

Valuation of Ecosystem Services
Geauga Park District

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Chardon, Ohio

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Date:
May 2013

Project Number:
34-29999A

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1 Introduction

Ecosystems represent a dynamic complex of animals, plants, and microbes along with non-living physical elements interacting as a functioning unit (Millennium Ecosystem Assessment, 2005). This gives rise to several benefits, known as ecosystem services, which are the benefits people obtain from naturally functioning ecosystems (Costanza et al., 1997; Daily, 1997; NRC, 2005; Millennium Ecosystem Assessment, 2005; EPA, 2009; Braat and de Groot, 2012).

Ecosystem services are enjoyed by humans directly through use and consumption of natural resources, indirectly through the support and production of enjoyed goods and services, and through non-consumptive means including existence and aesthetic values. Some ecosystem services contain market values. For example, timber and fish are extracted and sold as materials and food in markets. Markets are a useful way to measure the value people hold for different goods and services. However, most ecosystem services are not traded in markets and lack market indications of value because they are public goods. Therefore, many ecosystem services are underappreciated when weighed against choices that contain traditional market prices (Dailey et al., 2009). Recently, methods have become available to place a monetary value on ecosystem services that are not traded in markets. These methods rely on rigorous economic theory regarding how people make choices. These methods include a variety of well-established economic methods, such as willingness-to-pay, avoidance costs, travel costs, and hedonic pricing (TEEB, 2010; de Groot et al., 2012).

Categories of ecosystem services were formalized in the Millennium Assessment Report, published in 2005, and include: provisioning, regulating, habitat, and cultural services. In addition, there are other typologies, or classification schemes, for these services (de Groot et al., 2002; Fisher et al., 2009). Services may be grouped by the type of benefits to humans: direct or indirect. For example, direct benefits may include recreation, such as nature viewing, trails for walking, biking, and horseback riding, as well as hunting and fishing. The natural environment also provides many indirect benefits, such as spiritual well-being provided by natural habitats, water and air purification, noise abatement, erosion control, and climate regulation (e.g., avoidance of the heat island effect of developed urban areas). Some of these services are local (e.g., opportunities for recreation, hunting, and fishing) and others are provided over a much larger geographic scale (e.g., climate regulation and air and water purification). Regardless of the type or spatial scale of these services, they provide clear benefits to humans and therefore are valuable to humans (WRI, 2008; TEEB, 2010; Farley and Costanza, 2010).

Although services provided by the natural environment are important to humans and there are methods to monetize the benefits, some people disagree with the concept of placing a dollar value on something that is irreplaceable or considered priceless (Farley, 2012). This sentiment has some merit; treating ecosystem services as a commodity is fraught with peril. Can a land developer “take” a valuable wetland by just writing a check to cover the costs associated with the ecosystem services provided by the wetland? Although there are additional laws and regulations in place to protect wetlands, other types of habitats and ecosystems are not afforded the same level of protection and the decisions made by the public to preserve natural environments are often based on costs. These costs may be associated with tax levies and potential lost tax revenue associated with less residential or industrial development. To provide a framework to make decisions on land preservation, it is necessary to weigh the economic benefits provided by natural environments.

This report estimates the monetary value of ecosystem services provided by natural environments in properties owned and/or managed by the Geauga Park District. The Geauga Park District owns and/or manages more than 9,000 acres in Geauga County, Ohio. These properties include a variety of parks, preserves, and undeveloped parcels. These properties contain a variety of habitat types and provide a wide variety of recreational opportunities through a network of trails, picnic areas, boat launches, and naturalist-directed educational programs. The Park District is funded primarily through a property-tax levy and private donations. Although these properties provide some provisioning services, such as maple syrup production, agricultural leases, and hunting permits, this report focuses on the monetary value of ecosystem services that do not require the extraction and consumption of natural resources.

This report presents a variety of background information of the Geauga Park District properties, including, demographics of Geauga County, a brief description of each park and preserve, and a brief overview of the types of habitats present and available ecosystem services. Monetary values are presented for ecosystem services from each habitat type and property, direct human use based on the total attendance to each park, direct economic benefits based on increased property values associated with residential properties adjacent to Geauga Park District properties, payroll and sales, and a qualitative discussion of other potential economic benefits provided by undeveloped land owned and/or managed by the Park District.

2 Background Information

This section provides additional information to better understand the demographics of Geauga County, properties owned and managed by the Park District, land cover and habitat types, and types of ecosystem services considered in this analysis.

2.1 Geauga County Overview and Demographics

Geauga County is located in northeast Ohio (Figure 1). It was founded in 1806, as part of the Connecticut Western Reserve. The county has a total area of 256,100 acres, with approximately 2% permanently covered by water. The headwaters for three Lake Erie tributaries originate in Geauga County: Cuyahoga River, Chagrin River, and Grand River. Geauga County receives the most precipitation of any county in northern Ohio; average annual precipitation ranges from 42 to 44 inches. Although it is considered part of the Cleveland Metropolitan Statistical Area, the County has a distinct rural feel. According to the 2010 census, the population of Geauga County is 93,389; there are 34,285 households in Geauga County. The median household income in the County is \$65,663, the second highest in Ohio. The total GDP (Gross Domestic Product) of Geauga County exceeds \$3 billion annually. A comparison of demographics between Ohio and Geauga County is presented in Table 1.

2.2 Geauga Park District Properties

The Geauga Park District was established in 1961. It owns and/or manages numerous parks, preserves, reservations, and other properties scattered throughout the County (Figure 2). The landholdings of the Park District cover more than 9,000 acres (or approximately 3.75% of the total area of the county). There are a variety of amenities available throughout the park system, including over 100 miles of walking, biking, and equestrian trails, picnic areas and covered pavilions, amphitheaters, two nature centers, an observatory, a maple sugarhouse, canoe and kayak launches, and numerous fishing areas (Table 2). A brief description for some of the Park District properties is provided below and representative photographs are provided in Appendix A.

Bass Lake Preserve

Bass Lake Preserve is a 605-acre nature preserve located in Munson Township, south of the City of Chardon. The preserve includes the 160-acre Bass Lake and approximately 168 acres

of wetlands and 251 acres of forest. The 31-acre Spring Brook Sanctuary, a State Nature Preserve protecting Ohio's last known indigenous population of brook trout, adjoins Bass Lake Preserve along its western side. Bass Lake Preserve is home to wild turkey, ruffed grouse, white-tailed deer, masked shrew, the northern long-eared bat, and rare nesting birds (including bald eagles). The lake is open for boating and fishing. Fish caught at the lake include crappie, bass, sunfish, perch, and pike. Facilities at the preserve include a lodge with both indoor and outdoor picnic areas and an outdoor fireplace. A heated restroom is connected to the lodge by a covered walkway. A boat launch located near the lodge provides access to Bass Lake.

Beartown Lakes Reservation

Beartown Lakes Reservation is a 148-acre park located in Bainbridge and Auburn Townships. The park includes three lakes and approximately 20 acres of wetlands and 93 acres of forest. Spring Creek, a tributary to the Chagrin River, flows along the park's northwestern boundary. The park is home to beaver, great blue heron, red-shoulder hawk, turtle, and a wide variety of songbird and migratory waterfowl. Middle and Lower Bear Lakes are open to fishing. Rainbow trout is stocked in Lower Bear Lake in the fall. The park has hiking, bridle, and cross-county skiing trails. The all-purpose Lake Trail around Lower Bear Lake is paved and provides access for people of all abilities. Sledding is allowed in a designated area near Lower Bear Lake. Three picnic shelters are located in the park. The North Point and Minnow Pond shelters have electricity and restrooms nearby. In addition, the North Point shelter has a water fountain and playground. The third shelter is located along the all-purpose Lake Trail.

Beaver Creek Preserve

Beaver Creek Preserve is approximately 82 acres in size and is located on Mayfield Road (Route 322) south of Bass Lake Preserve, in Munson Township. The preserve includes Beaver Creek, two ponds, and approximately 56 acres of wetlands and 15 acres of deciduous forest.

Becvar Preserve

Becvar Preserve is approximately 67 acres in size and is located on Dines Road, south of Bessie Benner Metzenbaum Park in Russell Township. The preserve includes approximately 63 acres of deciduous forest.

Bessie Benner Metzenbaum Park

Bessie Benner Metzenbaum Park is a 69-acre park located in Chester Township, southwest of Chesterland. The park has approximately seven acres of wetlands and 49 acres of mature beech-maple forest. Griswold Creek flows through the eastern part of the park. The park has hiking and cross-county skiing trails. Two of the trails are paved and provide access for people of all abilities. Summit Trail ascends a sandstone-capped hill that rises 140 feet above Griswold Creek. The park also features a picnic shelter with a water fountain and playground and a boardwalk that winds through the wetlands surrounding Griswold Creek.

Big Creek Park

Big Creek Park is a 651-acre park located in Chardon Township, north of the City of Chardon. The park has four ponds, three of which are open for fishing, and approximately 17 acres of wetlands and 577 acres of forest. Wildlife in the park includes deer, turtle, beaver and other small woodland animals. Many species of neo-tropical songbirds migrate from equatorial rainforests to nest in the park. Big Creek Park has an extensive trail system for hiking, cross-county skiing, and horseback riding including two trails that are accessible to people of all abilities. A trail spur provides access to the northern segment of the Maple Highlands Trail. Camping is available in the park at four primitive sites, two of which are equipped with lean-to shelters. A restroom and a water fountain are located near the camping sites. The Donald W. Meyer Nature Center, which contains exhibits, meeting rooms, a wildlife feeding area, and an outdoor amphitheater, is located near the entrance to the park. Other facilities at Big Creek Park include several picnic shelters with restrooms, drinking fountains, and playgrounds. Included within Big Creek Park is Woodin Road Park, located along the southern boundary of the property.

Buff-Chardd Preserve

Buff-Chardd Preserve is approximately 17 acres in size and is located west of Ravenna Road (Route 44) southeast of Beaver Creek Preserve, in Munson Township. The preserve includes approximately two acres of wetlands and 15 acres of deciduous forest.

Burton Wetlands Nature Preserve

Burton Wetlands Nature Preserve is a 307-acre preserve located in Burton Township that

includes the Charles Dambach Preserve and is part of a 1,000-acre system of kettle bogs and fens, lower slope seeps, and wet flats known as the Cuyahoga Wetlands. Burton Wetlands Nature Preserve contains the 22-acre Lake Kelso, a kettle lake of glacial origin, and approximately 55 acres of wetlands and 154 acres of forest. The preserve supports several rare and unusual plants in the bog surrounding Lake Kelso including the green woodland orchid, cranberry bush, leather-leaf, tamarack tree, bunchberry, and pitcher plant. Several rare animals including the northern water thrush, veer, spotted turtle, and four-toed salamander make the preserve their home. The preserve has hiking and cross-county skiing trails. Glacier Trail to Lake Kelso is accessible to people of all abilities. Preserve facilities include a pergola at the beginning of Glacier Trail and a boardwalk and observation deck at Lake Kelso. A restroom is also available along Glacier Trail.

Chickagami Park

Chickagami Park is a 139-acre park located in Parkman Township within the headwaters of the Grand River. The park includes at least eight acres of wetlands and approximately 83 acres of forest. The park is home to many notable songbirds including the purple finch, pine warbler, great crested flycatcher, wood thrush, and scarlet tanager. Chickagami Park has hiking, cross-county skiing, and bridle trails. One trail is accessible to people of all abilities. Camping is available in the park in lean-to shelters and at tent pad sites. The park features two picnic shelters with capacities of 75 and 150 people. Other facilities include an amphitheater and four buildings used primarily by the Boy Scouts.

Eldon Russell Park

Eldon Russell Park (and adjacent parcels) is located in Troy Township along the Upper Cuyahoga River, a state-designated Scenic River. The 200-acre park is developed on glacial deposits including kames and kettles. The kames support an upland forest of beech, maple, oak, and native white pine. Deer, turkey, and other woodland wildlife are found in the forests. The kettles harbor a number of rare wetland plants. Forested wetlands found along the Upper Cuyahoga River contain elm, ash, silver maple, and white oak. A large grassland meadow located at the western edge of the park supports numerous species of birds including the eastern bluebird, swallow, eastern meadowlark, and bobolink. The park has a hiking and cross-county skiing trail. Facilities include Horwath's Landing which contains a picnic shelter, restroom, playground, boat launch, and fishing area.

Frohring Meadows

Frohring Meadows is a 286-acre park in Bainbridge Township that features 135 acres of forest dominated by red and sugar maples, 100 acres of prairie, and vernal pools. Frohring Meadows has hiking and cross-county skiing trails. The Dragonfly Trail is accessible to people of all abilities. The Big Bluestem Trail ties into the Chagrin Falls and Bainbridge Township community trail system. Facilities at the park include the Katydid Shelter which provides a picnic area that will seat up to 50 people, a nearby restroom, and a 40-car parking lot.

Headwaters Park

Headwaters Park is a 1,114-acre park and preserve located in Claridon and Huntsburg Townships, just east of the Maple Highlands Trail. The property is leased by the Geauga Park District from the City of Akron. Headwaters Park includes the 420-acre East Branch Reservoir. The park also includes approximately 186 acres of wetlands and approximately 405 acres of forest. The beech-maple forests, evergreen plantations, and meadows surrounding the reservoir are home to wild turkey, fox, mink, owl, hawk, and a wide variety of songbird. In addition, the reservoir is a popular stop-over for migratory waterfowl. Fishing is permitted from boats on the lake and from shoreline platforms. Fish caught in the lake include bass, northern pike, perch, bluegill, crappie, and catfish. Headwaters Park has a trail system along the western side of the reservoir for hiking, cross-county skiing, horseback riding, and biking. The trail system provides access to the central segment of the Maple Highlands Trail. Camping is available in the park in lean-to shelters and at tent pad sites. One tent pad site is accessible to people of all abilities. Facilities at the southern end of Headwaters Park include a picnic shelter with a drinking fountain and a nearby restroom and a boat launch. Other facilities include a picnic area and restroom at the northern end of the park.

Maple Highlands Trail

The Maple Highlands Trail is a linear park located in Chardon, Claridon, and Huntsburg Townships. The paved trail uses an abandoned Baltimore and Ohio railroad right-of-way and is accessible to people of all abilities. The Maple Highlands Trail currently consists of the 4.2-mile North Trail and the 8.2-mile Central Trail. Plans are completed for the construction of a roughly 7-mile South Trail. Parking areas and restrooms are located along the trail. In addition, the trail is connected to Big Creek Park, Mountain Run Station, and Headwaters Park.

Mountain Run Station

Mountain Run Station is a 32-acre park located in southwestern Hambden Township, just east of the City of Chardon. The park includes approximately 14 acres of wetlands and approximately 18 acres of deciduous forest. The park has a hiking, cross-county skiing, and biking trail that is accessible to people of all abilities. The trail, as noted above, provides access to the central segment of the Maple Highlands Trail. Facilities at Mountain Run Station include the Chardon Rotary Picnic Shelter, two outdoor picnic areas, restrooms, and parking.

Observatory Park

Observatory Park is a 1,123-acre park in rural Montville Township located in the Cuyahoga River Watershed. The Park has been designated as a provisionally certified Silver-Tier International Dark Sky Park by the International Dark-Sky Association. Observatory Park contains a variety of habitats including beech-maple forests on the uplands and mixed wetland forests of elm, ash, maple, and birch on the hummocky lowlands. There are also large emergent marshes, small vernal pools, and many transitional habitats such as meadows, shrublands, and young forests. The park has two self-guided interpretive trails. The Weather Trail contains interpretive displays of weather phenomena such as wind, water, air pressure, and weather forecasting. The Planetary Trail includes interpretive exhibits focused on each planet in the Solar System. The trails are accessible to people of all abilities.

Facilities at the park exploit the unique features of the area and include the Oberle Observatory which houses a sophisticated Newtonian-reflector telescope with a 25.5-inch mirror and the Nassau Astronomical Observing Station which houses a robotic telescope with a large 36-inch mirror. Telescope pads with electricity are located behind the Oberle Observatory. Other facilities at the park include the Robert McCullough Science Center with its planetarium, wind turbine and solar panels. Observatory Park also has a weather and seismic station, sundial, lunar phases display, constellation globe, compass rose with solstice lines, day and night gardens, and a waterless restroom.

Orchard Hills Park

Orchard Hills Park is a 192-acre park in Chester Township located in the Chagrin River Watershed. The park includes a lake and approximately 67 acres of forest. Fishing is permitted on the lake from three shoreline platforms. The park is home to five rare bird species including

the dark-eyed junco, Henslow's sparrow, bobolink, brown creeper, and Canada warbler. Other rare species found in the park include the pale sedge and the Great Lakes crayfish. Orchard Hills Park has a trail system for hiking, cross-county skiing, and biking. Three of the trails are accessible to people of all abilities. Facilities at the park include the Orchard Hills Lodge with its indoor and outdoor picnic areas and two outdoor picnic shelters. One of the picnic shelters is located near a hill designated for sledding. The lodge and two picnic shelters have outdoor fireplaces. Restrooms are located near the lodge and the sledding shelter.

Pine Brook Preserve

Pine Brook Preserve is approximately 784 acres in size and is located on Whitney Road east of Observatory Park, in Montville Township. The preserve includes several ponds and streams, and approximately 245 acres of wetlands and 449 acres of deciduous forest.

The Rookery

The Rookery is a 601-acre park and preserve in southwestern Munson Township. The Chagrin River and several of its tributaries flow through the Rookery. The Rookery is located on a glacial lake bed and includes approximately 179 acres of wetlands and 398 acres of forest. Shrubland and meadows are found in the remaining areas of the park. Streams flowing through the forested portion of the preserve provide cold water habitat for the state-threatened native brook trout. In addition, a large great blue heron rookery is located in the park. Other wildlife found at the Rookery include beaver, spotted turtle, deer, mink, turkey vulture, swamp sparrow, and other songbirds. The park has hiking, cross-county skiing, and biking trails. Woodcock Trail is accessible to people of all abilities and has an observation deck overlooking an oxbow lake (an abandoned meander of the Chagrin River). Facilities include the Great Blue Heron Lodge with a fireplace and a nearby restroom. Other facilities include a picnic area with a playground and drinking fountain.

Sunnybrook Preserve

Sunnybrook Preserve is a 73-acre park in Chester Township in the Chagrin River Watershed. The Preserve includes a pond, meadows, wetlands, and approximately 65 acres of forest. The forested portion of the preserve provides a home to several songbirds including the dark-eyed junco, black-throated green warblers, and wood thrush. Other woodland species found in the preserve include the Woodland jumping mouse (an Ohio species of concern), short-tailed

shrew, Hoary bat, and mink. A portion of the preserve is occupied by fens, a unique wetland fed by cold, alkaline springs seeping through gravel deposits of glacial origin. The fens are home to several rare plants including the American Cranberry Bush. Sunnybrook Preserve has a trail system for hiking and cross-county skiing. Pine Ridge Trail is accessible to people of all abilities. Facilities include the Sunnybrook Shelter with both a heated indoor picnic area and an outdoor picnic area with a fireplace. A restroom and a water fountain are located near the shelter.

Swine Creek Reservation

Swine Creek Reservation is a 434-acre park in the southeastern corner of Middlefield Township. The park includes two ponds, and approximately seven acres of wetlands and 244 acres of forest. Shrubland and meadows are found in the remaining areas of the park. Summer wildflowers such as asters and goldenrods attract butterflies to the meadows. Swine Creek Reservation has an extensive trail system for hiking, cross-county skiing, and horseback riding and includes two trails that are accessible to people of all abilities. Fishing is permitted in the two ponds. Facilities include the Swine Creek Lodge with indoor and outdoor fireplaces and a nearby restroom. Several picnic shelters with restrooms, drinking fountains, and playgrounds are also located at the park. Electricity and horse-and-buggy parking are available at some of the shelters. A sugarhouse is located in the park that is open to the public every March.

Walter C. Best Wildlife Preserve

Walter C. Best Wildlife Preserve is a 108-acre preserve located in Munson Township, east of Bass Lake Preserve and south of the City of Chardon. The park includes the 28-acre Best Lake, and approximately 32 acres of wetlands and 30 acres of forest. The lake and wetlands attract geese, grebes, mergansers, gulls, terns, and herons. In addition, many species of songbirds nest in the preserve. Other wildlife found at the preserve includes deer, red fox, mink, vole, beaver, woodchuck, chipmunk, squirrel, and raccoon. Best Lake is open for fishing from eight shoreline platforms, three of which are accessible to people of all abilities. Fish caught in the lake include channel catfish, bluegill, yellow perch, and crappie. The preserve has paved, all-purpose hiking and cross-county skiing trails that provide access to people of all abilities. The preserve has two picnic shelters, one with a restroom nearby and one with a drinking fountain nearby. Other facilities at the preserve include a wildlife observation blind overlooking Best Lake.

The West Woods

West Woods is a 909-acre park in Russell Township within the Silver Creek Watershed. The park contains sandstone ledges, a high-quality cold water stream, and approximately 78 acres of wetlands and 777 acres of mature forest. Several potentially threatened species have been identified in the West Woods including the butternut tree, closed gentian and blunt mountain mint wildflowers, tall manna grass, and morning warblers. The park has an extensive trail system for hiking, cross-county skiing, and horseback riding and includes two trails that are accessible to people of all abilities. Ansel's Cave Trail leads to an outcrop of the Sharon Conglomerate, a sandstone formation of Pennsylvanian age. Facilities include the West Woods Nature Center that houses displays and exhibits on the geology and hydrology of Geauga County. Other facilities include two picnic shelters with drinking fountains. A restroom is located near the shelters. The Lewis and Ruth Affelder House is open by reservation for small group meetings and gatherings.

Whitlam Woods

Whitlam Woods (and adjacent parcels) is a 208-acre forested area located in Hambden Township near Big Creek Park. Wildlife found at the park includes ruffed grouse, deer, turkey, and fox. Birds found in the shrubby meadow areas near the front of the park include Indigo Bunting, Goldfinch, Towhee, and Woodcock. Whitlam Woods has hiking and cross-county skiing trails. Facilities include a restroom and a drinking fountain at the trail head.

Additional Properties

Geauga Park District owns and/or manages several additional properties. Seventeen of these properties are included in the tables and Figure 2.

2.3 Habitat Types and Areas

Habitat types and areas within the Park District properties were determined using the 2006 land cover dataset provided by National Oceanic and Atmospheric Administration's (NOAA) Coastal Services Center.¹ The land cover dataset was created using Landsat Enhanced Thematic Mapper satellite imagery with 30-meter resolution. Using GIS, the 2006 land cover dataset was

¹ NOAA's Coastal Services Center <<http://www.csc.noaa.gov/crs/lca/greatlakes.html>>.

combined with the park boundaries to determine land cover within each property. In total, 15 different land cover types are present within park boundaries (Figure 2). These land cover types were grouped into five habitat types based similar ecosystem functions and common ecosystem service flows: wetlands, rivers and lakes (open water), temperate forest, shrublands, and grasslands (Table 3). A brief description of each habitat type is provided below. Two additional grouped habitat types (agriculture and developed) are present within park boundaries, but were not considered to provide ecosystem services in this study.

Wetlands

Wetland habitat is comprised of three wetland land cover classes: Palustrine Emergent Wetland, Palustrine Forested Wetland, and Palustrine Scrub/Shrub Wetland. Palustrine Emergent Wetland includes all non-tidal wetlands dominated by persistent emergents, emergent mosses, or lichens. Palustrine Forested Wetlands includes all non-tidal wetlands dominated by woody vegetation greater than 5 meters in height, whereas Palustrine Scrub/Shrub Wetlands are dominated by woody vegetation less than 5 meters in height.

Rivers and Lakes (open water)

Rivers and lakes include all areas of open water (e.g. lakes, rivers, streams) with less than 25 percent cover of vegetation or soil.

Temperate Forest

The temperate forest habitat is comprised of deciduous forest, evergreen forest, and mixed forest land cover classes. Temperate forest habitat is widespread within the parks, with a number of parks dominated by forest habitat. NOAA (2006) describes deciduous forest as areas dominated by single stemmed, woody vegetation with more than 75 percent of the tree species shedding foliage in response to seasonal change. Evergreen forest, on the other hand, includes areas in which at least two-thirds of the trees remain green throughout the year and includes both coniferous and broad-leaved evergreen trees. Mixed forest contains all forested areas in which both evergreen and deciduous trees are present. Trees in the forest land cover classes must be greater than 5 meters tall.

Shrublands

Scrub/Shrub is the only land cover class within the shrublands habitat designation. Scrub/Shrub is defined as areas dominated by woody vegetation less than 5 meters in height, including both evergreen and deciduous scrub. Shrubs, young trees, and small/stunted trees are classified as shrubland habitat.

Grasslands

Grassland/herbaceous and pasture/hay land cover classes are grouped into the grassland habitat type. Areas classified as pasture/hay are characterized by grasses, legumes, or grass-legume mixtures that are planted for grazing or hay crops. Grassland/herbaceous areas are dominated by naturally occurring grasses and non-grasses that are not actively farmed. Most parks have little grassland habitat.

2.4 Ecosystem Services

Ecosystem services are benefits to humans' welfare and well-being that are provided freely through the functions and processes of ecosystems (Daily, 1997; Millennium Ecosystem Assessment, 2005). Ecosystem services are described in terms of flows of value to human societies across time and space as a result of the state and quality of natural capital (TEEB, 2010; de Groot et al., 2012). The Park District properties system generates several ecological and human use services that benefit society. The Park District system is designed to preserve the healthy functions of ecosystems and maintain the flow of ecosystems services. Ecosystem services provided by the Park District properties may benefit society directly (human use/recreation) and indirectly (Figure 3). A brief description of some specific services considered in this study is discussed below.

Fresh Water Supply

The Park District's preservation efforts are essential to maintaining a healthy water supply for Geauga County and areas outside the county. These preservation efforts have resulted in over 640 acres of lakes and streams and nearly 1,400 acres of wetlands. The flow and balance of the water system also includes several shallow aquifers that continuously store, filter and support surface water supplies. One of the several wetlands conserved by Park District properties is the Burton Wetlands. Burton Wetlands remains part of a 1,000-acre system of

kettle bogs and fens, lower slope seeps, and wet flats known as the Cuyahoga Wetlands, an area that has remained relatively undisturbed since the last Ice Age.

Influence on air quality

Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality (Millennium Ecosystem Assessment, 2005). Trees reduce ozone, nitrogen dioxide, sulfur dioxide, and particulate matter (Nowak et al., 2006). The preservation effort of Park District properties has resulted in several thousand acres of forest and shrublands.

Climate regulation

Ecosystems influence climate both locally and globally. At a local scale, trees provide shade, thereby reducing cooling costs. At the global scale, ecosystems play an important role in climate by sequestering carbon dioxide (Nowak and Crane, 2002).

Moderation of extreme events

Ecosystems moderate extreme events by absorbing and buffering natural events such as floods. It is well understood that many inland waters, such as lakes, rivers, and wetlands, attenuate floods by storing and therefore reducing the need and cost for engineered flood control infrastructure (Millennium Ecosystem Assessment, 2005). While the service of flood water storage is valuable to human societies, the value does not enter private markets and therefore lacks a clear monetary value. In contrast, figures on the cost of flood damage are readily available after this function has been lost or seriously eroded (Millennium Ecosystem Assessment, 2005).

Soil and Sediment Formation and Retention

Soil formation and nutrient cycling which occurs in soils, supports the fertility of valuable farmland. Nutrient rich top soils which become degraded from development will become loose and then transported through wind dispersal or flooding (Millennium Ecosystem Assessment, 2005).

Aesthetic Information

Preserved landscapes provide scenic views of nature which enrich the surrounding landscape and provided humans and society with aesthetic information. This value is often captured in property values. The price of a home is made up of several characteristics including actual features of the home, but also location, neighborhood, and views. The value natural landscapes provide to a home can be isolated using econometric analysis which holds constant all other features of the homes and then allows the quantity of landscape to vary, revealing the landscape's impact on the home's price.

Cognitive Information (Education and Science)

The Park District properties system contributes to education and science by providing many educational opportunities and an area for general exploration of the natural environment. The Park District properties system has several special events throughout the year which educate visitors on local species as well as providing areas for Boy Scouts, Girl Scouts, and others to explore. Park District properties also provide "land/water labs" to area students. Annually, the Geauga Park District funds local university graduate and undergraduate research.

Inspiration for Culture, Art, and Design

The Park District properties system provides natural areas that can inspire local artists and writers as well as students. Natural and cultivated systems inspire an almost unlimited array of cultural and artistic expressions, including books, magazines, film, photography, paintings, sculptures, folklore, music and dance, national symbols, fashion, and even architecture and advertisement (Millennium Ecosystem Assessment, 2005).

Spiritual Well-being

The Park District properties system provides space for spiritual reflection for members of the Geauga County population. Nature provides spiritual information and guidance for many people. Ecosystems provide an important place for reflection and meditation along individual spiritual journeys or through more organized experiences (Millennium Ecosystem Assessment, 2005). Parts of nature are considered sacred by many religions or have ornamental significance during religious celebrations.

3 Valuation of Ecological and Indirect Human Use Services

Valuation of ecological and indirect human use services requires estimating the economic benefits they provide to society. Services such as clean water provide benefits to society in the form of potable water for municipalities and scenic views. Many of these services are not traded in an open market and therefore lack traditional methods of valuation such as examining price data. This study relied on the benefit transfer method for estimating the value of these services provided by Park District properties. Benefit transfer refers to methodologies that use knowledge gained from past studies regarding the value of similar services at comparable locations and applies this knowledge at a new location (Freeman, 2003). There are many factors that influence the value of services to society. This includes the location, the availability of substitute services, and the population benefiting from these services. The value of these services was estimated by transferring benefits from previous economic studies for the habitat types found in each Geauga Park District property.

3.1 Land Cover/Habitat Mapping

ESRI's ArcMap GIS software was used to support the analysis of service flows provided by Park District Parks and other properties. Shapefiles containing parcel boundaries for Geauga County parks were originally received from the Geauga Park District. Park names were assigned to each polygon using the Geauga Park District website as a reference. After conducting research using the Geauga County Auditor's website, parcel shapefiles for the entire county were downloaded and additional properties (consisting of parcels ≥ 10 acres) were added. Property identification numbers are provided for each property in Appendix B.

A 2006 land cover dataset with 30 meter resolution was downloaded from the NOAA Coastal Services Center. Land cover designations for each dataset were grouped into similar ecosystem categories (developed, agriculture, temperate forest, inland wetlands, open water, etc.) in order to more readily compare both datasets.

In order to summarize total acreage by park of each ecosystem category, the land cover datasets were converted from their original raster format into polygon shapefiles using the ArcMap conversion toolbox. A union was performed to join the property boundaries with the attributes of the land cover polygons. Acreages were calculated in ArcMap and total land cover acreages were calculated for each park, aggregating by habitat type (Table 4).

3.2 Ecological and Indirect Human Use Service Values

This study relied on estimates provided in de Groot et al. (2012) in which the minimum, median, and maximum values found in economic literature for ecological and indirect human use services per acre of habitat type are reported. The de Groot et al. study was selected because it is the most recent and comprehensive compilation of high quality service values. However, a value for each and every service is not available for all habitat types. For example, although it is well known that forest and shrubland habitats contribute to air quality by removing contaminants in the air, values for these services were not available. Therefore, the estimated values in this report tend to underestimate the total service value provided by Park District properties.

There are a few limitations to benefit transfer which complicates assessing the values which appropriately reflect the services provided by Park District properties. This includes adjusting the values to reflect the population of Geauga County including income, and controlling for spatially relevant substitute services such as other preserved lands that are not associated to Park District properties. Furthermore, although de Groot et al. provides a straightforward spatially explicit benefit transfer approach, the estimated values in the report reflect the minimum and maximum from the literature which may not be the most appropriate values for Park District properties due to location, productivity of the ecosystem, and population characteristics of the primary studies. Therefore, the median (50th percentile) value was used and a range from the 25th to the 75th percentiles is used to bound the central tendency estimate. If the low-end or high-end estimate is greater than 100% or less than 10% of the median value, a value plus or minus 40% of the median was used to provide a more reasonable estimate of the low- or high-end values (Table 5). Ecological and indirect human use service values provided by habitats ranged from \$493 per acre per year (Temperate Forests) to \$7,225 per acre per year (Inland Wetlands).

3.3 Valuation of Park Properties

As discussed, the value of ecological and indirect human use services provided by Park District properties was estimated using spatially explicit value transfer method. Once specific land cover types were identified, service values were determined by multiplying areas of each cover type, in acres, by the estimated annualized dollar value per acre. The total value of a given property was determined by adding up the individual service values associated with each land cover type (Table 6). The data clearly show that substantial economic values are being delivered to Geauga County residents each year by ecosystems owned and/or managed by the

Park District. The ecological and indirect human use service values of the individual parks and the total estimated value are summarized in more detail in Table 6. The individual average park values ranges from \$3,300 (Property 5) to over \$2.3 million (Headwaters Park) per year. The estimated total value of ecological and indirect human use services provided by the park system is over \$15.8 million per year.

4 Valuation of Direct Human Use Services

The value of direct human use or recreational services provided by nature is typically not established through traditional markets; rather, access is typically open to all interested parties at no cost. In some cases, a fee may be charged to enter a park, but this fee is usually not related to the public's willingness-to-pay for these services (Freeman, 2003). The Park District does not collect entrance fees, and the use of their properties and participation in special events is usually free of charge. We are able to estimate the economic value of recreational use by examining what trade-offs people make in order to enjoy the recreational experience (Freeman, 2003). These trade-offs include time in terms of traveling to the site, travel expenses such as fuel, and the opportunity cost of earning wages. The direct human use value of Park District properties was estimated based on available visitor data (e.g., vehicle counts and special event attendance records) and recreational use values from peer-reviewed literature. Each step in the evaluation is described in detail in the following subsections.

4.1 Human Use Methodology

We have two types of information to document human use of Park District properties: vehicle counts and special event attendance records. Vehicle counts were collected from several parks over a period of a few weeks. These data were not collected using a stratified random design and did not explicitly account for time of day, day of the week, season, or weather conditions. Human use of parks without vehicle counts was estimated based on general use data and semi-quantitative observations of Park District personnel. In general, special event attendance records are fairly accurate; however, attendance data were not collected at every event. Therefore, both vehicle counts and special event attendance records are expected to underestimate human use.

Vehicle Counts

Vehicle counts occurred at 13 of the Park District properties parks during 2010, 2011, and/or 2012 (Table 7). Vehicle counts generally occurred between April and October, but were variable in timing (days or months that vehicle counts occurred) and duration (number of days counted). To account for the variable time periods and count frequency, data were normalized for each park by extrapolating the average number of cars/day to average visits/season based on a 215 day season (April 15 to November 15). An estimate of 2.64 per car was applied based on a national summary report of visitor use conducted by the United States Department of

Agriculture (USDA, 2010). This number is further supported by three other recreational use studies which reported averages ranging from 1.8 to 3.5 visitors per vehicle (Kocis, 2004; Richer, 1999; PacifiCorp, 2004). Table 7 reports the estimated visits per season for each park. Average visits per season ranged from 5,100 for Burton Wetlands Nature Reserve and Whitlam Woods to 117,000 for Frohring Meadows. Estimated visitors are lower than the range of visitor trips reported by the Ohio State Park District (2009). Ohio State Park District reported a range of 12,554 for Great Seal State Park and over 3 million visitor occasions for Headlands Beach State Park. We used the counts for Mountain Run Station to represent use of the Maple Highlands Trail. This assumption is expected to underestimate use of the Maple Highland Trail since there are many other points-of-entrance for the Trail. There were three parks that did not have vehicle data available including Walter C. Best Wildlife Preserve, Chickagami Park, and Whitlam Woods. Data from the reporting parks, along with semi-quantitative observations of Park District staff, were used to estimate human use of non-reporting parks (Table 7).

Special Event Attendance Records

Direct visitor counts were compiled from attendance records for special events between 2010 and 2012. These include estimates from programs, shelter reservations, and facility use (Table 8). These records do not include all of the events and activities at Park District properties; therefore, these records underestimate the total attendance at special events.

4.2 Economic Value of Human Use Services

The estimated value of direct human use services provided by Park District properties was developed using the Rosenberger's extensive recreational use values database.² The database currently contains 352 documents of economic valuation studies that estimated the use value of recreational activities in the U.S. and Canada from 1958 to 2006, totaling 2,703 estimates in per user day. Twenty-four primary activity types are provided, along with numerous others. These direct human use value estimates are measures of net willingness-to-pay or consumer surplus for access to specific sites, or for certain activities at broader geographic scales, in per user day units.

Only studies that focused on the general US and/or Ohio were included for valuation of Geauga Park District properties. Rosenberger's recreational use database was sorted by primary

² The database is available for download at <http://recvaluation.forestry.oregonstate.edu/database>.

activity (e.g., backpacking, hunting, and biking) and only those activities provided by the Park District were included in this study. The average value of each primary activity was estimated. Values in 2010 United States Dollars (USD) were updated to 2011 USD based on the consumer price index.³ The values for various human use activities available throughout Geauga Park District properties are provided in Table 9. The estimated human use values range from \$10.46 (camping) to \$68.70 (hunting).

4.3 Valuation of Park Properties

The average value for each supported use (in 2011 USD) was applied to each park based on the estimated visits per season (from the vehicle counts) and the park-specific available amenities. Given that there are several human use services provided by each park including hiking, fishing, and picnicking, the average service value based on what recreational experiences are available at each park was calculated (Table 10). The underlying assumption with this approach is that each visitor was equally likely to participate in all of the activities available at each park. Table 10 reports the estimated number of visits per season, the average, minimum, and maximum human use values available at each park along with the and the resulting total direct human use value. The estimated value for each park and the total value are summarized in Table 10. The total human use value per park ranged from \$97,000 (Whitlam Woods) to \$2.1 million (Frohring Meadows), with a total value of \$16.7 million for the considered Park District properties.

4.4 Valuation of Special Events

In addition to the valuation of routine use of each park, the Park District holds many special events. These special events are considered educational; therefore, an estimated value that captured the educational value of ecosystems was required. Rosenberger's database reports an estimated value for nature study of \$19.36 per user per day (2011 USD). This value was applied to the total attendance. The estimated values for the different special event types and the total value are summarized in Table 11. The estimated value of special event activities ranged from \$1.1 million in 2011 to \$1.6 million in 2010.

³ US Department of Labor Bureau of Labor Statistics <<http://www.bls.gov/cpi/data.htm>>.

5 Economic Impact of Property Values

The market value of properties located near parks and open spaces is frequently higher than comparable properties located in other areas. Ecosystem services provided by these areas are enjoyed by the residents who are willing to pay a premium to live nearby. For example, parks and open spaces provide a buffer to development, abate noise pollution, enhance the aesthetic value of the property, and provide opportunities to observe and enjoy nature. The increase to the property value depends on several factors, including distance from the park or open space, the nature and amount of human use in the area, and the personal preference of the resident. Several studies have demonstrated the impact to property values is limited by the distance from the park; relatively little change in property values is observed more than 1,000 to 1,500 feet away from a park or open space (McConnell and Walls, 2005). Also, passive parks and open spaces tend to increase property values greater than other types of areas. High human use associated with ball fields and playgrounds can result in increased traffic and noise, for example. These characteristics may be viewed negatively and actually result in a decrease in property value.

In a review of 20 studies, Crompton (2004) suggested a 20% increase in property values was a reasonable estimate if the park was at least 30 acres in size and the properties were within 500 to 600 feet of the park. The Cleveland Metroparks (2012) conducted a survey of home sales within 500 feet of a Metroparks property and determined a 16% increase in sale price compared to other comparable homes in Cuyahoga County. However, the Cleveland Metroparks (2012) compared average selling prices of homes near parks to homes that were not near parks but did not control for other attributes of the homes such as size and number of bedrooms. Thorsnes (2002) estimated the value added to homes in Michigan bordering a forest preserve was approximately 8% using econometric analysis and hedonic pricing methods. To provide a conservative estimate of the potential increase in property value associated with Geauga Park District properties, this study assumes an 8% increase in property values to single-family houses that border a Geauga Park District property.

The total increase in property value was estimated by compiling a list of single-family residential properties adjacent to a Geauga Park District property from the Geauga County Auditor's Office. The number of properties adjacent to each Park District property was multiplied by the median fair-market value (and the 25th and 75th percentiles) and by 8% to estimate the portion of the property value that can be attributed to the home's proximity to a Geauga Park District property.

These values were then summed for all Park District properties to estimate the total home value attributable to Geauga Park District. Table 12 reports the median, low-end, and high-end estimate for the selling prices of homes near a respective park, the number of homes bordering the park, and the estimated increased property value due to the homes location near a park. The best estimate of the value added to homes near Park District properties is \$6.9 million and a reasonable range is between \$5.0 million and \$8.5 million.

On an annual basis, Geauga County collects property taxes based on the value of these homes. On average, the property tax in Geauga County is approximately 1.65% per year (Table 13). Therefore, the best estimate of property taxes collected each year due to the value added from Park District properties is \$114,000 and a reasonable range is between \$83,000 and \$140,000. This value should be considered a lower bound of the estimate since the increase in property values is expected to be greater than 8% and other homes that are close but not adjacent to a Park property were excluded from this analysis.

6 Economic Impact of Salaries and Sales

Geauga Park District impacts the regional economy through purchases of materials, income to employees, and concession sales. When the Park District purchases goods for operation, the suppliers of those goods respond to the Park District's demand. To meet the demand, suppliers purchase inputs for their own production. This is known as a 'ripple effect' in which the full supply chain responds to demand by purchasing inputs, paying employees, and selling products. The park's own purchases and payroll represent direct impacts. The supply chains purchases and payroll represents indirect impacts. Furthermore, the income the Park District pays employees is spent locally on goods and services. In return, this results in a supply chain ripple effects known as induced impacts. The sum of direct, indirect, and induced impacts is the total economic impact of Geauga Park District. The total impact divided by the direct impact is the impact multiplier. Multipliers are a general representation of how much additional economic activity is generated in the local economy in response to direct impacts. The size of the multiplier is a function of the diversity of a local economy and how interconnected different sectors are as well as the size of 'leakages' (where leakages refers to spending, employment and income occurring outside of the study area but are a result of the economic activity of the Park District).

Data was collected from the publically available Geauga Park District budget (Table 14). Impacts were estimated using data in a 2010 report on the economic impacts to local communities from National Park visitation and payroll (Stynes, 2011). The National Park System study reported annual impacts for each individual park which included seven parks in Ohio (Table 15). The reported data on spending and payroll and the resulting impacts from the Ohio National Parks was used to estimate multipliers specific to Ohio. Impacts were measured at the county level in the National Park System study and therefore impacts from Geauga Park District can be interpreted as local impacts occurring at the county level. This is because the multipliers are capturing only impacts occurring in counties and not the entire state (i.e., the multipliers are not accounting for 'leakages' into other Ohio counties or other parts of the state). Table 16 reports the Labor Income and the estimated Total Non-Local Receipts (i.e., spending attributable to individuals residing outside of Geauga County). These values are the direct impacts. Total impacts (the sum of direct, indirect and induced impacts) are reported for jobs, income and GDP. The estimated impact for fiscal year 2010 through 2012 is reported in Table 16. The resulting total impact from Geauga Park District on the local economy is estimated to be 83 local jobs, \$4.5 million in annual income, and \$5.1 million in contribution to the local GDP

annually. In addition, an average of \$158,000 in income taxes resulting from the \$4.5 million in annual income is reported in Table 16. The estimated income tax is based on 3.5% state income tax rate, and does not include local or school district income taxes.

7 Other Economic Impacts

Natural lands provide other indirect economics benefits that are more difficult to quantify, but nonetheless are important to consider. For example, the active use of Geauga Park District trails will provide health benefits to frequent users. These health benefits are expected to result in reduced health care costs associated with better cardio-vascular health, weight control, and even better mental health. The numerous bike and walking trails offer an opportunity for active recreation that is valued by the public, but the indirect benefits to society associated with improved fitness and conditioning are not quantified in this study. The Cleveland Metroparks (2012) estimated the health benefits at \$205 per frequent user and an annual benefit of just over \$5 million. This analysis only considered medical savings and did not quantify the cost savings associated with higher worker productivity and less loss work time due to illness. A reasonable estimate of the health benefits associated with the Geauga Park District biking and walking trails ranges between \$1 to 2 million per year.

As described in Section 5, it is well established that property values increase proximal to preserved parkland. These enhanced property values result in increased tax revenue. However, the impact on parkland in reducing the net tax deficit for residents is less well understood. Conventional wisdom suggests the highest and best use of undeveloped land is the best way to enhance local government revenues. This thinking is based on a premise that residential development will increase the tax base and will result in lower property taxes for local residents. Unfortunately, this is not the case since the cost of services for residential areas is typically greater than each dollar of revenue raised (Crompton, 2004). Alternatively, the cost of services for undeveloped land is relatively low and helps to offset the net tax deficit associated with residential development. The most sustainable communities have a healthy mix of commercial/industrial, open space, and residential development. Excessive residential development can not only alter the rural nature of the county, but it can also strain the tax base by requiring more government services per area than undeveloped areas. Clearly, preserving open space is a less costly alternative to development, and the strategy to preserve parks and open space is an important component to a community's long-term economic health (Trust for Public Land, 2007; Ruga, 2009).

8 Uncertainty Analysis

This study estimated the value of ecosystem/human use services and other economic benefits associated with the Geauga Park District properties. The main source of uncertainty in this study is transferring values obtained from the scientific literature for a primary location to a secondary location (i.e., Park District properties). The uncertainty associated with this process is due to differences in population demographics, quantity and quality of resources, spatial and temporal scales, and various other factors between the two locations (Plummer, 2009). In general, an error rate on the order of 40% is considered reasonable when transferring benefits from a primary site to another location (Navrud and Ready, 2007).

For the ecological and indirect human use services, we relied on a recent compilation of high-quality estimates reported in the peer-reviewed literature (de Groot et al., 2012). These values were estimated using numerous methods and represent a wide variety of locations, habitats, and services. We examine the full range of values for each habitat and used the median value as the best estimate and generally the 25th and 75th percentiles to represent a reasonable low- and high-end estimate. Based on the wide variety of locations and habitats and the relative affluence of Geauga County, the median value represents a reasonable proxy for the value of ecological and indirect human use services from Park District properties. In fact, since the values of numerous services are not available in the literature, these estimates tend to underestimate the value of these services.

For human use/recreational services, we relied on site-specific information, such as car counts and direct estimates of human use. There are limitations with this information, however. Car counts were collected from only a few parks over a short duration; these estimates were not intended to provide a statistically robust estimate of human use of the Park District properties. The data for special event participation are relatively accurate, when available, but participation at numerous special events was not always well documented. The human use estimates provided in this study provide a reasonable low-end estimate of human use; additional human use data would be expected to show more use of Park District properties. The monetary values for human use are based on well-established economic theory, and they represent similar activities from similar locations. The use of these values, therefore, is unlikely to represent a significant source of uncertainty.

Other inputs into this study (e.g., parcel boundaries, land-use maps, fair-market values of residential properties, Park District budgetary information) are relatively accurate and, therefore, do not represent a significant source of uncertainty. With respect to the land-use maps, the resolution is limited to 30x30 meters. On a county-wide basis, this level of resolution is reasonable, but more detailed information, accompanied by a reasonable level of field verification would provide a more accurate estimate of the spatial extent of various habitats. Also, all habitats are not created equal. Certain areas in certain Park District properties represent some of the most unique and highest quality habitats in the nation. In other areas, certain habitats have been disturbed and are in a state of recovery. Some areas represent old-growth forests and other areas have been recently restored. Although some areas are better than others (i.e., more valuable), we do not expect this limitation to significantly affect the results of the study. As with all valuation studies, a more detailed, primary study would provide a more accurate estimate, but the purpose of this study was to rely on published literature to provide a reasonable estimate of ecosystem/human use services and other economic benefits of Park District properties.

9 Summary and Conclusions

The value of ecosystem services is summarized in Table 17. The central tendency estimate of the ecological and indirect human use services is \$16 million per year. The range of estimates based on the uncertainty associated with transferring benefits from literature estimates is \$9.5 to 22 million per year. This range is consistent with literature estimates of transferring benefits of plus or minus 40%. The central tendency estimate of the total benefit of direct human use/recreational services, including routine use and attendance at special events, is \$18 million per year. The range of estimates based on the uncertainty associated with transferring benefits from literature estimates is approximately \$13 to 25 million per year. This range also is consistent with literature estimates of transferring benefits of plus or minus 40%. The total estimated benefit to the public from ecological and indirect and direct human use services is \$34 million per year, and the reasonable range of the annual total benefit is \$22 to 47 million.

Other studies have used this benefit transfer approach to estimate the monetary value of ecosystem services on a variety of geographic scales. Costanza et al. (1997) placed a value on the world's ecosystem services at \$22 to 76 trillion. In 2007, the State of New Jersey estimated the value of their ecosystem services at \$14 to 23 billion per year (Liu et al., 2010). The Cleveland Metroparks (2011) conservatively estimated the total value of their properties to the region at almost \$200 million per year. All values are expressed in 2011 US dollars to facilitate comparison to the values provided by this study. The authors of these studies used a variety of methods and underlying data to conservatively estimate the monetary value of the benefits provided from the natural environment.

Other economic benefits to the public are provided by the Park District, including increases in residential property values and associated property taxes and increases to the local GDP associated with salaries and sales. The long-term benefits (estimated for a 20-year period) of the ecosystem services and some of these other economic benefits are presented in Table 18. For benefits accrued in the future, the values are discounted at 3% to more accurately reflect the net present value of these benefits (NOAA, 1999; Weitzman, 2001; Newell and Pizer, 2003; Ludwig et al., 2005; EPA, 2010). Over a 20-year period, the benefit to the public associated with ecological and indirect and direct human use services is over \$500 million. The net present value of other economic benefits associated with property and income taxes and increases to local GDP over a 20-year period is nearly \$80 million. These other economic benefits exclude

potential health benefits associated with frequent exercise on Park District trails and the effect of reduced governmental services required for undeveloped Park District properties.

The state of the science for monetizing ecosystem service benefits has made tremendous advancements over the last 10 to 15 years. Although there are uncertainties associated with monetizing these economic benefits, we used conservative assumptions that tend to underestimate these benefits. There are several services that provide benefits to society, but have not been adequately quantified and are, therefore, excluded from this analysis. Also, the estimation of human use of Park District properties was not intended to be an exhaustive survey, and likely under-estimates human use of the properties. The valuation of these benefits can be done more accurately by a site-specific study. However, these studies require a significant level of time and are very costly. The benefits transfer approach used in this study provides a reasonable estimate of the ecosystem services and other economic benefits provided by the Park District properties. This information can be used to improve policy development and land-use decision-making.

10 References

- Braat, L.C. and R. de Groot. 2012. The ecosystem services agenda: bringing the natural science and economics, conservation and development, and public and private policy. *Ecosystem Services*, 1: 4-15.
- Cleveland Metroparks. 2011. The economic value of Cleveland Metroparks. Cleveland, OH.
- Costanza, R., R. d'Arge, R.S. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature*, 387: 253-260.
- Crompton, J.L. 2004. The proximate principle: The impact of parks, open space, water features on residential property values and the property tax base. National Recreation and Park Association. Ashburn, VA.
- Daily, H.E. 1997. *Nature's services: societal dependence on natural ecosystems*. Island Press. Washington, DC.
- Daily, G.C., S. Polasky, J. Goldstein, P.M. Kareiva, H.A. Mooney, L. Pejchar, T.H. Ricketts, J. Salzman, R. Shallenberger. 2009. Ecosystem services in decision making: Time to deliver. *Frontiers Ecology Environment*, 7(1): 21-28.
- de Groot, R.S., M.A. Wilson, and R.M.J. Boumans. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 3: 393-408.
- de Groot, R., L. Brander, S. van der Ploeg, R. Costanza, F. Bernard, L. Braat, M. Christie, N. Crossman, A. Ghermandi, L. Hein, S. Hussain, P. Kumar, A. McVittie, R. Portela, L.C. Rodriguez, P. ten Brink, P. van Beukering. 2012. Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, 1: 50-61.
- EPA. 2009. Valuing the protection of ecological systems and services. A report of the EPA Science Advisory Committee. US Environmental Protection Agency, Science Advisory Board. EPA-SAB-09-012. Washington, DC.
- EPA. 2010. Guidelines for preparing economic analyses. US Environmental Protection Agency, Office of the Administrator. EPA-240-R-10-001. Washington, DC.
- Farley, J. 2012. Ecosystem services: The economics debate. *Ecosystem Services*. 1: 40-49.
- Farley, J. and R. Costanza. 2010. Payments for ecosystem services: from local to global. *Ecological Economics*, 69: 2060-2068.
- Fisher, B., R.K. Turner, P. Morling. 2009. Defining and classifying ecosystem services for decision making. *Ecological Economics*, 69: 643-653.
- Freeman, A.M. 2003. The measurement of environmental and resource values: Theory and methods. *Resources for the Future*. Washington, DC.

- Geauga Park District. 2012. Proposed park budget for 2013. Available online: <http://www.auburntownship.org/geaugaparkdistrict/2013%20park%20budget.pdf> . Accessed August 14, 2012.
- Kocis, Susan M., Donal B. K. English, Stanley J. Zarnoch, Ross Arnold, Larry Warren, Catherine Ruka. 2004. National Visitor Use Monitoring Results USDA Forest Service Region 1: Gallatin National Forest. Available online at http://www.fs.fed.us/recreation/programs/nvum/reports/year4/R1_F11_gallatin_final.htm
- Ludwig, D., W.A. Brock, S.R. Carpenter. 2005. Uncertainty in discount models and environmental accounting. *Ecology and Society*, 10(2): 13.
- Liu, S., R. Costanza, A. Troy, J. D'Aagostino, W. Mates. 2010. Valuing New Jersey's ecosystem services and natural capital: A spatially explicit benefits transfer approach. *Environmental Management*, 45: 1271-1285.
- McConnell, V. and M. Walls. 2005. The value of open space: Evidence from studies of nonmarket benefits. *Resources for the Future*. Available online at: <http://www.rff.org/rff/Documents/RFF-REPORT-Open%20Spaces.pdf> .
- Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: Synthesis. Island Press, Washington, DC.
- Navrud, S and R. Ready. 2007. Environmental value transfer: Issues and methods. Springer, Dordrecht, NL.
- Newell, R.G. and W.A. Pizer. 2003. Discounting the distant future: How much do uncertain rates increase valuations? *Environmental Economics Management*, 46: 52-71.
- NRC. 2005. Valuing ecosystem services toward better environmental decision-making. National Research Council of the National Academies. National Academies Press. Washington, DC
- NOAA. 1999. Discounting and the treatment of uncertainty in natural resource damage assessment. Technical Paper 99-1, National Oceanic and Atmospheric Administration, Damage Assessment and Restoration Program. Silver Spring, MD.
- Nowak, D.J. and D.E. Crane. 2002. Carbon storage and sequestration by urban trees in the US. *Environmental Pollution*, 116: 381-389.
- Nowak, D.J., D.E. Crane, J.C. Stevens. 2006. Air pollution removal by urban trees and shrubs in the United States. *Urban Forestry & Urban Greening*, 4: 115-123.
- Ohio State Park District. 2009. Ohio State Park 2009 Annual Report. Columbus, OH.
- Plummer, M.L. 2009. Assessing benefit transfer for the valuation of ecosystem services. *Frontiers in Ecology and the Environment*, 7(1): 38-45.
- PacifiCorp. 2004. Klamath Hydroelectric Project (FERC Project No. 2082). Recreational Resources. Portland, OR. Available online at:

http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Hydro/Hydro_Licensing/Klamath_River/REC_Report.pdf

- Richer, J.R. 1999. Setting new fees for recreation: Daily and annual pricing options in the Southern California National Forests. Available online at: http://www.sscnet.ucla.edu/ssc/labs/cameron/e134s99/richer_jerrell.html.
- Ruga, E. 2009. The benefits of state investments in preservation programs: a compilation of reports, plans, and other studies detailing the benefits of land preservation, farmland preservation and historic preservation in New Jersey. New Jersey Conservation Foundation, in cooperation with New Jersey-Keep It Green Coalition. Far Hills, NJ.
- Stynes, D.J. 2011. Economic benefits to local communities from National Park visitation and payroll, 2010. National Park Services, US Department of the Interior, National Resource Report, NPS/NRSS/EQD/NRR-2011/481, Washington, DC.
- TEEB. 2010. The economics of ecosystems and biodiversity: Ecological and economic foundations. Edited by P. Kumar. Earthscan. London, UK.
- Thorsnes, P. 2002. The value of a suburban forest preserve: Estimates from sales of vacant residential building lots. *Land Economics*, 78(3): 426–41.
- Trust for Public Lands. 2007. The economic benefits of land conservation. Edited by C.T.F. de Brun. The Trust for Public Land. San Francisco, CA.
- USDA. 2010. National Visitor Use Monitoring Results. National Survey. Available online at: http://www.fs.fed.us/recreation/programs/nvum/nvum_national_summary_fy2009.pdf. Accessed August 14, 2012.
- Weitzman, M.L. 1998. Why the far-distant future should be discounted at its lowest possible rate. *Environmental Economics Management*, 36: 201-208.
- WRI. 2008. Ecosystem services: A guide for decision makers. World Resources Institute. Washington, DC.

Tables

Table 1. Overview and Demographics of Ohio and Geauga County

Category	Ohio	Gauga County
Land area (square miles)	40,861	400
Land area (acres)	26,150,842	256,102
Population	11,544,951	93,389
Households	4,552,270	34,285
Persons per Household	2.54	2.72
Per Capita Income	\$25,113	\$32,735
Median Household Income	\$47,258	\$65,663
Total Income (GDP Estimate)	\$289,928,354,463	\$3,057,088,915

Table 2. Geauga Park District Parks and Amenities

Name	Size (acres)	Trails (miles)					Facilities									
		Hiking	Handicap Accessible	Bridle	Skiing	Biking	Educational, Science, or Nature Center	Other Facilities	Restrooms (count)	Picnic Shelters (count)	Playgrounds (count)	Drinking Fountains (count)	Sled Riding Hills (count)	Camping	Fishing Platforms, Piers, and Areas	Boat Launches (count)
Bass Lake Preserve / Spring Brook Sanctuary	605.1	—	—	—	—	—	—	Bass Lake Lodge	1	—	—	—	—	—	by boat only	1
Beartown Lakes Reservation	148.3	2.8	0.7	1.5	2.8	—	—	—	2	3	1	1	1	—	shoreline and 3 platforms	—
Beaver Creek Preserve	81.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Becvar Preserve	67.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Bessie Benner Metzenbaum Park	68.6	1.0	0.5	—	0.5	—	—	boardwalk through wetlands	1	1	1	1	—	—	—	—
Big Creek Park / Woodin Road Park	650.8	6.4	0.3	2.9	1.2	—	Meyer Nature Center	picnic area	4	3	2	3	—	lean-to/primitive	3 ponds	—
Buff-Chardd Preserve	16.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Burton Wetlands Nature Preserve / Charles Dambach Preserve	307.0	1.52	0.22	—	1.52	—	—	boardwalk and observation deck	1	—	—	—	—	—	—	—
Chickagami Park	139.3	0.87	0.12	0.75	0.87	—	—	4 Boy Scout buildings and amphitheater	1	2	—	—	—	lean-to/tent pad	—	—
Eldon Russell Park	199.7	0.76	—	—	0.76	—	—	—	1	1	1	—	—	—	shoreline and by boat	1
Frohring Meadows	286.4	3.5	0.7	—	3.5	—	—	—	1	1	—	—	—	—	—	—
Headwaters Park	1,113.7	4.7	—	3.4	2.5	2	—	picnic area	2	1	—	1	—	lean-to/tent pad	4 platforms and by boat	1
The Maple Highlands Trail	225.3	12.4	12.4	—	12.4	12.4	—	—	2	1	—	—	—	—	—	—
Mountain Run Station	31.9	0.36	0.36	—	0.36	0.36	—	picnic sreas	1	1	—	—	—	—	—	—
Observatory Park	1,123.3	1.1	1.1	—	1.1	—	McCullough Science Center with wind turbine and solar panels, Weather and Seismic Station, Nassau Astronomical Observing Station, Oberle Observatory, telescope pads equiped with power	Lunar Phases Display, Constellation Globe, Compass Rose (with solstice lines), Sundial, Day and Night Gardens	1	—	—	—	—	—	—	—
Orchard Hills Park	192.1	3.6	1.5	—	3.6	3.6	—	Orchard Hills Lodge	2	2	—	—	1	—	pond with 3 platforms	—
Pine Brook Preserve	784.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
The Rookery	600.6	1.4	0.4	—	1.4	1	—	lodge and observation deck	1	—	1	1	—	—	—	—
Sunnybrook Preserve	73.2	1.69	0.37	—	1.69	—	—	Sunnybrook Shelter	1	—	—	1	—	—	—	—
Swine Creek Reservation	434.4	6.1	0.4	2.4	3.8	—	Sugarhouse	Swine Creek Lodge	4	3	2	3	—	—	2 ponds	—
Walter C. Best Wildlife Preserve	108.1	1.6	1.6	—	1.6	—	—	Wildlife Observation Blind	2	2	—	1	—	—	lake with 8 platforms	—
The West Woods	908.5	6.7	0.4	6.2	6.7	—	West Woods Nature Center	Affelder House	1	2	—	2	—	—	—	—
Whitlam Woods	207.5	1.1	—	—	0.3	—	—	—	1	—	—	1	—	—	—	—

Table 3. Land Use Coverage and Habitat Designations

Land Use Coverage NOAA (2006)	Habitat Designation for Ecosystem Services
Cultivated Crops	Agriculture
Deciduous Forest	Temperate Forest
Developed, High Intensity	Developed
Developed, Low Intensity	Developed
Developed, Medium Intensity	Developed
Developed, Open Space	Developed
Evergreen Forest	Temperate Forest
Grassland/Herbaceous	Grassland
Mixed Forest	Temperate Forest
Open Water	Open Water
Palustrine Emergent Wetland	Inland Wetland
Palustrine Forested Wetland	Inland Wetland
Palustrine Scrub/Shrub Wetland	Inland Wetland
Pasture/Hay	Grassland
Scrub/Shrub	Shrublands

Table 4. Land Coverage and Habitat Types for Parks and Other Properties

Park Name	Total Developed (acres)	Total Agriculture (acres)	Total Wetland (acres)	Open Water (acres)	Total Forest (acres)	Shrubland (acres)	Total Grassland (acres)	Total Area (acres)
Bass Lake Preserve / Spring Brook Sanctuary	10.2	6.1	168.0	160.2	251.4	5.4	3.7	605.1
Beartown Lakes Reservation	0.3	0.1	19.7	20.3	93.2	14.7	0.0	148.3
Beaver Creek Preserve	3.8	0.0	55.7	6.8	15.2	0.1	0.0	81.6
Becvar Preserve	0.2	0.0	0.0	0.0	62.8	4.3	0.0	67.3
Bessie Benner Metzenbaum Park	3.3	0.0	6.6	0.0	49.2	8.1	1.4	68.6
Big Creek Park / Woodin Road Park	8.3	0.5	16.7	0.0	577.0	36.3	12.0	650.8
Buff-Chardd Preserve	0.0	0.0	1.9	0.0	14.6	0.0	0.0	16.5
Burton Wetlands Nature Preserve / Charles Dambach Preserve	2.4	34.0	55.3	26.7	153.6	6.7	28.2	307.0
Chickagami Park	2.4	1.6	8.0	12.3	83.1	18.3	13.6	139.3
Eldon Russell Park	0.5	38.8	85.3	0.0	62.0	7.2	5.9	199.7
Frohring Meadows	17.3	86.1	20.5	0.0	135.2	14.2	13.1	286.4
Headwaters Park	20.2	21.6	186.2	351.1	405.2	82.9	46.5	1,113.7
The Maple Highlands Trail	25.5	6.1	29.4	0.3	138.9	10.1	15.1	225.3
Mountain Run Station	0.8	0.0	13.6	0.0	17.5	0.0	0.0	31.9
Observatory Park	6.3	136.3	95.0	2.1	744.0	127.6	11.9	1,123.3
Orchard Hills Park	122.5	0.0	0.0	0.0	66.6	2.6	0.5	192.1
Pine Brook Preserve	2.3	4.5	245.1	11.6	448.5	69.4	2.9	784.2
The Rookery	5.0	0.0	179.3	4.3	398.2	11.2	2.6	600.6
Sunnybrook Preserve	1.4	0.0	2.2	0.0	64.6	3.6	1.4	73.2
Swine Creek Reservation	8.3	77.7	7.4	2.0	243.5	47.1	48.4	434.4
Walter C. Best Wildlife Preserve	8.8	0.8	31.6	27.8	30.1	5.6	3.3	108.1
The West Woods	22.6	4.1	77.9	2.7	777.2	21.0	2.9	908.5
Whitlam Woods	0.9	0.0	0.0	0.0	196.8	8.6	1.2	207.5
Property 1 (Oakton Property)	1.2	21.1	62.9	9.2	176.8	6.1	0.4	277.8
Property 2	0.0	1.4	0.0	0.0	5.1	3.6	0.0	10.1
Property 3 (Clause Property)	2.3	0.0	3.4	0.0	15.9	0.0	0.1	21.6
Property 4 (Welton's Gorge)	2.7	1.7	3.8	0.0	54.9	18.0	5.8	86.9
Property 5	4.2	0.9	0.0	0.0	6.7	0.0	0.0	11.8
Property 6 (Heymeyer Property)	0.9	2.9	0.0	0.0	23.2	0.0	0.4	27.3
Property 7 (Stafford Property)	0.4	0.0	2.0	0.0	34.6	0.5	0.0	37.4
Property 8 (Red Raider Property)	2.8	0.2	1.7	0.0	4.2	2.5	5.4	16.7
Property 9 (Union Chapel / Krehlik Property)	1.3	0.0	3.3	0.0	10.9	0.0	2.5	18.0
Property 10 (Abela Property)	0.2	23.9	0.0	0.0	30.9	6.5	9.2	70.6
Property 11 (Farley Property)	0.5	34.2	2.7	0.0	42.0	21.8	0.1	101.1
Property 12 (Brede Property)	1.1	0.2	32.7	0.0	14.6	11.4	0.0	60.1
Property 13 (Husted Woods)	0.3	4.4	0.8	0.0	18.9	0.0	0.0	24.4
Property 14 (Ellerin Property)	8.6	2.0	7.2	0.0	92.7	17.3	2.7	130.5
Property 15 (Middlefield Wetlands)	0.0	0.2	95.2	0.0	85.9	14.3	0.3	195.9
Property 16 (Hyde-Kaplan)	1.3	20.9	11.2	5.5	77.0	8.8	1.7	126.4
Property 17 (Artim Property)	8.9	0.0	8.2	0.0	52.4	2.5	3.8	75.9

Table 5. Monetary Values of Ecological and Indirect Human Use Services Provided from Various Habitat Types

Habitat Type	de Groot et al. (2012)				This Study		
	Number of Estimates	Central Tendency (\$/ac/yr)	Minimum (\$/ac/yr)	Maximum (\$/ac/yr)	Central Tendency (\$/ac/yr)	Low-end Estimate (\$/ac/yr)	High-end Estimate (\$/ac/yr)
Inland Wetlands	168	7,225	1,320	45,878	7,225	4,272	10,115
Rivers and Lakes	15	1,722	632	3,392	1,722	1,177	2,557
Temperate Forest	58	493	122	7,173	493	307	690
Shrublands	21	665	600	957	665	399	811
Grasslands	32	1,180	54	2,593	1,180	617	1,886

Table 6. Value of Ecological and Indirect Human Use Services for Parks and Other Properties

Park Name	Habitat Area (acres)	Central Tendency (\$/yr)	Low-end Estimate (\$/yr)	High-end Estimate (\$/yr)
Bass Lake Preserve / Spring Brook Sanctuary	588.7	1,621,490	987,973	2,293,699
Beartown Lakes Reservation	147.9	233,099	142,613	327,527
Beaver Creek Preserve	77.8	421,683	250,666	591,335
Becvar Preserve	67.1	33,792	20,997	46,790
Bessie Benner Metzenbaum Park	65.3	78,848	47,330	109,746
Big Creek Park / Woodin Road Park	641.9	443,159	270,396	618,863
Buff-Chardd Preserve	16.5	20,665	12,450	28,931
Burton Wetlands Nature Preserve / Charles Dambach Preserve	270.6	559,236	335,114	792,637
Chickagami Park	135.3	148,053	89,823	210,044
Eldon Russell Park	160.4	658,727	390,064	922,734
Frohring Meadows	183.0	239,331	142,680	336,425
Headwaters Park	1,071.9	2,259,555	1,395,039	3,215,616
The Maple Highlands Trail	193.7	305,621	181,798	430,251
Mountain Run Station	31.1	107,061	63,583	149,885
Observatory Park	980.7	1,155,873	695,342	1,605,944
Orchard Hills Park	69.6	35,080	21,772	48,903
Pine Brook Preserve	777.5	2,061,192	1,227,915	2,879,676
The Rookery	595.6	1,509,831	899,625	2,113,658
Sunnybrook Preserve	71.8	51,807	31,560	72,439
Swine Creek Reservation	348.4	265,500	157,528	377,678
Walter C. Best Wildlife Preserve	98.4	298,739	181,306	422,406
The West Woods	881.9	968,318	585,171	1,354,201
Whitlam Woods	206.5	104,069	64,597	144,938
Property 1 (Oakton Property)	255.5	562,215	336,700	787,793
Property 2	8.7	4,895	2,996	6,423
Property 3 (Clause Property)	19.4	32,369	19,386	45,332
Property 4 (Welton's Gorge)	82.5	73,088	43,720	101,523
Property 5	6.7	3,314	2,065	4,643
Property 6 (Heymeyer Property)	23.6	11,884	7,362	16,727
Property 7 (Stafford Property)	37.0	31,561	19,211	44,130
Property 8 (Red Raider Property)	13.8	22,582	13,001	32,572
Property 9 (Union Chapel / Krehlik Property)	16.7	32,094	18,952	45,509
Property 10 (Abela Property)	46.6	30,371	17,744	43,887
Property 11 (Farley Property)	66.5	54,464	32,987	73,639
Property 12 (Brede Property)	58.8	251,157	148,812	350,240
Property 13 (Husted Woods)	19.6	14,817	9,059	20,744
Property 14 (Ellerin Property)	120.0	112,193	67,686	155,618
Property 15 (Middlefield Wetlands)	195.7	740,026	439,010	1,034,366
Property 16 (Hyde-Kaplan)	104.1	136,129	82,489	190,721
Property 17 (Artim Property)	67.0	91,279	54,507	128,387
Total Value of Ecosystem Services		15,785,165	9,511,028	22,176,580

Table 7. Estimated Visits per Season by Park

Park Name	Average Cars per Day¹	Estimated Visits per Season²
Bass Lake Preserve	27	15,325
Beartown Lakes Reservation	127	72,004
Bessie Benner Metzenbaum Park	88	49,776
Big Creek Park	114	64,747
Burton Wetlands Nature Preserve	9	5,108
Chickagami Park	45	25,542
Eldon Russell Park	57	32,505
Frohring Meadows	207	117,426
Headwaters Park	79	45,055
Mountain Run Station/Maple Highlands Trail	90	51,084
Observatory Park	100	56,981
Orchard Hills Park	83	46,997
The Rookery	90	51,084
Sunnybrook Preserve	60	34,287
Swine Creek Reservation	82	46,584
Walter C. Best Wildlife Preserve	90	50,856
The West Woods	118	67,217
Whitlam Woods	9	5,108

1 For parks where the number of cars was not available, the average cars per day was estimated based on qualitative observations. Values presented in *italics*.

2 Visit per season assumes 2.64 persons per car (USDA 2010) and 215 days per season (April 5 - November 15).

Table 8. Special Events Attendance

Event Name	Attendance 2009	Attendance 2010	Attendance 2011
Nature Center			
The West Woods Nature Center Attendance	31,558	25,590	26,465
Big Creek Park Donald W. Meyer Center	--	3,853	--
Shelter Reservations			
The Rookery	--	12,067	--
Swine Creek Reservation	--	7,620	--
Sunnybrook Preserve	--	7,098	--
In-Park Groups or Classes			
Individual Scout Groups	130	180	97
Park Directed Scout Programs	523	433	292
Senior Groups	165	74	142
Other Organizations Programs	645	583	229
School Groups In Park	3,386	2,902	2,597
Preschool Organizations	302	377	276
Other Children's Groups	132	20	142
Nature Scopes Programs - 2010-2011 Class	--	--	460
Nature Scopes Programs - 2011-2012 Class	--	--	440
In-Park Special Events			
50th Anniversary Birthday Blast & Observatory Park Dedication	--	--	1,493
Amphitheater Series	804	648	724
Art Takes A Bough	110	75	95
Bass Lake Preserve Dedication	--	--	70
Caveman Crawl	--	--	476
Creativity Tapped Art Show Visitation Jan-Mar	--	--	3,941
DiscArted Art Show Open House	350	--	--
DiscArted Art Show Visitation for Nov & Dec	6,532	10,009	--
Halloween Wagon Rides (2 days)	371	468	251
Maple Madness Tour	559	393	1,466
Nature Arts Festival (2 days)	2,803	3,887	2,545
Nature Writer's Coffee House	75	85	--
Orchard Hills Park Dedication	--	--	126
Sap's-A-Risin' Sundays	2,287	1,524	1,326
Scout Expo	--	665	--
Snow-belted Exhibit Visitation Nov & Dec	--	--	7,861
Tree Tappers Ball	140	155	170
Wild Nights Exhibit Visitation (Jan, Feb)	8,304	--	--
Winter Solstice Candle Light Walk	395	545	295
In-Park Kids Programs			
Crinkleroots	99	76	72
Home School Days	212	150	145
Little Explorers	--	41	--
Muskrateers	45	58	31
Nature Time for Two's	--	44	--
Timbertots	1,034	988	908
Toddler Time	304	171	--
Other In Park Programs			
50 Years / 50 Miles Hiking Series	--	--	345
Armchair Adventures	235	--	--
Art Open House	735	262	321
Arts & Crafts Workshops	114	159	164
Astronomy Programs	331	347	319
Canoe/Kayak Programs	165	168	164
DiscArted Family Craft Day	210	--	--
Food & Farms Program	48	117	87
Geauga Walkers	356	313	331
Grandparents in the Park	135	98	133
Horse Programs	123	136	129
Hound Hikes	85	159	115
Maple Town Tune Traders Jam Session	312	419	389
Shutterbugs Camera Club	579	476	527
Travelogue Speaker Series	--	792	636
TOTAL ATTENDANCE	64,693	84,225	56,795

Table 9. Direct Human Use Values by Type of Activity

Primary Activity	Average Value (2011 USD)
Backpacking	\$51.24
Biking	\$26.33
Boating, Kayaking, Tubing, Rowing	\$31.93
Camping	\$10.46
Cross-country Skiing	\$18.95
Downhill Skiing	\$29.32
Family Gathering	\$54.17
Freshwater Fishing	\$23.25
Gathering Forest Products	\$33.52
General Recreation	\$11.23
Hiking, Walking, Running	\$18.98
Horseback Riding	\$22.57
Hunting (big game, small game, waterfowl)	\$68.70
Nature Study	\$19.36
Off-roading	\$29.82
Photography	\$20.87
Picnic	\$16.21
Picnic and Family Gathering (combined)	\$24.24
Sightseeing	\$26.55
Swimming	\$24.66
Visiting Historic Sites	\$41.72
Visiting Pre-historic Sites	\$11.84
Water Skiing	\$53.30
Wildlife Viewing	\$31.36

Table 10. Summary of Direct Human Use Valuation

GPD Park or Reserve	Estimated Visits per Season	Average Value per trip (2011 USD)¹	Minimum Value per trip (2011 USD)	Maximum Value per trip (2011 USD)	Average Seasonal Value per Park	Minimum	Maximum
Bass Lake Preserve	15,325	\$26.47	\$23.25	\$31.93	\$405,697	\$356,305	\$489,310
Beartown Lakes Reservation	72,004	\$18.59	\$11.23	\$26.33	\$1,338,783	\$808,302	\$1,896,140
Bessie Benner Metzenbaum Park	49,776	\$16.34	\$11.23	\$18.98	\$813,394	\$558,775	\$944,532
Big Creek Park	64,747	\$17.63	\$10.46	\$23.25	\$1,141,248	\$677,277	\$1,505,340
Burton Wetlands Nature Preserve	5,108	\$23.09	\$18.95	\$31.36	\$117,977	\$96,796	\$160,199
Chickagami Park	25,542	\$16.40	\$10.46	\$22.57	\$418,874	\$267,179	\$576,529
Eldon Russell Park	32,505	\$20.09	\$11.23	\$31.93	\$653,029	\$364,889	\$1,037,821
Frohring Meadows	117,426	\$18.05	\$16.21	\$18.98	\$2,119,095	\$1,903,999	\$2,228,240
Headwaters Park	45,055	\$21.09	\$10.46	\$31.93	\$950,002	\$471,294	\$1,438,542
Mountain Run Station/Maple Highlands Trail	51,084	\$20.12	\$16.21	\$26.33	\$1,027,711	\$828,296	\$1,345,235
Observatory Park	56,981	\$23.09	\$18.95	\$31.36	\$1,315,949	\$1,079,696	\$1,786,906
Orchard Hills Park	46,997	\$19.88	\$11.23	\$26.33	\$934,489	\$527,581	\$1,237,616
The Rookery	51,084	\$21.85	\$11.23	\$31.36	\$1,116,042	\$573,458	\$1,601,985
Sunnybrook Preserve	34,287	\$20.72	\$18.95	\$24.24	\$710,474	\$649,690	\$831,111
Swine Creek Reservation	46,584	\$20.02	\$11.23	\$29.62	\$932,642	\$522,939	\$1,379,635
Walter C. Best Wildlife Preserve	50,856	\$21.75	\$16.21	\$31.36	\$1,106,105	\$824,606	\$1,594,847
The West Woods	67,217	\$22.97	\$16.21	\$41.72	\$1,543,668	\$1,089,882	\$2,804,173
Whitlam Woods	5,108	\$18.96	\$18.95	\$18.98	\$96,866	\$96,796	\$96,935
Estimate of Total Annual Benefits					\$16,742,044	\$11,697,760	\$22,955,095

1. Average central tendency value of the various recreational activities available at GPD Park location

Table 11. Total Value of Special Events

Event Name	2009 Value	2010 Value	2011 Value
Nature Centers	\$611,097	\$570,141	\$512,474
Shelter Reservations	\$0	\$518,671	\$0
In-park Groups or Classes	\$102,301	\$88,475	\$90,528
In-park Special Events	\$432,500	\$346,794	\$397,819
In-park Kids Programs	\$32,803	\$29,589	\$22,385
Other In Park Programs	\$66,381	\$66,729	\$70,873
Total Value	\$1,252,730	\$1,630,953	\$1,099,792

Table 12. Estimated Benefit Associated with Increased Property Values near Parks and Other Properties

Park Name	Number of Houses	Residential House Value			Total Increased Property Value		
		Median Value	Low-end Estimate	High-end Estimate	Median Value	Low-end Estimate	High-end Estimate
Bass Lake Preserve/Spring Brook Sanctuary	53	\$173,800	\$139,100	\$239,900	\$736,912	\$589,784	\$1,017,176
Beartown Lakes Reservation	7	\$171,600	\$131,700	\$203,100	\$96,096	\$73,752	\$113,736
Beaver Creek Preserve	5	\$205,500	\$167,900	\$223,000	\$82,200	\$67,160	\$89,200
Becvar Preserve	8	\$235,200	\$207,300	\$292,725	\$150,528	\$132,672	\$187,344
Bessie Benner Metzenbaum Park	22	\$165,150	\$138,275	\$185,075	\$290,664	\$243,364	\$325,732
Big Creek Park / Woodin Road Park	29	\$189,900	\$161,500	\$253,400	\$440,568	\$374,680	\$587,888
Buff-Chardd Preserve	3	\$162,300	\$162,300	\$216,200	\$38,952	\$38,952	\$51,888
Burton Wetlands Nature Preserve / Charles Dambach Preserve	3	\$96,000	\$73,500	\$109,900	\$23,040	\$17,640	\$26,376
Chickagami Park	3	\$169,500	\$91,800	\$228,200	\$40,680	\$22,032	\$54,768
Eldon Russell Park	0	-	-	-	-	-	-
Frohring Meadows	23	\$213,000	\$159,100	\$320,900	\$391,920	\$292,744	\$590,456
Headwaters Park	21	\$166,900	\$132,500	\$179,300	\$280,392	\$222,600	\$301,224
Mountain Run Station/Maple Highlands Trail	40	\$303,100	\$142,275	\$340,975	\$969,920	\$455,280	\$1,091,120
Observatory Park	24	\$162,850	\$109,625	\$184,475	\$312,672	\$210,480	\$354,192
Orchard Hills Park	17	\$168,800	\$156,900	\$205,300	\$229,568	\$213,384	\$279,208
Pine Brook Preserve	17	\$126,600	\$104,300	\$162,700	\$172,176	\$141,848	\$221,272
The Rookery	15	\$213,800	\$147,850	\$255,950	\$256,560	\$177,420	\$307,140
Sunnybrook Preserve	2	\$218,450	\$209,500	\$227,400	\$34,952	\$33,520	\$36,384
Swine Creek Reservation	7	\$96,600	\$88,850	\$122,600	\$54,096	\$49,756	\$68,656
Walter C. Best Wildlife Preserve	16	\$167,850	\$132,100	\$202,875	\$214,848	\$169,088	\$259,680
The West Woods	17	\$170,700	\$146,600	\$208,200	\$232,152	\$199,376	\$283,152
Whitlam Woods	9	\$181,700	\$111,700	\$284,400	\$130,824	\$80,424	\$204,768
Property 1 (Oakton Property)	22	\$302,600	\$248,975	\$350,475	\$532,576	\$438,196	\$616,836
Property 2	2	\$176,500	\$117,400	\$235,600	\$28,240	\$18,784	\$37,696
Property 3 (Clause Property)	5	\$163,500	\$127,900	\$181,700	\$65,400	\$51,160	\$72,680
Property 4 (Welton's Gorge)	1	\$171,000	\$171,000	\$171,000	\$13,680	\$13,680	\$13,680
Property 5	2	\$398,050	\$331,600	\$464,500	\$63,688	\$53,056	\$74,320
Property 6 (Heymeyer Property)	3	\$210,400	\$204,400	\$236,200	\$50,496	\$49,056	\$56,688
Property 7 (Stafford Property)	6	\$221,850	\$205,475	\$241,900	\$106,488	\$98,628	\$116,112
Property 8 (Red Raider Property)	0	-	-	-	-	-	-
Property 9 (Union Chapel / Krehlik Property)	1	\$101,800	\$101,800	\$101,800	\$8,144	\$8,144	\$8,144
Property 10 (Abela Property)	2	\$105,650	\$104,300	\$107,000	\$16,904	\$16,688	\$17,120
Property 11 (Farley Property)	2	\$136,400	\$131,400	\$141,400	\$21,824	\$21,024	\$22,624
Property 12 (Brede Property)	2	\$211,950	\$182,200	\$241,700	\$33,912	\$29,152	\$38,672
Property 13 (Husted Woods)	0	-	-	-	-	-	-
Property 14 (Ellerin Property)	20	\$247,450	\$84,550	\$328,525	\$395,920	\$135,280	\$525,640
Property 15 (Middlefield Wetlands)	0	-	-	-	-	-	-
Property 16 (Hyde-Kaplan)	12	\$194,150	\$125,925	\$251,250	\$186,384	\$120,888	\$241,200
Property 17 (Artim Property)	7	\$290,000	\$236,950	\$308,350	\$162,400	\$132,692	\$172,676
		Estimate of Total Value Added to Property			\$6,865,776	\$4,992,384	\$8,465,448
		Estimated Annual Property Taxes			\$113,556	\$82,571	\$140,013

Table 13. Geauga County Residential Property Tax Rates

Community Name / School District	Rate (%)
Auburn Township / Kenston LSD	1.92
Bainbridge Township / Kenston LSD	2.07
Bainbridge Township / Chagrin Falls EVSD	2.30
Burton Township / Berkshire LSD	1.26
Burton Village / Berkshire LSD	1.33
Chardon Township / Chardon LSD	1.62
Chardon Township / Painesville LSD	1.62
Chardon Township / Kirtland LSD	1.76
Chardon Township / Mentor LSD	1.70
City Of Chardon / Chardon LSD	1.63
Chester Township / West Geauga LSD	1.80
Claridon Township / Berkshire LSD	1.28
Claridon Township / Chardon LSD	1.61
Aquilla Village / Chardon LSD	1.64
Hambden Township / Chardon LSD	1.69
Huntsburg Township / Cardinal LSD	1.52
Huntsburg Township / Ledgemont LSD	1.36
Middlefield Township / Cardinal LSD	1.45
Middlefield Village / Cardinal LSD	1.41
Montville Township / Ledgemont LSD	1.34
Munson Township / Chardon LSD	1.68
Munson Township / West Geauga LSD	1.72
Newbury Township / Newbury LSD	1.76
Newbury Township / Kenston LSD	1.86
Parkman Township / Cardinal LSD	1.47
Russell Township / West Geauga	1.90
Hunting Valley / West Geauga	1.61
Russell Township / Chagrin Falls	2.31
So. Russell Village / Chagrin Falls	2.09
Thompson Township / Ledgemont LSD	1.40
Thompson Township / Madison LSD	1.56
Troy Township / Berkshire LSD	1.37
Troy Township / Cardinal LSD	1.54
Average	1.65
Median	1.62

Source: Cleveland Home Titles. 2010 Geauga county Residential Property Tax Rates. Available online at: <http://www.clevelandhometitle.biz/wp-content/uploads/2011/04/Tax-Sheet-Geauga-2011.pdf>. Accessed December 3, 2012.

Table 14. Summary of Geauga Park District Budget

Fiscal Year	2010 Actual	2011 Actual	2012 Budget
Balance January 1	\$1,908,479	\$2,853,756	\$4,146,958
Carryover Encumbrances	\$95,520	\$52,399	\$88,603
Balance Unencumbered	\$1,812,960	\$2,801,356	\$4,058,355
<i>Revenue Name</i>			
Real Estate Tax	\$6,022,519	\$6,080,795	\$6,110,149
State Reimbursed Real Estate Tax	\$882,137	\$855,209	\$817,458
Tangible Person Property Tax	\$15,258	\$790	-
State Government Personal Property Tax	\$586,240	\$348,666	\$107,044
Local Government Funds	\$94,255	\$89,482	\$91,521
Investment Income	\$3,229	\$2,226	\$2,500
Donations, Gifts	\$47,922	\$50,223	\$38,563
Fees	\$20,608	\$27,757	\$10,260
Other Receipts	\$49,349	\$91,116	\$38,782
Refunds	\$275	\$944	-
Sales	\$21,279	\$33,740	\$15,000
Grants	\$45,403	\$14,971	\$15,000
Transfers - In (from Retirement reserve)	-	-	-
Total Revenue	\$7,788,474	\$7,595,919	\$7,246,277
Revenue and Beginning Balance	\$9,696,953	\$10,449,675	\$11,393,235
<i>Expenditure Name</i>			
Personnel & Benefits	\$3,845,317	\$3,817,621	\$3,908,250
Department Budget	\$1,915,683	\$1,485,096	\$1,648,225
Contingency	-	-	\$600,000
Transfer to Land/Retirement Fund	\$1,082,197	\$1,000,000	\$1,500,000
Total Expenditures	\$6,843,197	\$6,302,717	\$7,656,475
Balance December 31	\$2,853,756	\$4,146,958	\$3,736,760

Table 15. Economic Impact of Parks in Ohio

Ohio National Parks	Park Information				Total Regional Economic Impact		
	Recreational Visits	Overnight Stays	Visitor Spending	Labor Income	Annual Job Impact	Annual Labor Income Impact	Annual GPD Impact
Cuyahoga Valley NP	2,492,670	2,719	\$39,449,000	\$10,409,000	819	\$29,793,000	\$42,411,000
Hopewell Culture NHP	33,918	0	\$1,099,000	\$862,000	37	\$1,339,000	\$1,668,000
Dayton Aviation	63,961	0	\$3,092,000	\$1,480,000	87	\$3,212,000	\$4,359,000
First Ladies NHS	8,766	0	\$528,000	-	9	\$205,000	\$332,000
North County	-	-	-	\$349,000	7	\$414,000	\$469,000
Perry's Victory	92,944	1,685	\$7,150,000	\$1,019,000	167	\$4,676,000	\$7,036,000
James A Garfield	24,853	0	\$700,000	-	11	\$341,000	\$566,000
Geauga Park District	961,777	-	\$54,341	\$3,845,317	82	\$4,492,810	\$5,030,517

Table 16. Economic Impacts of Geauga Park District

Fiscal Year	2010	2011	2012	Average
Labor Income	\$3,845,317	\$3,817,621	\$3,908,250	\$3,857,063
Total Non-local Receipts	\$54,341	\$96,064	\$41,380	\$63,928
Total Annual Job Impact	82	82	83	83
Total Annual Labor Income Impact	\$4,492,810	\$4,479,535	\$4,560,063	\$4,510,802
Total Annual Income Tax ¹	\$157,248	\$156,784	\$159,602	\$157,878
Total Annual GPD Impact	\$5,030,517	\$5,025,468	\$5,102,591	\$5,052,859

1. Assumes 3.5% state income tax rate.

Table 17. Summary of Ecosystem Service Values and Range of Uncertainties

Estimated Ranges	Central Tendency	Low Estimate	High Estimate
<i>Ecological and Indirect Human Use Value</i>			
Estimated Value Range	\$15,785,165	\$9,511,028	\$22,176,580
Central Value $\pm 40\%$		\$9,471,099	\$22,099,231
<i>Recreational Use Value</i>			
Estimated Value Range	\$16,742,044	\$11,697,760	\$22,955,095
Central Value $\pm 40\%$		\$10,045,226	\$23,438,862
<i>Special Events Value</i>			
Estimated Value Range	\$1,327,825	\$1,099,792	\$1,630,953
Central Value $\pm 40\%$		\$796,695	\$1,858,955
<i>Total Ecosystem Service Value</i>			
Estimated Value Range	\$33,855,034	\$22,308,580	\$46,762,628
Central Value $\pm 40\%$		\$20,313,020	\$47,397,048

Table 18. Estimated Flow of Ecosystem Services and Economic Benefits Over 20 Years

Years	Discounted Value of Ecological and Indirect Human Use Services	Discounted Value of Direct Human Use Services	Discounted Value of Property and Income Taxes	Discounted Value of Salary and Sales to GDP
1	\$15,325,403	\$17,543,562	\$263,528	\$4,905,688
2	\$14,879,032	\$17,032,585	\$255,852	\$4,762,804
3	\$14,445,662	\$16,536,490	\$248,400	\$4,624,082
4	\$14,024,915	\$16,054,845	\$241,165	\$4,489,400
5	\$13,616,422	\$15,587,228	\$234,141	\$4,358,640
6	\$13,219,827	\$15,133,231	\$227,322	\$4,231,690
7	\$12,834,784	\$14,692,457	\$220,701	\$4,108,437
8	\$12,460,955	\$14,264,522	\$214,272	\$3,988,773
9	\$12,098,014	\$13,849,050	\$208,031	\$3,872,596
10	\$11,745,645	\$13,445,680	\$201,972	\$3,759,801
11	\$11,403,539	\$13,054,058	\$196,090	\$3,650,293
12	\$11,071,397	\$12,673,843	\$190,378	\$3,543,973
13	\$10,748,929	\$12,304,702	\$184,833	\$3,440,751
14	\$10,435,854	\$11,946,312	\$179,450	\$3,340,535
15	\$10,131,897	\$11,598,361	\$174,223	\$3,243,238
16	\$9,836,793	\$11,260,545	\$169,149	\$3,148,775
17	\$9,550,284	\$10,932,568	\$164,222	\$3,057,063
18	\$9,272,121	\$10,614,144	\$159,439	\$2,968,022
19	\$9,002,059	\$10,304,994	\$154,795	\$2,881,575
20	\$8,739,863	\$10,004,848	\$150,286	\$2,797,645
	\$234,843,394	\$268,834,023	\$4,038,250	\$75,173,779

Figures



NOAA Land Cover Classes

- Developed, High Intensity

Developed, Medium Intensity

Developed, Low Intensity

Developed, Open Space

Cultivated Crops

Pasture/Hay

Grassland/Herbaceous

Deciduous Forest

Evergreen Forest

Mixed Forest
- Scrub/Shrub

Palustrine Forested Wetland

Palustrine Scrub/Shrub Wetland

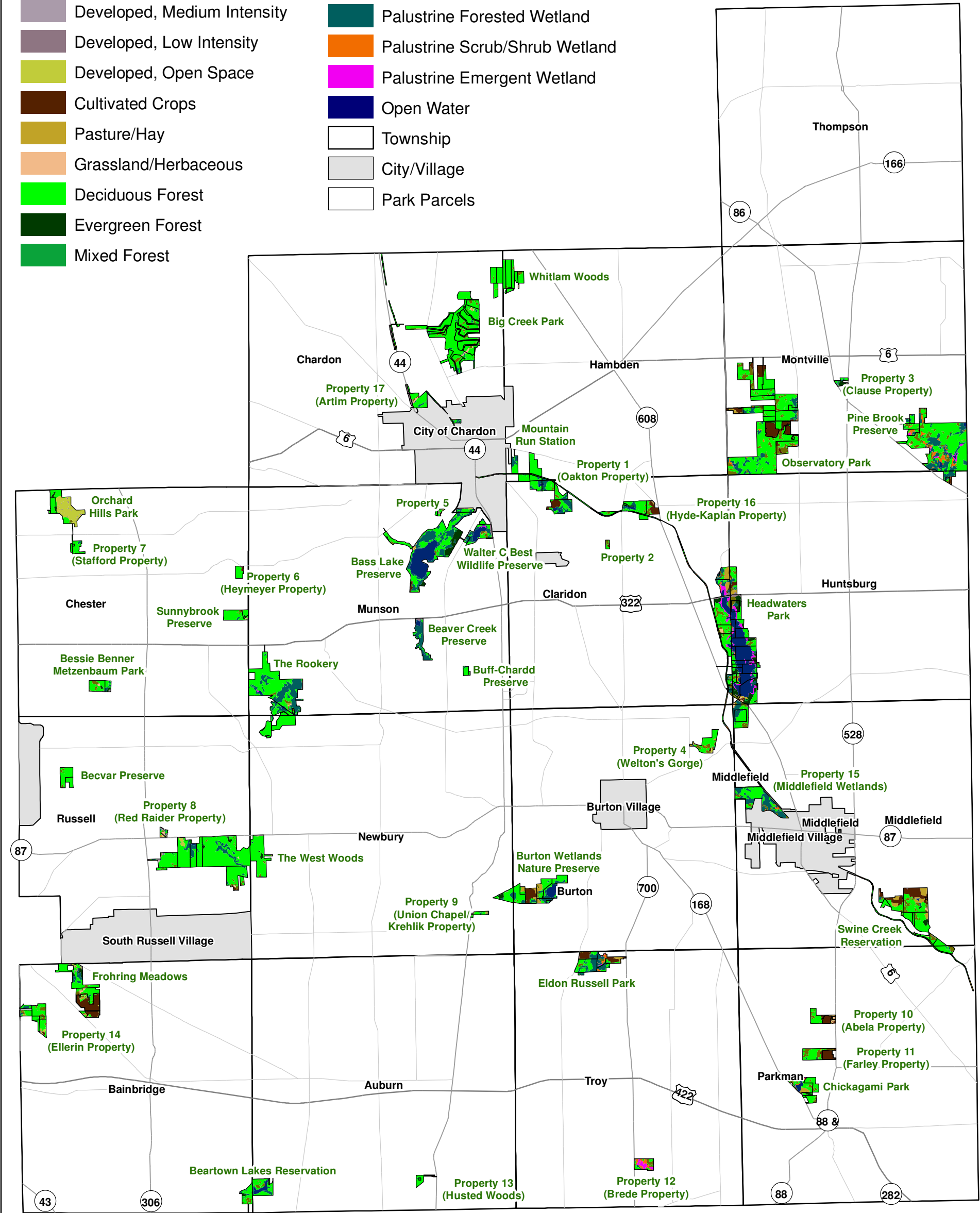
Palustrine Emergent Wetland

Open Water

Township

City/Village

Park Parcels



Land Use/Land Cover data based on NOAA Digital Coast, Coastal Change Analysis Program. 2006. Available at: <http://www.csc.noaa.gov/digitalcoast/data/ccapregional/>

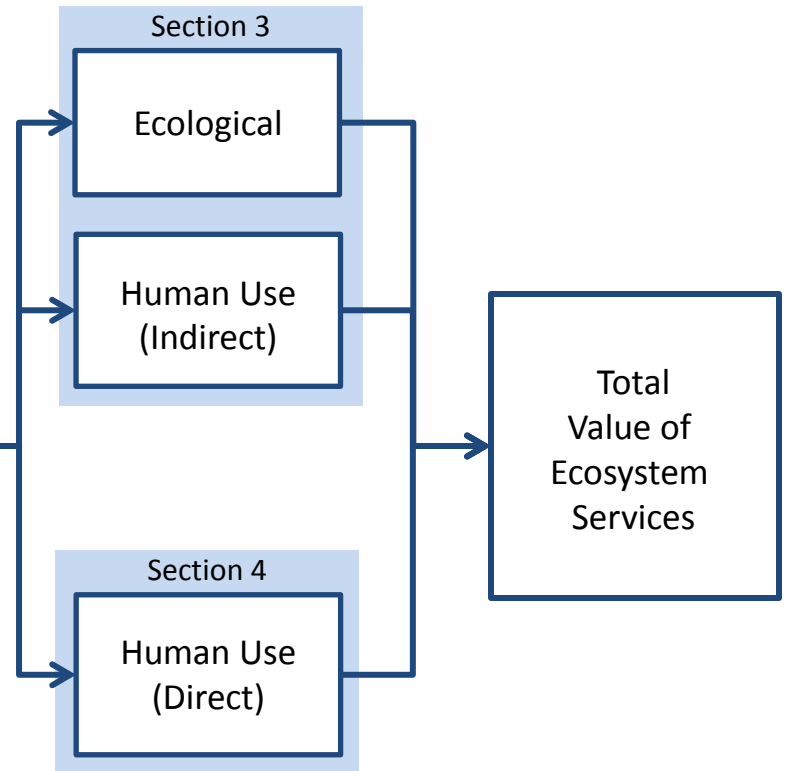
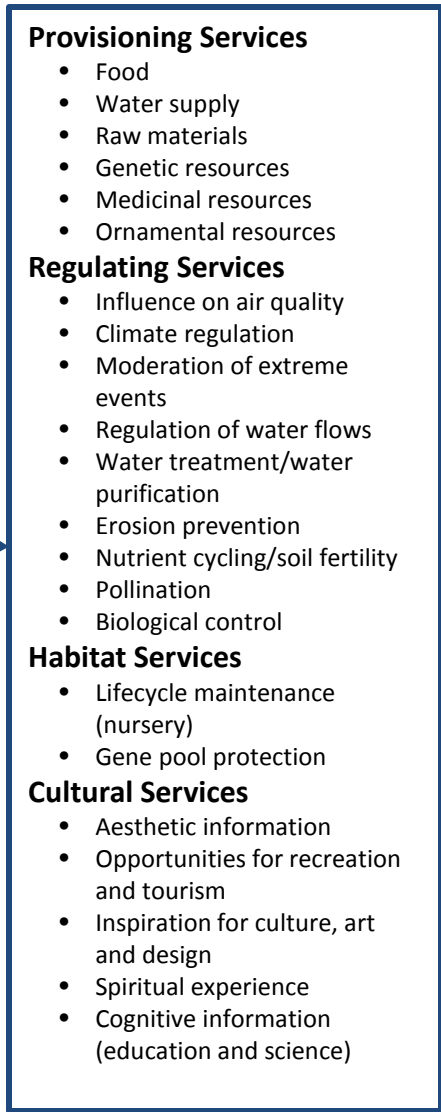
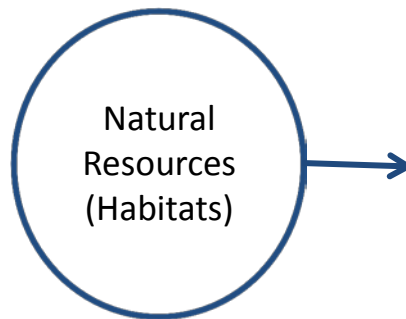


0 1 2 4 Miles



Geauga Parks District
Properties and Land Cover

Figure
2



Appendix A


Photographs



No. 1: Donald W. Meyer Nature Center at Big Creek Park.

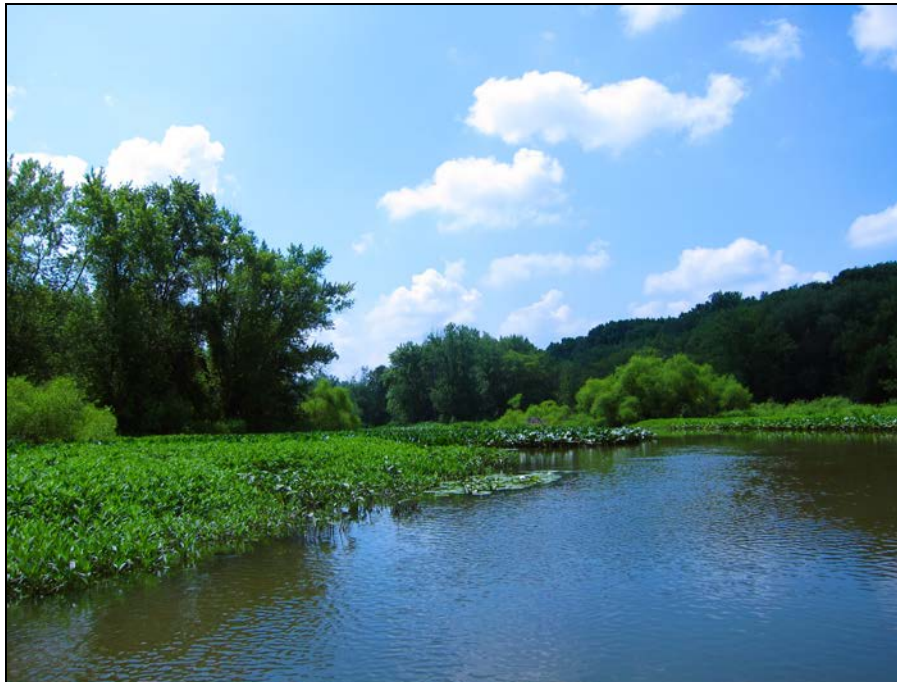


No. 2: Robert McCullough Science Center at Observatory Park.


Title:	Valuation of Ecosystems Services	Date : May 2013
Site:	Geauga Park District Properties	Project-No.: 34-29999A
Client:	Geauga Park District	



No. 3: Wetland habitat at Burton Wetlands Nature Preserve.



No. 4: Wetland habitat along the Upper Cuyahoga River in Eldon Russell Park.


Title:	Valuation of Ecosystems Services	Date : May 2013
Site:	Geauga Park District Properties	Project-No.: 34-29999A
Client:	Geauga Park District	



No. 5: Open water habitat at Bass Lake Preserve.

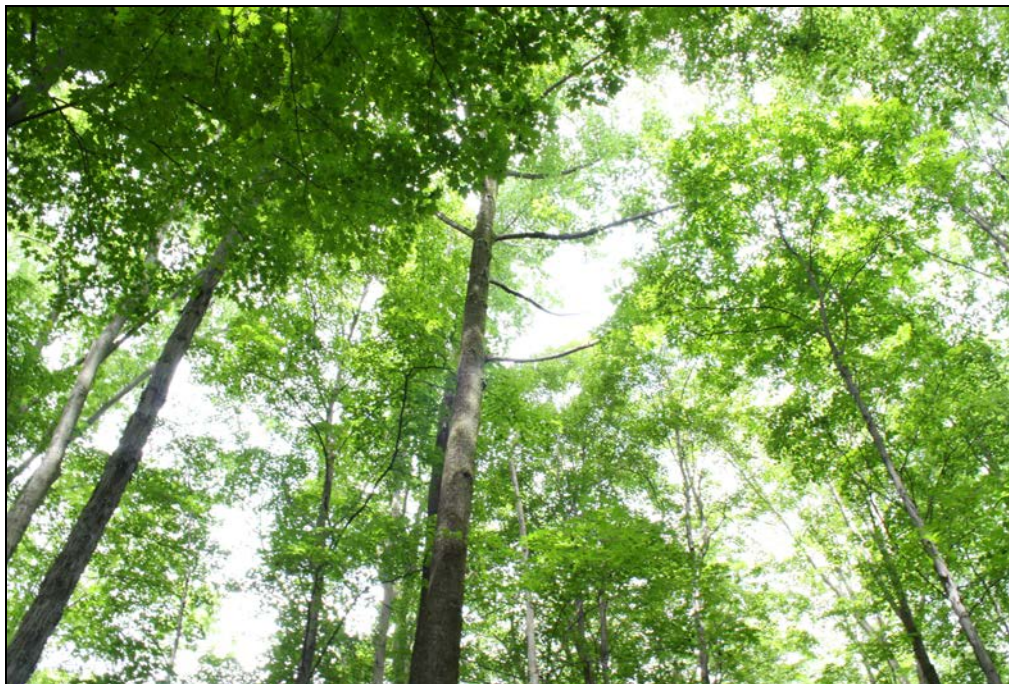


No. 6: Trail through grassland habitat at Frohring Meadows.


Title:	Valuation of Ecosystems Services	Date : May 2013
Site:	Geauga Park District Properties	Project-No.: 34-29999A
Client:	Geauga Park District	

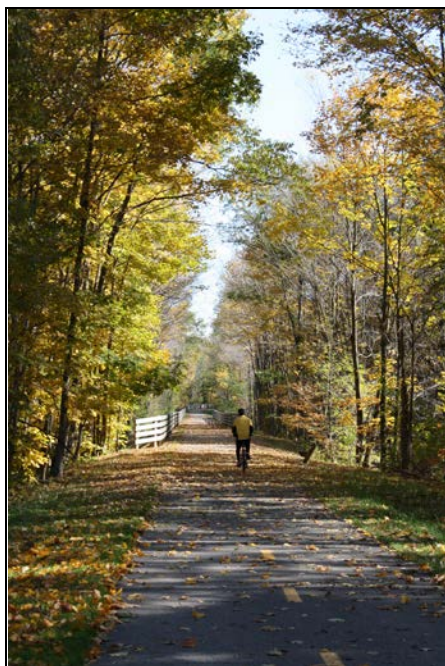


No. 7: Grassland and shrub habitat (background) at Walter C. Best Wildlife Preserve.



No. 8: Deciduous forest at Whitlam Woods.


Title:	Valuation of Ecosystems Services	Date : May 2013
Site:	Geauga Park District Properties	Project-No.: 34-29999A
Client:	Geauga Park District	



No. 9: Biking on the Maple Highlands Trail.



No. 10: Sledding near Lower Bear Lake at Beartown Lakes Reservation.


Title:	Valuation of Ecosystems Services	Date :	May 2013
Site:	Geauga Park District Properties	Project-No.:	34-29999A
Client:	Geauga Park District		



No. 11: Walking the dogs at the park.



No. 12: Horsebacking on the equestrian trail at Headwaters Park.


Title:	Valuation of Ecosystems Services	Date : May 2013
Site:	Geauga Park District Properties	Project-No.: 34-29999A
Client:	Geauga Park District	



No. 13: The Nature Arts Festival at The West Woods.



No. 14: The Sugarhouse at the Swine Creek Reservation is open to the public every March.

Title:	Valuation of Ecosystems Services	Date :	May 2013
Site:	Geauga Park District Properties	Project-No.:	34-29999A
Client:	Geauga Park District		

Appendix B

Property Identification Numbers

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
Bass Lake Preserve	10-709602	21.0
Bass Lake Preserve	21-703244	30.9
Bass Lake Preserve	21-703245	0.6
Bass Lake Preserve	21-703251	552.5
Bass Lake Preserve	Total	605.1
Beartown Lakes Reservation	01-708977	2.0
Beartown Lakes Reservation	01-708978	93.4
Beartown Lakes Reservation	02-729297	52.9
Beartown Lakes Reservation	Total	148.3
Beaver Creek Preserve	21-703236	81.6
Beaver Creek Preserve	Total	81.6
Becvar Preserve	26-705600	50.9
Becvar Preserve	26-705700	16.3
Becvar Preserve	Total	67.3
Bessie Benner Metzenbaum Park	11-711300	49.9
Bessie Benner Metzenbaum Park	11-711400	18.7
Bessie Benner Metzenbaum Park	Total	68.6
Big Creek Park	06-701500	13.9
Big Creek Park	06-701600	12.6
Big Creek Park	06-701800	233.0
Big Creek Park	06-702000	22.6
Big Creek Park	06-702400	30.0
Big Creek Park	06-707414	28.6
Big Creek Park	06-707416	37.6
Big Creek Park	06-707417	25.2
Big Creek Park	06-707418	34.1
Big Creek Park	06-707419	21.7
Big Creek Park	06-707420	28.5
Big Creek Park	06-707421	31.7
Big Creek Park	06-707422	36.2
Big Creek Park	06-707423	29.2
Big Creek Park	06-707424	29.0
Big Creek Park	06-707428	1.5
Big Creek Park	06-707431	30.4
Big Creek Park	06-707451	5.0
Big Creek Park	Total	650.8
Buff-Chardd Preserve	21-703239	14.9
Buff-Chardd Preserve	21-703254	1.5
Buff-Chardd Preserve	Total	16.5
Burton Wetlands Nature Preserve	04-707110	49.6
Burton Wetlands Nature Preserve	04-707122	3.1
Burton Wetlands Nature Preserve	04-707123	0.8
Burton Wetlands Nature Preserve	04-707124	49.4

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
Burton Wetlands Nature Preserve	04-707142	50.2
Burton Wetlands Nature Preserve	04-707146	51.0
Burton Wetlands Nature Preserve	04-707181	10.7
Burton Wetlands Nature Preserve	04-707195	30.8
Burton Wetlands Nature Preserve	04-707212	16.6
Burton Wetlands Nature Preserve	23-707900	44.8
Burton Wetlands Nature Preserve	Total	307.0
Chickagami Park	25-700300	75.4
Chickagami Park	25-700400	20.7
Chickagami Park	25-700600	10.0
Chickagami Park	25-700700	31.5
Chickagami Park	25-704007	1.7
Chickagami Park	Total	139.3
Eldon Russell Park	32-074353	58.6
Eldon Russell Park	32-700500	40.8
Eldon Russell Park	32-702555	4.2
Eldon Russell Park	32-702556	75.9
Eldon Russell Park	32-702570	20.0
Eldon Russell Park	32-702581	0.1
Eldon Russell Park	Total	199.7
Frohring Meadows	02-729395	58.8
Frohring Meadows	02-729396	10.3
Frohring Meadows	02-729405	84.1
Frohring Meadows	02-729406	22.5
Frohring Meadows	03-710900	110.6
Frohring Meadows	Total	286.4
Headwaters Park	12-011900	39.1
Headwaters Park	12-706202	1.1
Headwaters Park	12-706203	5.5
Headwaters Park	12-706205	52.5
Headwaters Park	12-706206	7.7
Headwaters Park	12-706207	32.7
Headwaters Park	12-706208	9.2
Headwaters Park	12-706209	5.1
Headwaters Park	12-706259	51.8
Headwaters Park	12-706261	129.7
Headwaters Park	16-013300	55.2
Headwaters Park	16-703102	39.7
Headwaters Park	16-703109	10.1
Headwaters Park	16-703110	6.8
Headwaters Park	16-703111	15.3
Headwaters Park	16-703112	1.7
Headwaters Park	16-703113	3.8
Headwaters Park	16-703117	83.8

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
Headwaters Park	16-703119	22.4
Headwaters Park	16-703120	35.0
Headwaters Park	16-703121	0.8
Headwaters Park	16-703123	9.9
Headwaters Park	16-703124	111.2
Headwaters Park	16-703126	26.4
Headwaters Park	16-703127	25.7
Headwaters Park	16-703129	2.6
Headwaters Park	16-703130	65.5
Headwaters Park	16-703131	18.6
Headwaters Park	16-703132	58.6
Headwaters Park	16-703133	7.4
Headwaters Park	16-703147	48.7
Headwaters Park	16-703148	9.8
Headwaters Park	16-703149	9.6
Headwaters Park	16-703151	8.7
Headwaters Park	18-015200	63.1
Headwaters Park	18-706130	38.8
Headwaters Park	Total	1113.7
The Maple Highlands Trail	04-151001	1.8
The Maple Highlands Trail	04-707143	7.6
The Maple Highlands Trail	06-048200	16.5
The Maple Highlands Trail	06-707425	6.6
The Maple Highlands Trail	06-707439	1.0
The Maple Highlands Trail	06-707440	0.0
The Maple Highlands Trail	06-707441	6.8
The Maple Highlands Trail	06-707442	2.2
The Maple Highlands Trail	07-705903	8.2
The Maple Highlands Trail	10-165595	10.1
The Maple Highlands Trail	10-709544	4.3
The Maple Highlands Trail	10-709545	3.4
The Maple Highlands Trail	10-709603	0.9
The Maple Highlands Trail	10-709607	1.6
The Maple Highlands Trail	12-031600	1.0
The Maple Highlands Trail	12-095188	2.6
The Maple Highlands Trail	12-706201	3.2
The Maple Highlands Trail	12-706204	1.1
The Maple Highlands Trail	12-706210	11.5
The Maple Highlands Trail	12-706211	23.4
The Maple Highlands Trail	12-706212	9.3
The Maple Highlands Trail	12-706213	4.4
The Maple Highlands Trail	12-706214	6.8
The Maple Highlands Trail	12-706240	0.6
The Maple Highlands Trail	12-706241	0.3
The Maple Highlands Trail	12-706242	1.3
The Maple Highlands Trail	12-706243	0.4

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
The Maple Highlands Trail	12-706244	0.2
The Maple Highlands Trail	12-706246	2.5
The Maple Highlands Trail	12-706249	2.1
The Maple Highlands Trail	12-706250	2.4
The Maple Highlands Trail	12-706251	5.2
The Maple Highlands Trail	12-706252	0.4
The Maple Highlands Trail	12-706255	0.7
The Maple Highlands Trail	12-706256	0.5
The Maple Highlands Trail	12-706257	14.0
The Maple Highlands Trail	13-705034	1.0
The Maple Highlands Trail	15-703802	11.8
The Maple Highlands Trail	18-706134	18.8
The Maple Highlands Trail	18-706135	6.2
The Maple Highlands Trail	18-706137	5.8
The Maple Highlands Trail	25-703905	9.2
The Maple Highlands Trail	25-703906	7.4
The Maple Highlands Trail	Total	225.3
Mountain Run Station	15-703819	31.9
Mountain Run Station	Total	31.9
Observatory Park	20-000200	75.1
Observatory Park	20-070960	18.9
Observatory Park	20-090817	58.5
Observatory Park	20-701400	9.7
Observatory Park	20-701910	45.7
Observatory Park	20-701920	67.7
Observatory Park	20-701930	97.7
Observatory Park	20-701940	19.7
Observatory Park	20-701950	29.8
Observatory Park	20-701963	17.8
Observatory Park	20-701971	461.4
Observatory Park	20-701972	47.1
Observatory Park	20-701973	38.5
Observatory Park	20-701974	76.4
Observatory Park	20-701975	36.8
Observatory Park	20-701976	4.3
Observatory Park	20-701977	18.1
Observatory Park	Total	1123.3
Orchard Hills Park	11-714493	25.1
Orchard Hills Park	11-714494	1.2
Orchard Hills Park	11-714497	165.2
Orchard Hills Park	11-714498	0.6
Orchard Hills Park	Total	192.1
Pine Brook Preserve	17-700100	27.5
Pine Brook Preserve	17-700101	6.0

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
Pine Brook Preserve	20-090820	17.7
Pine Brook Preserve	20-090822	4.9
Pine Brook Preserve	20-090823	6.7
Pine Brook Preserve	20-090824	13.6
Pine Brook Preserve	20-090825	3.3
Pine Brook Preserve	20-701978	25.2
Pine Brook Preserve	20-701979	674.3
Pine Brook Preserve	20-701980	5.2
Pine Brook Preserve	Total	784.3
The Rookery	22-701000	439.5
The Rookery	22-701003	2.7
The Rookery	22-701004	0.6
The Rookery	22-701005	51.8
The Rookery	22-701006	3.0
The Rookery	23-209200	2.4
The Rookery	23-707923	65.2
The Rookery	23-707926	35.4
The Rookery	Total	600.6
Sunnybrook Preserve	11-714480	61.2
Sunnybrook Preserve	11-714481	12.0
Sunnybrook Preserve	Total	73.2
Swine Creek Reservation	18-703100	76.9
Swine Creek Reservation	18-703200	166.7
Swine Creek Reservation	18-703300	6.9
Swine Creek Reservation	18-703400	3.0
Swine Creek Reservation	18-703500	18.7
Swine Creek Reservation	18-705200	1.6
Swine Creek Reservation	18-705400	16.2
Swine Creek Reservation	18-705500	14.5
Swine Creek Reservation	18-706136	3.4
Swine Creek Reservation	18-706172	76.2
Swine Creek Reservation	18-706178	11.7
Swine Creek Reservation	18-706179	7.3
Swine Creek Reservation	25-703900	31.3
Swine Creek Reservation	Total	434.4
Walter C Best Wildlife Preserve	21-703210	92.0
Walter C Best Wildlife Preserve	21-703211	7.6
Walter C Best Wildlife Preserve	21-703230	1.3
Walter C Best Wildlife Preserve	21-703250	7.3
Walter C Best Wildlife Preserve	Total	108.2
The West Woods	23-707908	151.8
The West Woods	26-707015	44.4
The West Woods	26-707016	45.3
The West Woods	26-707018	84.2

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
The West Woods	26-707019	102.3
The West Woods	26-707021	363.1
The West Woods	26-707027	100.9
The West Woods	26-707037	10.0
The West Woods	26-707048	6.5
The West Woods	Total	908.5
Whitlam Woods	06-707447	17.1
Whitlam Woods	06-707448	27.5
Whitlam Woods	06-707449	28.8
Whitlam Woods	15-700500	24.3
Whitlam Woods	15-700600	46.6
Whitlam Woods	15-700700	22.7
Whitlam Woods	15-703812	5.6
Whitlam Woods	15-703813	1.4
Whitlam Woods	15-703814	0.2
Whitlam Woods	15-703815	1.2
Whitlam Woods	15-703823	1.0
Whitlam Woods	15-703824	21.2
Whitlam Woods	15-703825	9.9
Whitlam Woods	Total	207.5
Property 1 (Oakton Property)	12-706248	31.2
Property 1 (Oakton Property)	13-705035	82.0
Property 1 (Oakton Property)	13-705038	35.8
Property 1 (Oakton Property)	13-705039	32.6
Property 1 (Oakton Property)	15-703821	3.2
Property 1 (Oakton Property)	15-703822	22.8
Property 1 (Oakton Property)	15-703826	16.6
Property 1 (Oakton Property)	15-703827	53.7
Property 1 (Oakton Property)	Total	277.8
Property 2	12-706258	10.1
Property 2	Total	10.1
Property 3 (Clause Property)	20-701964	21.6
Property 3 (Clause Property)	Total	21.6
Property 4 (Welton's Gorge)	04-707216	86.9
Property 4 (Welton's Gorge)	Total	86.9
Property 5	21-703246	8.6
Property 5	21-703247	0.0
Property 5	21-703264	3.2
Property 5	Total	11.8
Property 6 (Heymeyer Property)	11-714462	26.9
Property 6 (Heymeyer Property)	11-714463	0.5
Property 6 (Heymeyer Property)	Total	27.3

Appendix B. Property Identification Numbers

Park Name	PIN	GIS Acreage
Property 7 (Stafford Property)	11-714505	4.7
Property 7 (Stafford Property)	11-714506	1.0
Property 7 (Stafford Property)	11-714507	31.7
Property 7 (Stafford Property)	Total	37.4
Property 8 (Red Raider Property)	26-707040	12.4
Property 8 (Red Raider Property)	26-707041	4.4
Property 8 (Red Raider Property)	Total	16.7
Property 9 (Union Chapel/Krehlik Property)	23-707919	2.0
Property 9 (Union Chapel/Krehlik Property)	23-707921	16.0
Property 9 (Union Chapel/Krehlik Property)	Total	18.0
Property 10 (Abela Property)	25-000200	3.0
Property 10 (Abela Property)	25-190447	17.4
Property 10 (Abela Property)	25-704022	50.2
Property 10 (Abela Property)	Total	70.6
Property 11 (Farley Property)	25-190470	27.9
Property 11 (Farley Property)	25-704017	73.2
Property 11 (Farley Property)	Total	101.1
Property 12 (Brede Property)	32-702568	60.1
Property 12 (Brede Property)	Total	60.1
Property 13 (Husted Woods)	01-706200	1.4
Property 13 (Husted Woods)	01-706300	20.5
Property 13 (Husted Woods)	01-708500	2.5
Property 13 (Husted Woods)	Total	24.4
Property 14 (Ellerin Property)	02-729393	10.7
Property 14 (Ellerin Property)	02-729397	20.9
Property 14 (Ellerin Property)	02-729398	46.5
Property 14 (Ellerin Property)	02-729399	7.6
Property 14 (Ellerin Property)	02-729400	7.6
Property 14 (Ellerin Property)	02-729401	8.9
Property 14 (Ellerin Property)	02-729402	28.3
Property 14 (Ellerin Property)	Total	130.5
Property 15 (Middlefield Wetlands)	19-706207	195.9
Property 15 (Middlefield Wetlands)	Total	195.9
Property 16 (Hyde-Kaplan Property)	12-706253	52.8
Property 16 (Hyde-Kaplan Property)	12-706254	73.6
Property 16 (Hyde-Kaplan Property)	Total	126.4
Property 17 (Artim Property)	06-707444	3.3
Property 17 (Artim Property)	06-707446	70.0
Property 17 (Artim Property)	06-707450	1.5
Property 17 (Artim Property)	10-709605	0.6
Property 17 (Artim Property)	10-709606	0.5
Property 17 (Artim Property)	Total	75.9