesions and often fatality
	Asian longhorn beetle	Deciduous trees	Tree death occurs 10-15 years after infestation
Future	Chronic Wasting Disease & Tuberculosis & Epizootic Hemorrhagic Disease (EHD)	Deer	Deer mortality
	Gypsy moth (*Lymantria dispar*)	Deciduous trees	Severe damage or death after second defoliation
	Beech leaf disease	Beech trees	Large scale leaf damage, permanent consequences unknown

GPHC collaborates in monitoring and research efforts with state agencies and local universities. GPHC also implements management practices such as purchasing only kiln-dried firewood for campgrounds to reduce the risk of introducing insects like ALB.

4.1 Resources at Risk

Invasive species are a rapidly-expanding threat to habitats at GPHC with immediate impacts. This is reflected in the fact that the majority of NR work in each park is dedicated to treating

and removing invasive plant species (e.g. honeysuckle removal) and evaluating damage to habitat from invasive pests (e.g. hazardous tree inventory). All natural resources covered in this NRMP are at risk from invasive species. Soils can become destabilized when vegetation cover is lost due to disease or infestation of native plants (e.g. emerald ash borer), or establishment of aggressive invasive plants (e.g. lesser celandine). Aquatic resources may be directly impacted from introduced aquatic invasive species or indirectly impacted from a loss in ecosystem function (e.g. sedimentation increases in streams due to lack of native riparian buffers). Vegetation is directly impacted by changes in composition of species, which results in changes to our native vegetation. For example, ephemeral native wildflower displays are at risk in areas where high densities of early spring non-native plants, such as lesser celandine and garlic mustard, exist. Fish and wildlife are impacted by changed forage, which may be of lower nutritional value, and habitat for nesting and breeding birds may be altered by changing species composition. Threatened and endangered species are and recreation and education can be diminished when native species are displaced (Sections 3.1 – 3.7).

4.2 Approach – Manage, Monitor and Educate

NR is addressing the vast challenges of invasive species by prioritizing the highest quality areas and most sensitive resources to protect against invaders, then creating expanding buffers around those areas. As stated above, many hours of C&P labor are dedicated each year to the removal of bush honeysuckle and other aggressive invasive plants. The overarching goal is to preserve habitat for early spring ephemeral species of the forest floor that may be outcompeted for resources in early spring before trees leaf out. These plants provide a vital food source for pollinators early in the season when other food sources are not yet available. Additionally, eliminating invasive plants can provide openings in forests for young native forest to regenerate. Thus, this management strategy coincides with deer management, tree planting, and many other natural resource management activities.

NR endeavors to stay abreast of invasive species that are spreading nearby and strives to educate staff to monitor for signs of them during routine duties. As of the writing of this draft in Spring 2021, the spotted lanternfly (*Lycorma delicatula*) is an invasive species appearing in nearby areas. NR staff have attended webinars about this pest in order to learn signals of its presence. Most recently, GPHC has been tasked with the management of the emerald ash borer. In Great Parks, many thousands of ash trees were removed when they died or presented a hazard due to the pest. Great Parks has also implemented restrictions on moving firewood.

5.0 Wildlife imbalances and conflicts

Human activity can significantly change the behavior of animals. For instance, hunting, habitat modification, feeding wildlife, and getting too close to wildlife can lead to wildlife imbalances, conflicts, and perceived conflicts. Some species of wildlife have adapted to urban conditions, as they provide novel food sources, suitable habitat, and a lack of predators.

Since wolves have been removed from the landscape, depriving white-tailed deer of a natural predator, deer populations have reached unsustainable levels. This is an example of a wildlife imbalance. Raccoons present a wildlife conflict, as they have adapted to surviving on food scraps from garbage cans and often approach people. Raccoon populations in developed areas now exceed those in rural areas because reproductive and survival rates are higher (Prange et al. 2003). Perceived conflict occurs when an animal is observed by the public and is identified as a problem but is not actually posing a real threat to health, safety or financial security. Perceived conflicts are communicated to GPHC via many phone calls from the public regarding injured animals, noises from coyotes (*Canis latrans*) in early morning hours, and lawns occupied by Canada geese (*Branta canadensis*). Managing boundaries between humans and wildlife in order to prevent conflicts is an ongoing challenge that requires education, active management and monitoring. GPHC Interpreters provide educational resources to the public for these wildlife encounters, and NR also plays a role in monitoring, preventing and resolving conflicts.

5.1 Resources at Risk

Animals themselves are at risk when there are community imbalances and conflicts at play. Overabundance of a species can lead to insufficient food and poor nutrition. On the other end of the spectrum, feeding of wildlife can also lead to poor nutrition and increased chances of transmitting disease within and among species. Similarly, feral cats and pet cats left outdoors can negatively impact the songbird populations through predation.

Aquatic resources (Section 3.2) may be negatively impacted by an overabundance of Canada geese, as is often seen in the spring during nesting season for these animals. In GPHC lakes and ponds, negative impacts to water quality and riparian vegetation can be significant. Impacts from geese can also impact recreational activities (Section 3.6), such as fishing, in these areas.

Asian carp[2] are present in the Ohio River and pose a potential threat to water resources, but they haven't been identified in recent lake fish surveys (Booth 2020). Asian carp are fast-growing and prolific feeders that out-compete native fish and can have a negative impact on the environment. However, common carp (*Cyprinus carpio*), a non-native fish introduced as a game species, is a dominant species in both Winton Lake and Miami Whitewater Forest Lake (Hageman and Lorentz 1995; Buschelman et al. 1998; Lorentz et al. 2001; Lorentz 2005; Enviro Science 2008). Common carp often dominate in hypereutrophic conditions and are considered naturalized. They can increase lake turbidity by uprooting vegetation while feeding.

[2] The collective term for the four types of carp that originated from Asia - bighead carp, black carp, grass carp, and silver carp.

5.2 Approach – Manage, Monitor and Educate

Management of urban wildlife by GPHC focuses on preserving biological carrying capacities that promote a diversity of species. NR responds to wildlife imbalances and conflicts first by minimizing the conditions which lead to these situations. For example, allowing lawn and aquatic vegetation to grow up adjacent to areas of open water will deter Canada geese from gathering there. In the case of raccoons, educating campers about the importance of keeping a tidy campsite and installing appropriate trash receptacles can prevent inadvertent feeding and conflicts. In some cases where animals have become socialized and cannot be deterred, GPHC may resort to removal. The only animal hunted on Great Parks property is white-tailed deer.

The second approach that GPHC uses to manage wildlife conflicts is education. The public often reaches out to GPHC Guest Services regarding wildlife, and usually the guest is referred to NR or to Interpreters. Sometimes listening to the concern, explaining GPHC's approach to managing wildlife, and sharing advice on how to avoid conflicts addresses the issue. Educational materials may be shared or a visit to property may be warranted. Signage designed and installed in collaboration with GPHC Marketing & Planning staff is sometimes utilized to address ongoing issues such as wildlife feeding.

6.0 Pollution

Pollution can come in various forms, affecting air, water, soil, plants, and animals. Within GPHC parks and preserves, the pollution of greatest concern includes nutrient loads in waterways, trash, contamination events such as flooding or sewer overflows, and air pollution. The location of the park or preserve is a major factor in what types of pollution impact it. For example, parks located in more urbanized areas, such as Sharon Woods, are likely to be impacted by the development and activities of surrounding neighborhoods and roadways. More rural locations like Miami Whitewater Forest, on the other hand, are more likely to be impacted by agricultural and industrial activities.

Contamination of GPHC waterways is addressed in collaboration with other stakeholders in each watershed. Spills into waterways are coordinated with Hamilton County Public Health (HCPH) and Ohio EPA, as well as the responsible party. For example, sanitary sewer overflows in neighboring communities have a responding team that includes representatives from GHPC, HCPH, Ohio EPA, and Metropolitan Sewer District of Greater Cincinnati, while vehicular accidents involving spills will be responded to by GPHC, Ohio EPA, and the trucking company or vehicle owner.

Air quality is primarily affected by combustion of fossil fuels from vehicle emission and power plants, which leads to increased particulate matter and greenhouse gasses. These conditions have unhealthy effects on sensitive groups such as active children and adults, and people with respiratory disease like asthma. Air quality advisories are not uncommon in warmer seasons of the Ohio River Valley.

Inadvertent littering from vehicles and park users as well as illegal dumping can pass non-biodegradable particles and toxins into the food web and increase the workload for C&P staff. This is especially true after flood events in riverfront parks such as Fernbank Park and Otto Armleder.

6.1 Resources at Risk

Aquatic resources (Section 3.2) are degraded when pollution enters them, which directly impacts fish and wildlife (3.4). Native species may be at a disadvantage in areas where pollution is heavy, opening opportunities for invasive species (Section 3.4) to become established. Recreation (Section 3.6) can also be negatively impacted by by pollution, with activities and even access being limited depending on the severity of the issue. Ecosystems overall become be less resilient to changes amplified by climate change when they are negatively impacted by pollution (Section 3.8).

6.2 Approach – Resolve, Monitor and Educate

GPHC strives to minimize impacts from pollution, especially litter and illegal dumping. Great Parks C&P staff respond to illegal dumpsites promptly and involve NR and appropriate agencies if there appear to be any chemicals or other items of concern present. C&P staff and volunteers conduct litter pick-up events regularly.

Volunteer programs such as the aquatic benthic macroinvertebrate sampling program can help to inform NR of water quality issues through indicator species identified during sampling. Findings that reflect impaired waterways may warrant further water quality sampling and investigation of potential impact areas in a stream. NR also reviews all state-issued water quality reports that impact GPHC parks and preserves. For example, in the fall of 2020, Ohio EPA issued a water quality report for the Whitewater River, and NR coordinated a review of the report, sharing it with managers and leadership so that they were informed about the water quality of that river system.

NR is partnering with the Mill Creek Alliance and other watershed-based conservation groups to protect Hamilton County waterways from pollution. Most recently, Great Parks and the Mill Creek Alliance installed a “Litter Gitter” in Winton Woods, a device which intercepts litter and other solid debris in the stream and holds it for removal to reduce the impact of these pollutants to the Mill Creek watershed. Along with other Mill Creek Watershed partners, GPHC is collaborating with the Mill Creek Alliance on a Clean Water Act 319 Plan interactive map that will help guide pollution-reducing projects with the Ohio EPA in future years.

Air quality alerts are received by NR staff from the Southwest Ohio Air Quality Agency (http://www.southwestohioair.org/) and shared with GPHC. The Air Quality Index (AQI) is a tool that indicates how clean the air is and any associated impacts to public health. This is mostly an issue during the warmer months. GPHC continues to evaluate how it can help to reduce air pollution permanently and is committed to transitioning towards more hybrid vehicles. Currently, 6.2% of GPHC’s vehicle fleet is made up of hybrid vehicles. Great Parks

responds to air quality advisories with a series of management actions such as altered schedules for fueling and driving.

7.0 Stormwater runoff and harmful algal blooms

Natural surfaces, such as meadows and forests, permit greater absorption of precipitation, allowing it to filter slowly into the groundwater. Stormwater not absorbed into the ground can travel across the land surface entering streams, rivers and other surface water bodies, especially during heavy rain storms when the soils have become saturated. Water flowing across natural surfaces or below ground is filtered and cooled along the way through natural processes.

With an increase in impervious cover (roads, sidewalks, and surfaces associated with buildings) in urbanized areas, stormwater rushes across pavement and into storm drains, which then release a torrent of warm, sometimes contaminated, water directly into streams. This can cause scouring of the streambanks, which leads to deeper, incised and eroded stream channels, displacement of aquatic life, and downstream sedimentation.

Such storm events and the ensuing runoff can import excessive nutrients and sediment into waterways, leading to problems such as poor water quality and harmful algal blooms (HABs).

7.1 Resources at Risk

Resources at risk are the waterways themselves (Sections 3.2), the flora and fauna that depend on them (Section 3.4), and park guests seeking recreational experiences (Section 3.6) in lakes, ponds, rivers and streams. The severity of the risk for these resources depends on surrounding land uses, degree of urbanization, topography, and other factors. These are addressed further in park-specific NR plans.

7.2 Approach – Manage, Monitor and Educate

Management for water quality includes preserving vegetated buffers around streams and preventing dumping, as well as monitoring water quality of lakes and ponds, assessing all primary headwater streams, and conducting fish surveys.

Wetland management entails occasionally mowing dense swaths of cattails which can foster plant diversity directly and indirectly by creating micro variations in the soil surface (Klein and Conover 2010). In some instances of restored wetlands like at the Shaker Trace complex at Miami Whitewater Forest, water levels are periodically fluctuated to mimic natural cycles, provide time-sensitive habitat, and discourage invasive or aggressive plant species from establishing.

Monitoring for HABs at Great Parks focuses largely on the lakes and ponds that receive the most recreational traffic. HAB informational signs in both English and Spanish were created in 2020 and were installed at all potentially-impacted sites. These signs inform the public of what to look out for and discourage allowing pets to enter or drink from the body of water,

citing the potential health dangers associated with HABs. Great Parks also has a Harmful Algal Bloom Plan (Appendix B) and stays abreast of best management practices to prevent and mitigate impacts from HABs on aquatic resources, recreational activities and park guests.

Management for stormwater is multi-pronged and includes a Municipal Separate Storm Sewer System (MS4) permit with Ohio EPA. In addition, GPHC NR and C&P staff investigate stormwater conditions by monitoring outfalls for illicit discharges. Great Parks maintains stormwater infrastructure, installing green infrastructure where possible, such as the rain gardens adjacent to the parking lot at Winton Woods. Other activities carried out by GPHC include protecting riparian corridors with buffers, strategically planting trees and other vegetation, restoring streams to natural conditions, coordinating litter pickups, and minimizing excess sediment and nutrient inputs with periodic dredging of lakes to remove built-up sediment.

8.0 Flooding/Landslides

GPHC has had multiple flooding events and landslides in the past several years. Winton Woods and Sharon Woods have both experienced landslides. Flooding occurs at Winton Lake and its associated campground, Fernbank Park, the parks and parcels within the Little Miami River Corridor, Woodland Mound, and Otto Armleder Parks. It is not unusual for these parks to experience flooding multiple times per year, particularly in the spring. Hamilton County's soils and deep ravines contribute to the natural incidence of these phenomena, but they are greatly exacerbated by human land use changes and are likely to intensify under climate change scenarios that predict more volatile patterns of rainfall.

Unstable slopes are characteristic of the greater Cincinnati region due to the shape of the landscape mentioned, as well as the underlying materials prone to instability such as lacustrine clays, glacial tills and clay-rich colluvium. Development of these hillsides can increase likelihood of slippage by denuding the slopes of stabilizing vegetation like trees, and concentrating the amount of runoff in unpaved areas. Therefore, GPHC stewards hillsides by limiting development or modification and promoting healthy forests. Water and land use practices can alter the likelihood of both of these events, and riparian corridors continue to be crucial zones for mitigating downstream flood potential.

8.1 Resources at Risk

Resources at risk from flooding and landslides are the geology and soils (Section 3.1) impacted by these events as well as the aquatic resources (Sections 3.2) that receive large inputs of sediment from them. Fish and wildlife (Section 3.4) are likely to be impacted by shifts in lands and the sediment inputs to waterways as well as the vegetation and trees on slopes that slide. Infrastructure and park guests could be effected by unstable hillsides and yet are more likely to be damaged or inconvenienced by floods. Additionally, cultural resources (Section 3.7) and infrastructure in or near floodways or on slopes prone to landslides can acquire damage from frequent flooding and erosion.

8.2 Approach – Manage and Monitor

NR is addressing the challenge of flooding/landslides through monitoring and maintaining stormwater infrastructure. In addition, GPHC is committed to installing green infrastructure where possible. C&P strategically plants trees and other vegetation to stabilize soils and protect and enhance riparian corridors. Livestaking projects in cooperation with regional partners is a low-cost method of revegetating riparian corridors and wetlands with native riparian species.

In addition, stream restoration activities that include reconnecting incised streams to their floodplains and improving channel sinuosity in altered streams are under consideration for several locations in the parks with problematic hydrogeology. Examples of streams with these types of problems include the former golf course at Shawnee Lookout, the channelized stream at Trillium Trails in Glenwood Gardens, and the dammed creek near the Timberlakes Trail in Miami Whitewater Forest. Local mitigation groups are interested in working in partnership with GPHC to potentially restore these streams and offset impacts to streams within the watersheds where they are located.

Appendix F – Implementation Table

2021 NRMP Implementation Table: Goals & Objectives for GPHC NRMP						
Objective			**Criteria: Green**	**Criteria: Amber**	**Criteria: Red**	**Responsibility**
Goal 1: Monitor the state of natural resources and ecological structure and function						
1.1	High Quality Areas: Monitor biodiversity and key attributes of priority conservation areas using Monitoring Grid in Collector.	See training and instructions for monitoring grid. Complete as many assigned cells as possible and report out total number done. -Conservation Biologist to verify	At least 90% of assigned monitoring grid cells completed	60-89% of assigned prority monitoring grid cells completed	Less than 60% of assigned priority monitoring grid cells completed	C&P/NR (Conservation Biologist confirm)
1.2	Required checks: inspect and report conditions A) trail checks/erosion, and B) stormwater outfalls.	A) Continue Trail checks and submit completed forms to Trails Specialist via email - Trails Specialist to confirm and report out B) Continue stormwater outfall monitoring if not complete - Watershed Specialist to report out	More than 90% of stormwater outfall checks completed and trail inspections recorded for at least 9 months	Between 90-50% of stormwater outfall checks completed and trail checks done for at least 6 months of the year	Less than 50% of stormwater outfall checks completed and trail checks done for at least 0-5 months of the year	C&P (Watershed & Trails Specialists to confirm)
1.3	Management Effects: Monitor changes in vegetation following management. (choose at least one topic to monitor in 2021). A. Honeysuckle Removal B. Other Invasive Plant Removal C. Prescribed Burns D. Forestry Operations or Tree Plantings - more documentation.....	Choose one area of any size greater than 0.25 acres that had management activity in the past 2 years. Reference the instruction sheet for 1.3 to do a walk through and estimate the percent cover of native plants and invasive plants. Note any other signs of success or degradation. Verify with estimates and at least one photo emailed to Natural Resources Manager	Monitoring indicates vegetation responding as expected with 90% or more native plant cover and less than 10% invasive plant cover	Monitoring indicates 60-89% native plant cover and/or 11-30% invasive plant cover	Monitoring indicates less than 60% native plant cover and 31% or more invasive plants	C&P (Natural Resources Manager to confirm)
1.4	Maintain spatial data for respective parks via iPad maps	Check on spatial records in iPad for landscaping, legacy benches, invasive species and burn units. Verify all locations and details visible in field. For invasive species map, limit updates to areas treated and add new species as discovered. Director of Natural Resources to spot check and report out.	Layers for burn units, lanscaping, legacy benches and invasive species are 90% accurate	Layers for burn units, lanscaping, legacy benches and invasive species are 75-89% accurate. Less than 3 natural resources datasets are outdated	Layers for burn units, lanscaping, legacy benches and invasive species are 75-89% accurate	C&P (Director of Natural Resources to spot check)
Goal 2: Establish priorities based on best management practices and available data						
2.1	Reprioritize and plan work in sensitive areas based on results of monitoring and resources available		Spatial and temporal priorities set for each park manager	Either spatial or temporal priorities set for each park manager	Neither spatial or temporal priorities set for each park manager	NR
2.2	Reprioritize trail work, stream protection/restoration, prescribed fire intervals, etc based on results of monitoring and resources available		Spatial and temporal priorities set for each park manager	Either spatial or temporal priorities set for each park manager	Neither spatial or temporal priorities set for each park manager	NR
2.3	Maintain biodiversity and key attributes of sensitive areas		No loss of rare species or communities; no decline in key attributes	Temporary or reversible loss of rare species or decline in key attributes, with a plan to mitigate adverse effect	Permanent loss of rare species or decline/loss of key attribute; temporary loss but with no plans to mitigate adverse effect	NR

2.4	Begin internal environmental awareness program to minimize adverse environmental impacts, to include workshops and materials		All materials current and readily available; all requested/required training conducted	More than 50% requested/required training completed;	Materials out of date; less than 50% of requested/required training completed	NR
2.5	Identify and remove potential hazards trees, especially near sensitive and high-traffic areas (e.g. trails, roads, buildings)		Survey of hazardous trees completed annually; hazardous trees prioritzed and removed on target	Survey of hazardous trees completed annually; 75% or more of hazardous trees prioritzed and removed	Survey of hazardous trees completed annually; less than 50% of hazardous trees prioritzed and removed	NR
2.6	Conduct forest activities in a manner that supports recreation, protects against invasive plants, and forest pests, and provides resilient ecosystems with regionally appropriate biodiversity		No conflicts or loss of biodiversity/ecosystem service	Temporary (scheduling or less than one year) conflict or loss of biodiversity/ecosystem service, with a plan to mitigate adverse effect	Forest area unsuitable for use (for more than a year) as a result of forestry or long-term loss of biodiversity/ecosystem service	C&P, NR
Goal 3: Protect and restore natural resources through conservation and sustainable practices						
3.1	High Quality Areas: Maintain biodiversity and key attributes of sensitive areas using results of Monitoring Grid in Collector.	Draft plans to address 3 issues identified while completing monitoring grid, in coordination with NR. Examples include, dumping removal, tree seedling protection, invasive removal, streambank stabilization, wildlife habitat improvement (vernal pools, brush piles), or maple thinning. If limited capacity 1-2 plans are better than none. - Conservation Biologist to verify	Make plans to address 2-3 issues identified while completing monitoring grid, in coordination with NR.	Make plans to address at least 1 issue identified while completing monitoring grid, in coordination with NR.	Make plans to address at least 1 issue identified while completing monitoring grid, in coordination with NR.	C&P/NR (Conservation Biologist to verify)
3.2	When undertaking new or renovated landscaping transition to plants that are regionally native and provide a wildlife benefit, when possible*; start replacing invasive legacy trees and landscape plants with more appropriate species; coordinate with the Directors & Shaker Trace Nursery	Open the "Landscape Map" on the iPad and for any beds that contain invasive species edit the record for "Number of Planted invasives". Other problematic plants like heavenly bamboo, periwinkle and winter aconite are not required but bonus if you'd like to track those! Invasives list here: https://www.oipc.info/invasive-plants-banned-on-ohio.html Legacy pear trees are already known and that list will be shared with you to review and add any records that might be missing. - Chief of C&P to spot check and report out	No new invasive plants in landscaped areas; No remaining invasive legacy trees and landscape plants; consulting with Shaker Trace Nursery occurs before purchasing landscape seed	No new invasive plants in landscaped areas; quantity of invasive legacy trees and landscape plants known and half remain in park; consulting with Shaker Trace Nursery occurs before purchasing landscape seed on more than 50% of projects	Increase in invasive plants that are impacting native vegetation and no plan to address them; no invasive legacy trees and landscape plants removed from park; no coordination with Shaker Trace Nursery.	C&P (Chief of C&P to spot check and report out)

3.3	Ratio of trash cans recycling bins to should be 2:1 in each park with emphasis on high traffic areas.	By December 31st update asset spreadsheet with total number of trash cans and total number of recycling bins per park. Conservation and Parks Administrator to verify	1-2 trash cans for every 1 recycling bin ratio is achieved	3-4 trash cans for every 1 recycling bin ratio achieved	4+ trash cans for every 1 recycling bin	C&P (Conservation and Parks Administrator to verify)
3.4	Report annual pesticide use to NR by responding to email in January each year	Send data to Watershed Coordinator by annual MS4 deadline - Watershed Coordinator to confirm completed	Turn in on time and complete with less than 10% increase than previous year	Turned in on time and complete with more than 10% increase than previous year	Turned in on time and complete with 10% more or less use than previous year	C&P, NR (Watershed Coordinator to confirm)
3.5	Sustainability Audit/Suggestions	Water, Energy & Recycling audits complete in 2021- Sustainability Task Force and volunteers to complete	Water, Energy & Recycling audits complete in 2021;	Two audits complete in 2021;	One audit complete in 2021;	Sustainability Task Force with support from C&P
		Suggest 2-3 conservation actions to Sustainability Coordinator based on water and energy use - Sustainability Coordinator to report out	Suggest 2-3 conservation actions based on water and energy use	Suggest 1 conservation action based on water and energy use	No suggestions to reduce energy or water consumption	C&P (Sustainability Coordinator to report)
3.6	Reduce existing woody debris (first estimate the cubic yards present) attend training on handling woody debris	Reduce stored woody debris at facilities as much as possible by end of the year by working with Regional Director - Regional Director to report out percent reduction since May '21	Reduce stored woody debris by at least 50%	Reduce stored woody debris by 49-25%	Reduce woody debris by less than 25%	C&P (Regional Director to report out)
		Park managers and as many FT staff as practical, attend woody debris handling training. Urban Forester to confirm and report out.	Two or more FT staff have completed/watched training including manager	At least 1 FT staff have completed/watch training	No FT staff have completed/watch training	C&P (Urban Forester to confirm)
3.7	Manage construction, roads/trails, slopes, and exposed soils to minimize erosion and soil loss and comply with all regulations and permitting	NR to set up training of BMPs for preventing soil loss and will provide training. Director of Natural Resources to confirm and report out.	BMPs for preventing soil loss will be made available and a training will be provided	BMPs for preventing soil loss will be made available	No BMPs for preventing soil loss are be made available and no training is be provided	NR (Director of Natural Resources to confirm)
Goal 4: Engage the public and partners in regional collaborations to promote conservation of natural resources						
4.1	Continue public outreach in coordination with other regional entities as available and appropriate		All materials current and readily available; present during at least 1 public event annually	n/a	Materials out of date or not available to the public; no public presentations within last 18 months	C&P, NR
4.2	Continue to cooperate with other agencies and local landowners on regional land and natural resources management efforts		Participate in regional meetings/planning (at least 2 annually); maintain updated list of encroachment issues and letters	Participated in only one regional meeting annually; at least 50% of encroachment issues addressed	No participation in any regional efforts or cooperative projects; less than 50% of encroachment issues addressed	C&P, NR