Glass City Metropark

Toledo, Ohio

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Researchers:

Jess Le – Habitat Quality

Christopher Nosek – Stormwater Management

Sydney Zachos – Carbon Storage and Sequestration

Dr. Haoyue Yang

LA 883 Environmental Design Seminar

Michigan State University

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Performance Goals and Design Intent:

This research evaluated Glass City Metropark 6 years after its initial Phase 1 construction, and 3 years after Phase 2 construction. It is intended to assess the environmental benefits of the park and investigate if the design meets the primary objectives set before construction and completion. This investigation was conducted in collaboration with the design firm SmithGroup. SmithGroup's environmental design goals for this site design included prioritizing reforestation, improving water quality, and adhering to the 80/20 rule of park development.

The research involved collecting and reviewing both primary and secondary source data. This data consisted of collecting citizen science records on species biodiversity, calculating total runoff comparing current site conditions with former, and calculating carbon sequestration of trees planted on site.

The intended goals of this study are to quantify the park's ecological impacts, evaluate effectiveness of ecological design elements, identify key ecological benefits and limitations, establish basis for future ecological managements, and contribute to broader landscape performance assessment studies.

Benefit 1: Habitat Quality

Supports habitat for at least 159 bird species observed at Glass City Metropark, representing a 41.3% increase between Phase 1 and Phase 2 (December 2020-June 2023); bird population hotspot showed increased species richness and rising observation totals.

Background:

Glass City Metropark, located along the Maumee River, serves as a critical habitat stopover for native migratory birds. Recent ecological enhancements, including riverfront stabilization and installation of a habitat island, have significantly improved habitat quality and increased use by waterfowl, herons, and raptors. The Grosbeak Adventure Play Area, inspired by a native migratory bird species, reinforces the park's identity as a habitat stopover through nature-based play. The park's connectivity to riparian corridors and regional trail networks strengthens its ecological function by linking habitat types such as native prairies, woodland edges, and wetlands. These features support a rich diversity of bird species and reinforce the site's role as a key node within the regional habitat system.

Figure 1.1. Grosbeak Adventure Play Area concept; bird species inspiration. Source: Earthscape

Performance Question:

How much has bird species richness increased after habitat improvements, compared to pre-design conditions in Glass City Metropark?

Methods:

For this study, eBird, a global user-generated biodiversity platform, was used to compile bird sighting data. Supported by a network of partner organizations, regional experts, and birding enthusiasts, and managed by the Cornell Lab of Ornithology, eBird provides an extensive dataset for tracking species presence and frequency. Glass City Metropark is a bird sighting hotspot. The study evaluated species diversity and observation frequency within the park through three tracked metrics: total species observed annually, annual counts of selected indicator species, and calculated percent change in species richness across defined project phases: pre-implementation (2018–December 2020), Phase 1 (2020–2023), and Phase 2 (2023–2025). This approach tracked changes in bird species richness and habitat use associated with the park's development and ecological enhancements.

Figure 1.2. Images of bird species found at Glass City Metropark. Source: eBird website reference

Figure 1.2 highlights the diverse range of functional bird groups observed at Glass City Metropark, illustrating the ecological richness of the area. Notably, raptor species such as Cooper's Hawk and Bald Eagle are consistently present, reflecting the park's role as a suitable habitat for top predators. The images also showcase waterfowl and wading birds, emphasizing the importance of wetland and aquatic habitats.

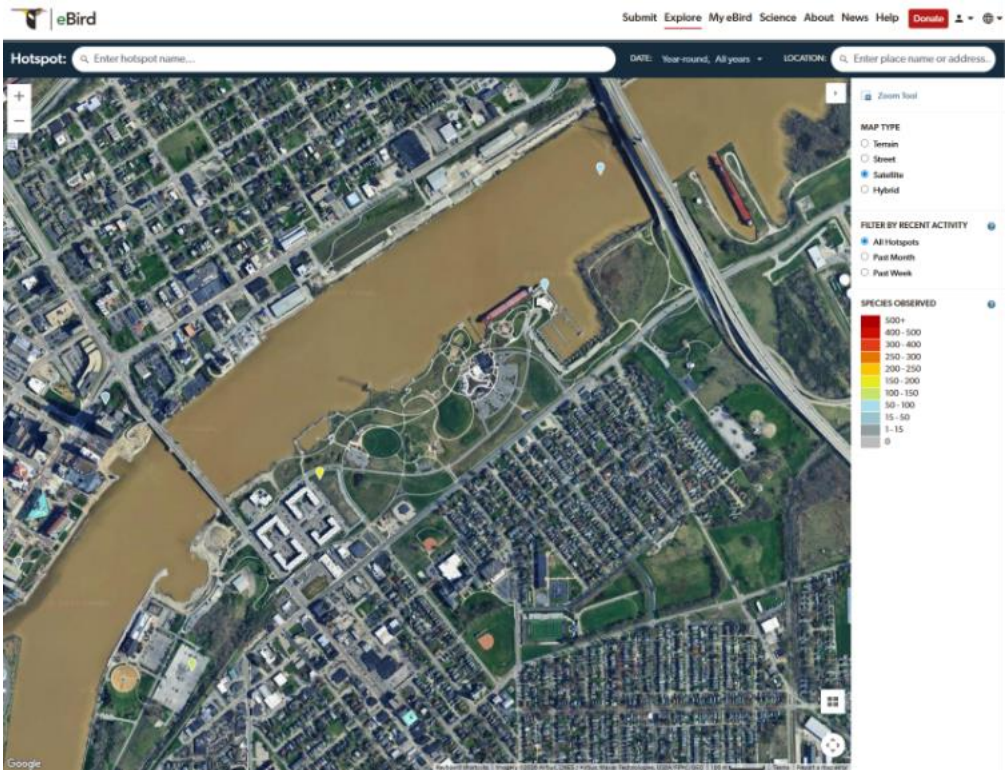

Figure 1.3. eBird Hotspot Map including Glass City Metropark. Source: eBird Hotspot

Figure 1.3 shows Glass City Metropark as a mid-sized birding hotspot, where 159 species have been recorded from 2013 to 2026. This highlights the park's value for long-term avian monitoring and biodiversity tracking.

Calculations:

Table 1.1. Total species observed annually within Glass City Metropark (2020–2025). Source: eBird Bar chart with adaptations

Hotspot Observed Data	**2020***	**2021**	**2022**	**2023****	**2024**	**2025**
Bird Observations: total avian species observed within each year						
Glass City Metropark	59	63	76	125	148	131

*Phase 1 opened in December 2020
**Phase 2 opened in June 2023

Table 1.1 presents annual bird species richness at Glass City Metropark based on eBird data. From 2020 to 2024, the total number of species recorded shows a steady increase, rising from 59 species to a peak of 148 species. The most noticeable growth occurs between 2022 and 2024, where the number of species increases more rapidly from 76 to 125. In 2025, the total

drops slightly to 131 species but remains well above earlier years. Overall, the data indicate that the number of bird species observed at the site has increased over time, with the highest levels occurring in the most recent years.

Table 1.2. Total annual sightings of selected indicator species within Glass City Metropark. Species were selected based on suitability to represent avian functional groups. Source: eBird Bar chart with adaptations

Selected Indicator Species	**Functional Group**	**2020***	**2023****	**2025**
Totals: on eBird Bar Charts, the sum total of all counts from all observations for a species within a specified date range and region				
American Robin (*Turdus migratorius*)	Songbird (Passerine)	151	140	414
Bald Eagle (*Haliaeetus leucocephalus*)	Raptor	1	10	22
Canada Goose (*Branta canadensis)*	Waterfowl	22	392	1460
Double-crested Cormorant (*Nannopterum auritum*)	Waterfowl	2	104	1022
European Starling (*Sturnus vulgaris*)	Songbird (Passerine)	14	151	1356
Great Blue Heron (*Ardea herodias*)	Waterbird (Wader)	2	43	49
Great Egret (Ardea alba)	Waterbird (Wader)	0	7	9
Killdeer (*Charadrius vociferus*)	Shorebird	3	131	177
Osprey (Pandion haliaetus)	Raptor	0	3	39
Peregrine Falcon (*Falco peregrinus*)	Raptor	2	2	10
Red-winged Blackbird (*Agelaius phoeniceus*)	Songbird (Passerine)	0	382	674
Ring-billed Gull (*Larus delawarensis*)	Waterbird (Generalist)	333	514	3385

*Phase 1 opened in December 2020

**Phase 2 opened in June 2023

Table 1.2 records observation counts for selected bird species across key years and includes their functional group classifications. The species selected represent a range of groups, including songbirds, waterfowl, waterbirds, shorebirds, and raptors. A common trend observed is the increase in counts for water-associated species such as Canada Goose and Double-crested Cormorant, particularly between 2020 and 2025. Waterbirds like Great Blue Heron and Ring-billed Gull show higher observation numbers in later years. Songbirds such as American Robin and Red-winged Blackbird demonstrate increases as well, although with more variation across years. Raptors, including Bald Eagle and Peregrine Falcon, show lower overall counts but gradual increases over time. The data show that multiple types of species are recorded in greater numbers across the selected time periods.

Table 1.3. Distribution of bird species by conservation status within Glass City Metropark. Source: IUCN Red List

Species Classification	Count	Percent (%)
Species of Concern	9	5.7
Threatened	2	1.3
Endangered	2	1.3

Table 1.3 summarizes the number of bird species classified as species of concern, threatened, and endangered within the study area over all recorded years (2013-2026). A total of nine species of concern are recorded, as well as two threatened and two endangered species. Percentages are calculated based on the full dataset of 159 total bird species observed across the study period. The table shows that, in addition to commonly observed species, the dataset includes species across multiple conservation categories.

Table 1.4. Overall percent change of observed bird species between years. Source: eBird Bar chart with adaptations

Number of Bird Species Between January 2018 - December 2020 (Phase 1)	Number of Bird Species Between January 2021 – June 2023 (Phase 2)	Overall Percent Change (%)
43	75	74.4
Number of Bird Species Between January 2021 – June 2023 (Phase 2)	**Number of Bird Species Between June 2023 – December 2025**	**Overall Percent Change (%)**
75	106	41.3

Percent Change Formula:

(Number of Bird Species Between January 2021 to June 2023 – Number of Bird Species Between January 2018 – December 2020) / Number of Bird Species Between January 2018 to December 2020 x 100 =

(74 - 43) / 43 x 100 = 74.4%

(Number of Bird Species Between June 2023 to December 2025 – Number of Bird Species Between January 2021 – June 2023) / Number of Bird Species Between January 2021 to June 2023 x 100 =

(106 - 75) / 75 x 100 = 41.3%

Table 1.4 presents changes in species richness across defined time periods. From 2018–2020, a total of 43 species were recorded. This increases to 75 species between 2021 and June 2023, representing a 74.4% increase. From June 2023 to 2025, the number rises again to 106 species, with a 41.3% increase. The largest increase occurs between the first and second time periods, followed by continued growth at a slower rate in the final period. The data show a consistent increase in the number of species recorded across each project phase.

Findings:

Table 1.5. Field observations of avian and wildlife presence and behavior recording in 15-minute intervals during site visit to Glass City Metropark.

Time (Approx.)	Habitat Type	Observed Species	Number Observed	Observed Behavior
2:00–2:15 PM	Grassland / Open Field	Red-winged Blackbird (*Agelaius phoeniceus*)	9	Perching, foraging
2:00–2:15 PM	Riverfront Edge	Canada Goose (*Branta canadensis*)	2	Flying, swimming, walking
2:00–2:15 PM	Riverfront Edge	Ring-billed Gull (*Larus delawarensis*)	18	Flying
2:00–2:15 PM	Grassland / Open Field	Horned Lark (*Eremophila alpestris*)	4	Flying
2:00–2:15 PM	Grassland / Open Field	American Robin (*Turdus migratorius*)	8	Flying, perching, foraging
2:15–2:30 PM	Grassland / Open Field	Killdeer (*Charadrius vociferus*)	7	Flying, nesting, resting
2:15–2:30 PM	Riverfront Edge	Double-crested Cormorant (*Nannopterum auritum*)	5	Flying, foraging
2:15–2:30 PM	Riverfront Edge	Bald Eagle (*Haliaeetus leucocephalus*)	1	Flying, perching, nesting
2:15–2:30 PM	Grassland / Open Field	Peregrine Falcon (*Falco peregrinus*)	1	Flying, foraging, vocalizing
2:30–2:45 PM	Grassland / Open Field	House Sparrow (*Passer domesticus*)	6	Flying, perching, Socializing
2:30–2:45 PM	Grassland / Open Field	European Starling (*Sturnus vulgaris*)	1	Vocalizing
2:30–2:45 PM	Riverfront Edge	Great Blue Heron (*Ardea herodias*)	1	Flying, wading
2:30–2:45 PM	Grassland / Open Field	American Crow (*Corvus brachyrhynchos*)	1	Flying
2:30–2:45 PM	Grassland / Open Field	Groundhog (*Marmota monax*)	1	Foraging
2:30–2:45 PM	Grassland / Open Field	Eastern Cottontail (*Sylvilagus floridanus*)	1	Foraging

Site visit observations recorded during a 30 to 40-minute field session provide supplemental qualitative data supporting eBird-derived trends in species richness and habitat use at Glass City Metropark. Observations were organized into 15-minute intervals to document activity across grassland/open field and riverfront edge habitats. A total of 15 species were recorded, representing multiple functional groups including songbirds, waterfowl, raptors, and terrestrial mammals.

Avian activity was distributed across both habitat zones, with the riverfront edge primarily supporting water-associated species such as Canada Goose, Ring-billed Gull, and Double-crested Cormorant. These species were observed engaging in high-mobility and foraging behaviors, including flying, swimming, and fishing. In contrast, grassland and open field areas supported a greater diversity of songbirds and edge species, including Red-winged Blackbird, American Robin, Killdeer, and House Sparrow, with observed behaviors dominated by perching, foraging, and nesting activity. Raptor species, including Bald Eagle and Peregrine Falcon, were present in low numbers but demonstrated wide-ranging movement and predatory behavior across habitat zones. Additionally, the presence of Groundhog and Eastern Cottontail in edge conditions indicates that terrestrial habitat structure contributes to broader ecological activity beyond avian populations.

Discussion and Implications:

The calculations and findings show an evident increase in bird biodiversity at Glass City Metropark. Species richness rose from 43 species in the pre-implementation phase to 106 species in the most recent phase. eBird data and field observations both support this trend, showing not only more species over time but also more varied behavioral activity. This suggests that the design interventions along the Maumee River have improved habitat quality and made the site more suitable for a wider range of species.

From a landscape design perspective, the results highlight the importance of varied habitat types. The mix of riverfront edges, grassland, and open areas support different functional groups of birds. The increase in water-associated species shows that river restoration and habitat island creation are working effectively. At the same time, it suggests the need for diverse shoreline and wetland designs to avoid over-supporting only a few dominant generalist species.

The increase in raptors such as Bald Eagle, Osprey, and Peregrine Falcon is especially important. These species sit higher in the food chain, so their presence suggests a healthier and more stable ecosystem overall. It indicates that lower-level species populations are also strong enough to support them. This shows the value of designing landscapes that support full ecological systems, not only individual species groups.

Overall, the calculations and findings suggest that phased ecological design and long-term habitat planning can significantly improve biodiversity in urban riverfront parks. They also show that ecological systems take time to develop and stabilize after construction. This reinforces the

importance of long-term monitoring and adaptive management, including tools like citizen science data, to guide future landscape design decisions.

Limitations:

- Bird observations are based on citizen science data, which may introduce some sampling bias and affect the accuracy of species records.
- The increasing popularity of birdwatching may lead to more observations being reported over time on platforms like eBird, which can influence trends.
- The COVID-19 pandemic may have reduced outdoor activity, leading to fewer observations and lower reported species counts beginning in 2020.
- Public access was limited during construction of Phase 1 and Phase 2, resulting in fewer recorded observations during these periods.

Sources:

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Benefit 2: Stormwater Management

The redesign of Glass City Metro Park allowed for a 90% decrease in runoff during a 1-inch rainstorm event; preventing roughly 818,775 extra gallons of water runoff from entering the Maumee River compared to the previous site conditions.

Background:

Glass City Metroparks, located in Toledo, OH, occupies a formerly industrial waterfront site along the Maumee River. The property was formerly home to the Toledo Edison Acme Power Plant, which ceased operations in 1993. Due to the industrial nature of the site, much of the area

was heavily polluted from fly ash disposal associated with plant operations (Woodle, 2026). Plans to help the reinvigorate the site started in 2008 with private developers, though halted quickly due to the 2008 recession. Once sold to the Toledo Metroparks System, the site was able to enter into construction with a focus on remediation and creating a thriving ecosystem.

Due to the heavy pollution which effects both the Maumee River and subsequently Lake Erie, designers emphasized the importance of adding green stormwater infrastructure (GSI) that would help reduce the amount of on-site pollution from making its way into the river. Working on formerly polluted land, the construction first began with replacing the thin layers of clean fill, which was poured over the fly ash, with nutrient rich dredge (SmithGroup, 2024). Next, numerous strategies were incorporated with an intention to reduce runoff volume and improve water quality before discharge. These features include retention and detention of ponds, protected wetlands, rain gardens, green roofs, garden beds, and extensive native and naturalized plantings. The purpose of this test is to better understand if the added GSI is reducing runoff, especially when compared to the previous site's conditions.

Performance Question:

Will the added GSI placed throughout Glass City Metropark reduce the amount of runoff when compared to the previous site conditions? How many gallons of runoff will be reduced between the two cases?

Methods:

For this study, the stormwater performance was evaluated using ArcGIS Pro, which helped visualize and calculate land cover for both the existing and previous site. This was combined with the NRCS Curve Number Method, which is a widely used planning-level model that estimates the direct runoff from a rainfall event (USDA, 1986).

To begin, the site boundary was traced according to the 'phase one' and 'phase two' construction plans on GIS. This means that any landcover of the commercial space located West of the site, or the Great Lake's Museum property located just Northeast of the site was not included. The landcover types separated into multiple feature classes; classifying each as either plant beds, green stormwater infrastructure (GSI) retention/detention basins, forested space, impervious surface, or pervious paving (see Figure 2.2).

Figure 2.1: Different land cover types (in order: left to right, up to down): 1. Turf, 2. Garden Beds, 3. Stormwater Infrastructure (GSI), 4. Pervious Gravel Paths, 5. Impervious Concrete/Asphalt Paths, and 6. Dense Tree Plantings. Source: 1-5 taken on site April 10, 2026, Photo 6 Source: Google Earth

Figure 2.2: Digitized GIS map displaying boundary of study and the separate land cover categories for the Current Metropark. Turf is not traced exactly since it is the predominant land cover; it will be left as the residual land cover and calculated after the other land covers are shown. Source: ArcGIS Pro.

Using the data provided, overall acreage was calculated, as well as each land cover's percentage. The remaining turf space was calculated as the remaining park area after subtracting mapped pervious, impervious, planted, forested, and water-management surfaces from the overall acreage (see Table 1). A similar tracing method was repeated to figure out the former industrial site's land cover; though only splitting that into two categories. One category for the impervious industrial development formerly found on the site and another for the disturbed turf and industrial open space (see Figure 2.3 and Table 2.2).

Figure 2.3: Digitized GIS map displaying boundary of study and the separate land cover categories for the former industrial site. Turf is not traced exactly since it is the predominant land cover; it will be left as the residual land cover and calculated after the other land covers are shown. Source: ArcGIS Pro.

Table 2.1: Current Metropark's acreage and land cover percentage for each surface type.

Current Site Land Cover (2026)		
Land Cover Type	**Acreage**	**Percentage**
Impervious	11.47	18.14%
Pervious	1.69	2.67%
Garden Bed	2.5	3.95%
Retention Basin	3.87	6.12%

Forested	12.19	19.28%
Turf	31.72	50.17%
Total	**63.44**	

Table 2.2: Previous industrial acreage and land cover percentage for each surface type.

Previous Site Land Cover (2006)		
Land Cover Type	**Acreage**	**Percentage**
Impervious	31.16	49.12%
Turf/open land	32.28	50.88%
Total	**63.44**	

With the land cover mapped out and percentage types identified, the NRCS Curve Number Method could begin. The equation for this method is:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S}$$

- Q = runoff (in)
- P = rainfall (in)
- S = potential maximum retention after runoff begins (in)

To find 'S, or the maximum retention after runoff begins (in), the weighted curve number for each version of the site must be identified. With the soil contents throughout the site primarily being made up of 'dredge', the hydrologic soil group can be inferred as group 'C' as based off information given by the Soil Conservation Service (USDA, 1986). With this group identified, each land cover type's curve number was identified (see Tables 2.3 and 2.4).

Table 2.3: Current land cover and curve number for the total site (weighted).

Current Metropark: Calculated Curve Weight and Soil CN			
Land Cover Type	**Soil Type 'C' CN**	**Percentage**	**Weighted Curve Number (% x CN)**
Impervious	98	18.14%	.1814 x 98 = **17.7772**
Pervious	74	2.67%	.0267 x 74 = **1.9758**
Garden Bed	74	3.95%	.0395 x 74 = **2.923**

Retention Basin	70	6.12%	.0612 x 70 = **4.284**
Forested	70	19.28%	.1928 x 70 = **13.496**
Turf	74	50.17%	.5017 x 74 = **37.1258**
		Current	**77.5818 = 78**

- Current Metropark's overall CN = **78**

Table 2.4: Previous land cover and curve number for the total site (weighted).

Former Industrial: Calculated Curve Weight and Soil CN				
Land Cover Type	**Acreage**	**Soil Type C CN**	**Percentage**	**Weighted Curve Number (% x CN)**
Impervious	31.16	98	49.12%	.4912 x 98 = 48.1349
Disturbed turf/open land	32.28	91	50.88%	.5088 x 91 = 46.3033
Total	**63.44**			**94.4382 = 95**

- Former Industrial Site's overall CN = **95**

Both weighted curve numbers were then entered into the equation to find 'S':

$$S = \frac{1000}{CN} - 10$$

- Current Metropark = (1000 / 78) -10 = **2.8205**
- Former Industrial Site = (1000 / 95) – 10 = **.5263**

For 'P', a 1-inch rain event will be calculated into the equation for 'Q'. This was chosen to keep all

Findings:

Through calculating a 1-inch rainstorm on the current site, it was found that only **0.05 inches of rain runs off** into the Maumee River. This, compared to the former industrial site which had around 0.5 inches of runoff during the same 1-inch storm. To better visualize the reduction, the inch of rain across the site was converted into gallons to accurately see the decrease in runoff post-construction. Converted to acres, a 1-inch rainstorm over an acre is around 27,154 gallons.

- Current Park = 0.0538 x 63.44 x 27,154 = 92678.5571 = **92,679 gallons of runoff**
- Former Industrial Site = 0.5291 x 63.44 x 27,154 = 911453.988 = **911,454 gallons of runoff**

Table 2.5: Total findings of research comparing the amount of total runoff and water retention between the former industrial site and the current metropark.

Findings: Industrial vs Current conditions				
	Curve Number	**Water Retained** S	**Runoff (in)** Q	**Runoff (gallons)**
Current Metropark	78	2.8205	0.0538 in	92,679 gallons
Former Industrial	95	.5263	0.5291 in	911,454 gallons
Results	**-17**	**+2.29 in**	**-.4753**	**-818,775**

In total, the redesign of Glass City Metro Park allowed for a **90% decrease** in runoff during a 1-inch rainstorm event, preventing roughly **818,775 extra gallons of water runoff** from entering the Maumee River, compared to the previous site's conditions.

Discussion and Implications:

Through the findings, the benefits of reclaiming polluted industrial areas and converting them to multi-use parks are shown. The conversion of Glass City Metropark substantially improved the amount of water runoff that enters the Maumee River, even on relatively low-infiltrating soils. The large amount of land that was designated for green space, garden beds, and stormwater retention and detention allowed this park to reduce the amount of stormwater runoff, further helping to reduce pollution by holding and filtering water on-site. For cities like Toledo, which are home to major industrial plants and are built around major river systems like the Maumee, this reduction is important. Untreated urban runoff can transport sediment, nutrients, metals, oils, and debris into important water bodies. By retaining more rainfall on site, the park likely helps reduce pollutant loading to the Maumee River. Retaining water on-site also aids infrastructure and cost-reduction by decreasing stress on municipal drainage infrastructure. This test of runoff proves the importance of green infrastructure and how it aids both recreational activities and high-performing green infrastructure systems.

Limitations:

- Former industrial land-cover conditions were modeled based on historic site use rather than detailed archival mapping.

- Though cross checked with modern imagery, land-cover for current site was mapped off of older imagery, meaning some areas labeled as one land cover could have changed.
- Curve numbers describe average conditions that are useful for design purposes. If the rainfall event used is a historical storm, the modeling accuracy decreases.
- Soil conditions were interpreted from publicly available mapping and may vary locally.
- The model estimates runoff volume only and does not account for peak flow timing, water quality treatment, or subsurface drainage infrastructure.
- Modeled rainstorm amount does not represent the site's ability to handle water during extreme or historic rain events; site performance may vary depending on rainfall intensity, seasonal moisture, and maintenance conditions.

Sources:

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Benefit 3: Carbon Storage and Sequestration

Sequesters an estimated 33,180 lbs of CO_2 annually in 1,149 newly planted trees and is projected to sequester over 663,600 lbs of carbon over the next 20 years.

Background:

The design of Glass City Metropark integrates large-scale reforestation as a central strategy for ecological restoration and user experience enhancement on a formerly industrial waterfront site. A total of 207 trees were planted during Phase 1 in 2020, followed by an additional 942 trees in Phase 2 in 2023, contributing to the establishment of over 17 acres of new forest habitat. Planted at a density of approximately 500 trees per acre, these trees are part of a broader effort to reintroduce native plant communities reflective of the region's historic mixed oak forest ecosystem (Woodle, 2026).

Beyond their ecological role, the trees are strategically distributed throughout the park to improve pedestrian comfort and spatial quality by providing shade along trails, gathering spaces, and activity areas. As the canopy matures, these plantings are expected to enhance microclimatic conditions, reduce urban heat island effects, and contribute to long-term environmental performance through carbon sequestration, stormwater interception, and habitat creation. This reforestation effort supports the project's goal of transforming a degraded brownfield site into a resilient, multifunctional landscape that prioritizes both environmental sustainability and community use (SmithGroup, 2024).

Performance Questions:

How does planting new tree species influence carbon sequestration in the area?

How could carbon sequestration be predicted for 20 years from now?

Methods:

For this study, trees planted on site from both Phase 1 and Phase 2 of the design were measured. Trees were measured using standard diameter measurement at breast height (DBH) of roughly 4.5 feet from the base of the tree. Additional data was sourced from the firm's planting plan.

A carbon sequestration analysis was conducted using the iTree Eco tool V6, generally used to collect data from both single trees and complete inventories. On site measurements were used as sample data to inform DBH values for the complete planting plan. Species name, DBH, percent of crown dieback, and land use type were imported into iTree Eco, resulting in values indicating the annual carbon sequestration of trees by species.

Calculations:

Table 3.1 - Site Measurements taken on 4/10/2026 of diameter breast height of trees.

Glass City Site Measurements – 4/10/2026		
Phase	**Tree Species**	**DBH (inches)**
1	Crabapple	6
1	Red Sunset Maple	7.5
1	London Planetree	12
1	Bald Cypress	7.25
1	Elm	7.5
2	Red Maple	6.25
2	Kentucky Coffee tree	8
2	Redbud	7
2	Hawthorn	6

Site Measurements were taken on select trees around the site. Trees selected were commonly planted species on the site, determined from the planting plan provided by the firm. DBH was

measured at 4.5 feet above the ground using a soft measuring tape, which is the standard measurement method (City of Portland, n.d.).

Table 3.2 - Calculations for DBH Weighted Average.

DBH Weighted Average Calculations			
Phase	**Average DBH Value**	**DBH at Planting**	**DBH Weight**
Phase 1	7.06	1.5	3.71
Phase 2	6.81	1.5	3.54
London Planetree*	12	1.5	7

*London Planetree was excluded from average DBH calculations as the growth rate for this tree species is considered faster than average (Yiesla, 2026).

Each species was given a size at planting noted from the planting plan provided by the firm. An average DBH at planting value was determined from the caliper size at planting. The caliper size at planting is commonly 2 inches, resulting in a DBH of roughly 1.5 inches (OpenAI, 2026; U.S. Department of Agriculture, 1993). The DBH at planting was multiplied by the DBH weight values determined from Phase 1 and Phase 2 site measurements. This resulted in a DBH value used and imported into iTree Eco for reporting.

DBH Weight Formula:

(Average DBH from site measurements – DBH at planting) / DBH at planting) = DBH Weight

Phase 1: (7.06 - 1.5) / 1.5 = 3.71

Phase 2: (6.81 - 1.5) / 1.5 = 3.54

Table 3.3 – Annual Carbon Sequestration for Phase 1 of the design.

Annual Carbon Sequestration of Trees by Species – Phase 1		
Species	**Gross Carbon Sequestration (ton/yr)**	**CO_2 Equivalent (ton/yr)**
Ironwood	0.01	0.05
Amur Maple	0.06	0.23
Red Maple	0.12	0.43
Serviceberry spp	0.12	0.45
Downy Hawthorn	0.03	0.11
Black Gum	0.04	0.13
Honeylocust	0.05	0.19
Kentucky Coffee tree	0.03	0.12
Witchhazel spp	0.01	0.02
Japanese Flowering Crabapple	0.07	0.24

American Sycamore	0.03	0.10
Swamp White Oak	0.08	0.29
Bur Oak	0.03	0.11
Redbud	0.03	0.12
Common Linden	0.03	0.11
Elm spp	0.05	0.19
TOTAL	**0.79**	**2.90**

CO_2 Equivalent Carbon Sequestration can be converted to pounds per year through this equation:

(CO_2 Equivalent in tons x 2000 lbs) = CO_2 Equivalent carbon sequestration in pounds per year =

(2.90 x 2000) = **5,800 lbs CO_2/year for Phase 1.**

Table 3.4 – Annual Carbon Sequestration for Phase 2 of the design.

Annual Carbon Sequestration of Trees by Species – Phase 2		
Species	**Gross Carbon Sequestration (ton/yr)**	**CO_2 Equivalent (ton/yr)**
Ironwood	0.04	0.13
Red Maple	0.45	1.67
Sugar Maple	0.15	0.55
Serviceberry spp	0.46	1.68
American Hornbeam	0.09	0.31
Downy Hawthorn	0.24	0.89
Black Gum	0.58	2.13
Honeylocust	0.16	0.59
Kentucky Coffee tree	0.04	0.14
Witchhazel spp	0.09	0.32
Tuliptree spp	0.20	0.73
Japanese Flowering Crabapple	0.13	0.47
Norway Spruce	0.12	0.43
Serbian Spruce	0.07	0.24
London Planetree	0.44	1.63
Redbud	0.05	0.19
Bald Cypress	0.11	0.39
Common Linden	0.24	0.89
Elm spp	0.08	0.31
TOTAL	**3.73**	**13.69**

The CO_2 equivalent carbon sequestration in pounds per year:

(13.69 x 2000) = **27,380 lbs CO_2/year for Phase 2.**

To forecast carbon sequestration over the next 20 years, the annual sequestration value is multiplied by 20 years; assuming sequestration stays constant.

(5800 lbs + 27380 lbs) x 20 years = **663,600 lbs CO_2 over the next 20 years.**

Findings:

Through calculating and estimating the DBH of newly planted tree species on site, it was determined that these trees sequester an estimated 33,180 lbs of CO_2 annually. Compared to the former industrial site that was generally barren with trees, this level of carbon sequestration is a major improvement. While carbon sequestration changes as the growth and health of maturing trees change, we can estimate that the site will sequester well over 663,600 lbs of CO_2 over 20 years.

Discussion and Implications:

The findings show that the design's reforestation strategy produces meaningful ecological value beyond visual improvement. The 1,149 planted trees provide measurable carbon sequestration and storage while also supporting shade, habitat creation, and a more resilient microclimate. Especially given the former industrial waterfront, this design shows that the landscape can function as a restorative infrastructure solution. Effectively transforming degraded land into a multifunctional public landscape that has large environmental benefits.

This park highlights the importance of designing with long-term ecological performance in mind. Especially through native and regionally appropriate plant palettes, strategic tree placement, and an understanding of how canopy growth changes site performance over time.

Limitations:

- Not every tree included in the planting plan was measured on-site individually. Real DBH measurements andestimated DBH measurements used in iTree Eco could vary.
- Some specific tree varieties were not listed under iTree Eco's tree inventory database and were substituted for similar varieties for calculations. This could have shifted the carbon sequestration results slightly.
- DBH at planting values used in the complete inventory were determined from standard and average values taken from other sources. There is potential for inaccuracy.
- The 20-year projection of carbon sequestration is based on a constant sequestration value. Trees grow and sequester more carbon over time, making the projection a rough estimate and not biologically grounded.

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Glass City Metropark, Toledo, Ohio

Landscape Performance Assessment - Option B: Detailed Research Plan and Instrument

Research Fellow:
Samia Tasnim Faiza
4th year, Landscape Architecture
Michigan State University

Course Instructor: **Dr. Haoyue Yang**
Assistant Professor, Landscape Architecture
School of Planning, Design, and Construction
Michigan State University

Overview: The Glass City Metropark is a large public park situated next to the Maumee River. The park was created to allow outdoor activities and make waterfront access easier for everyone. The park features open lawns, walking paths, benches, and a children's playground. It offers great views of the river and allows gatherings that bring people closer together. The main aim of the design is to create a place where socialization and leisure can take place safely and comfortably. Visitors enjoy walking, working out, and being with their families and friends at the park.

Table of Contents:

1. Project Goals and Design Objective – Key design goals and intended outcomes.
2. Performance Questions – The performance questions guiding my analysis.
3. Methods and Metrics – The metrics selected and the methods used to calculate or evaluate them.
4. Performance Findings – Results from analysis, or initial data collection.
5. Limitations – Data limitations and uncertainties.
6. Discussion and Implications – Interpretation of findings.
7. References – Sources of tools used in the analysis.

Acknowledgements: I would like to sincerely thank Dr. Haoyue Yang (Professor) and Brandon Woodle for their guidance and support throughout this project. Their suggestions helped me better understand landscape performance and improve my analysis. I also appreciate the opportunity to visit Glass City Metropark, which allowed me to observe and collect valuable data for this study.

I am grateful to my team member, Adam Hershner, for his collaboration during the project. Lastly, I acknowledge the use of observation methods and tools such as SOPARNA, which helped structure the behavioral analysis in this study.

Research Strategy: This study uses a behavioral observation approach to evaluate social performance at Glass City Metropark. The SOPARNA toolkit is applied to systematically observe how visitors use different areas of the park and how social interactions occur.

> **Site objective → SOPARNA Method → Zone Selection → Observation → Data Collection → Analysis → Visualization → Findings**

Metric Title: Assessment of Social Interaction and Activity Patterns

***Project Goal and Objective*:** The goal of this project is to focus on social performance analytics and evaluate how well “Glass City Metropark" supports community gathering, recreation, social interaction, and user activity through behavioral observation. It also focuses on how people use different spaces, what activities they do, and how they interact with each other.

***Performance Questions*:** This study asks; How do visitors use different spaces within the park? Which areas of the park support more social interaction? What type of activities are most common in the park?

***Methods and Metrics*:** I used behavioral observation to evaluate how people use the park. I collected data like how many people were in different areas, the age groups, and interaction levels. I have also used a timer to record short activities of how much time they were spending in an activity.

Performance Findings: I observed areas at the **Boardwalk (Across the Glass City Pavilion), Prairie and Pollinator Discover Play Area**, and **Glass City Metro Park Slides**. The observed areas were engaging and interactive. Since they were playground areas, it was mostly occupied with children and parents.

- All the observation zones show high levels of social interaction, especially among children and families.

- Riverwalk areas show mixed interaction levels, supporting both movement and casual social use.
- Larger group sizes are concentrated in play zones, while smaller groups dominate linear spaces.

Limitations: The observations were done for a limited period of time so it may not show full patterns. Findings will be different at different times and days of the week which is challenging as it may not fully understand visitor reasons just by observing.

Discussions and Implications: The study suggests that the space is actively engaging. It brings together communities and supports social interaction, biodiversity, and well being.

Social Performance

Overall Method (SOPARNA Behavioral Observation): The study used direct observation to record how people use the park. The site is divided into three key zones such as the Boardwalk (Across the Glass City Pavilion), Prairie and Pollinator Discover Play Area, and Glass City Metro Park Slides. Observations are conducted through repeated visual scans, where data on activity type, group size, age range, and interaction level are recorded.

Data Collection:

Data is collected during specific times of the day to capture variations in park use. For each observation:

- Activity type (walking, playing, sitting) is recorded
- Group size (individual, pair, group) is noted
- Age group is estimated
- Interaction level (low, medium, high) is observed

This structured method allows comparison between zones and helps identify patterns of social use.

Key Social Performance Indicators:

Social Interaction Level → Measures how actively people engage with others.
Group Activity → Identifies whether spaces support group use.
Age Distribution → Shows which age groups use different areas.
Activity Type → Indicates how the space is used (active vs passive).

Interpretation:

- Play structures and flexible spaces encourage group interaction.
- Pathways support movement and moderate interaction.
- Seating and open spaces allow for passive and social use.

Conclusion:

The study shows that Glass City Metropark supports strong social interaction, especially in play areas where group activities are common. Spaces like the riverwalk provide more flexible use, allowing both movement and casual interaction. The findings highlight that design elements such as play structures, seating, and open spaces influence how people gather and interact. Overall, the park successfully promotes social engagement, but further data collection would provide a more complete understanding of user behavior.

Behavioral Observation Sheet: SOPARNA (System for Observing Physical Activity and Recreation in Natural Areas)

Observer name: **Samia Tasnim Faiza**
School: **Michigan State University**
Course instructor: **Dr. Haoyue Yang**
Date: **10th April, 2026**
Day: **Friday**
Observation Time: **Afternoon (1 - 3PM)**
Weather: **Gloomy**

Site: **Glass City Metropark, Toledo, Ohio**

Overview of the Park: The Glass City Metropark is a large public park situated in Toledo, Ohio. The park was created to allow outdoor activities and make waterfront access easier for everyone. The park features open lawns, walking paths, benches, and children's play areas. It offers great views of the river and allows gatherings that bring people closer together. The main aim of the design is to create a place where socialization and leisure can take place safely and comfortably. Visitors enjoy walking, working out, and being with their families and friends at the park.

Purpose of "SOPARNA": SOPARNA toolkit was used to systematically observe and record user behavior, activity types, and social interactions across different park zones. Observations were conducted at a specific time of the day, and behavior mapping was used to identify patterns of use and social engagement.

Observation Zone:

Figure: Aerial map of Glass City Metropark showing three different observation areas

❖ Zone 1: **Glass City Riverwalk**
❖ Zone 2: **Glass City Metropark Slides**
❖ Zone 3: **Prairie and Pollinator Discover Play Area**

Behavioral Observation Data

Table: Overall Data

Observation Zone	Group Size	Activity Type	Age Range Group (y/o)	Interactive Level	Duration (minutes/seconds)	Notes
Glass City Riverwalk (Boardwalk across Pavilion) - 1	2 adults	Playing, Socializing	(18 - 20)	Interaction: High, Active	Recorded time: 4:53	Two young adults were playing and running after one another on the boardwalk bridge. The interactive rope bridges are an attraction of the park which is used by all age groups of people.
Glass City Riverwalk (Boardwalk across Pavilion) - 2	2 adults	Dog strolling	(30 - 35)	Interaction: Medium, Moderately active	Recorded time: 9:11	One man and a woman were strolling a dog near the boardwalk area. They both took a break after 9 minutes 11 seconds, hence that was the amount of time I could record.
Glass City Metropark Slides	11 children	Playing, Socializing, Running	(2 - 12)	Interaction: High, Active	Recorded time: 7:53	Three groups of families were present in the area where each of the families were busy playing and interacting with their children. Family 1: 4 members, Family 2: 4 members, Family 3: 3 members
Prairie and Pollinator Discover Play Area	9 children	Playing, Socializing, Running	(2 - 10)	Interaction: High, Active	Recorded time: 5:23	A total of 9 children were playing, waiting for their turns to use the slides, eating, running , and socializing with each other.

Fig: Table shows overall data collection during the entire observation time

Bar graph 1:

➔ Metropark Slides and Prairie and Pollinator Discover Play Area have larger group sizes, whereas Glass City Riverwalk has smaller group size.

➔ This shows family/group activity vs individual use spaces.

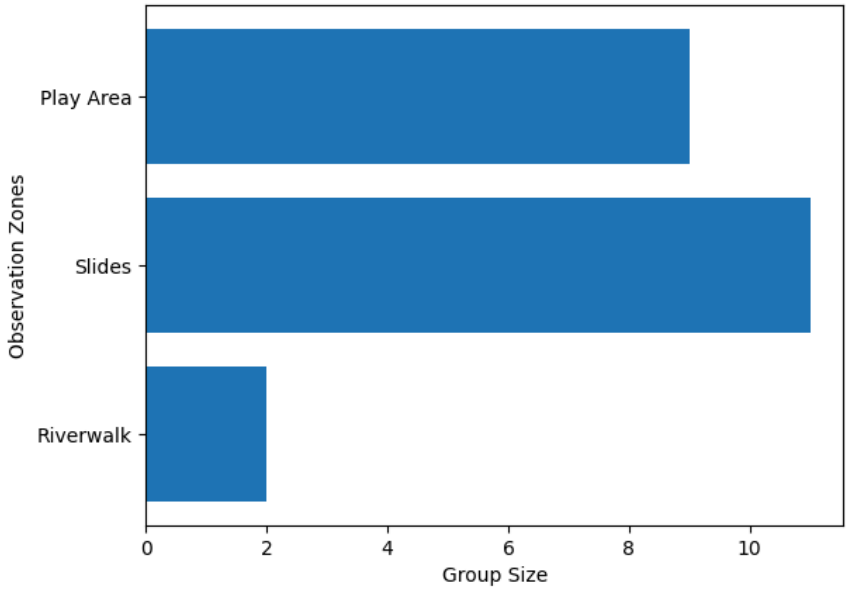


Fig: Bar graph showing the Group Size vs Observation Zones

Bar graph 2:

- ➔ Prairie and Pollinator Discover Play Area and Metropark Slides show only high interaction, meaning these spaces strongly support social activity.
- ➔ The riverwalk shows both medium and high interaction, indicating a mix of social and individual use.
- ➔ This suggests that design features like play equipment encourage stronger social engagement, while walkways support more flexible use.

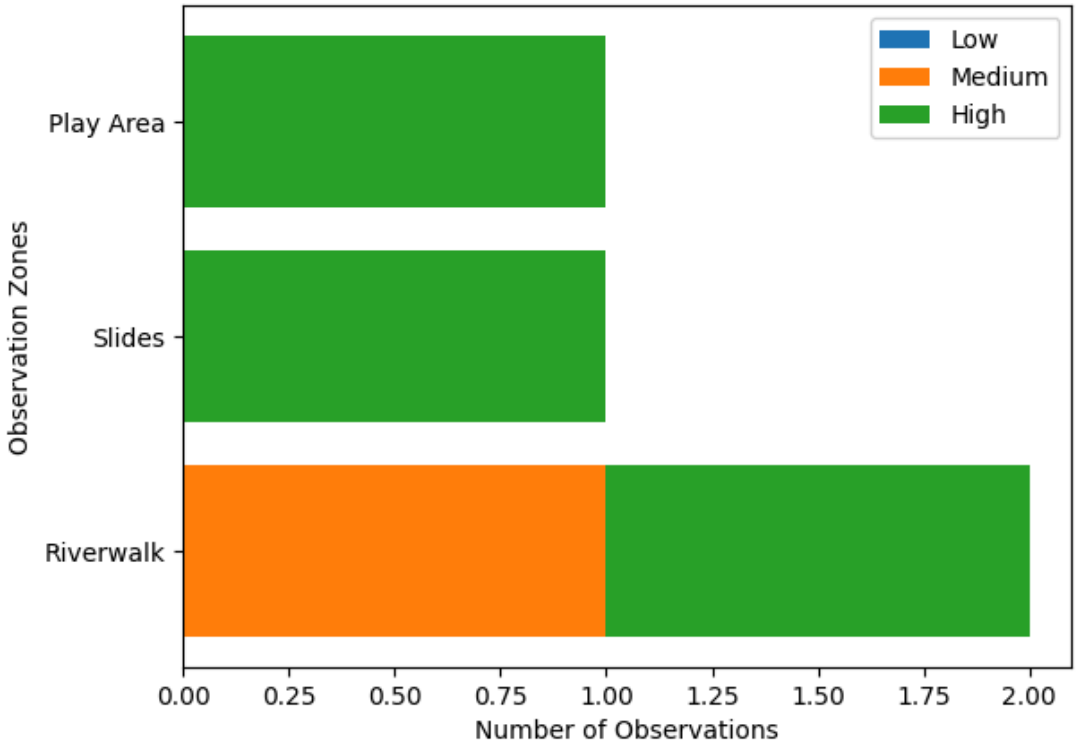


Fig: Bar graph showing Social Interaction Levels vs Observation Zones

Observation notes: All the three observation zones were interactive and engaging, however, the Glass City Metro Park Slides was highly active as most children were gathered in the same area and interacting among themselves.

Conclusion: From the observations made, it can be seen that each zone in the park encourages different forms of social interactions. In the play zones and

slides, people engage highly socially, but in other parts like the riverwalk, it is possible to either socialize or act alone.

Planned Methods Document: Glass City Metropark

Michigan State University

Prepared by:
Adam Hershner
Student of Landscape Architecture
Michigan State University

In Partnership with:
Samia Tasnim Faiza
Student of Landscape Architecture
Michigan State University

Course Instructor:
Dr. Haoyue Yang
School of Planning, Design, and Construction
Michigan State University

Overview

The Glass City Metropark is a park built in downtown Toledo, Ohio, being a riverside park along the Maumee River. Before formation, the site was entirely within the river, before the addition of the Toledo Edison Acme Power Plant in 1918, where industrial waste and fly ash was deposited into the river, building up landmass. The power plant ran until 1993, where the site sat undeveloped until the firm SmithGroup was chosen to redesign it. The result is Glass City Metropark, a currently Phase II riverside park with a larger Riverwalk project still in development.

Project Objectives and Goals

Overall, the Glass City Metropark sought to create a recognizable sense of place from an industrial wound near the heart of the city, turning a negative into a positive. Within the framework of social benefits, this expressed itself as a focus on creating a new addition to Toledo's interconnected Metropark system, built along the Maumee River.

Notable social benefit goals include:

- Create a variety of amenities for all seasons.
- Reconnect the east bank of the Maumee River to the western downtown of Toledo in order to return waterfront access to Toledo.
- Create an extension of Toledo's existing and vibrant culture within the site.
- Create unique opportunities that are not found in other parks.
- Create the titular "best" riverside park.
- Focus on Discovery Play, Water Play, and Winter Play as the three most critical program elements.
- Create regional interconnectivity within both surrounding neighborhoods and all of northwest Ohio.
- Establish a strong foundation for future phases of the Riverwalk project.

Performance Questions

Has community engagement and visitor numbers increased across different phases of development?
This question relates to the overall phasing of Glass City Metropark; while two phases have been completed thus far, this is only a quarter of the entire planned Riverwalk. As such, analyzing success metrics throughout the process will allow for design adjustments and adaption for future development.

Which amenities are being most utilized, and which are being underutilized?

In a pairing to the above question, this seeks to better understand use of the site for the sake of future development, allowing for plan refinement for similar planned amenities or upgrading to those previously made.

Do users of Glass City Metropark have a positive opinion of the park?
The driving factor of social benefits and repeated use of a particular site. This can be best measured by ratings, surveys, and consistency of return visits, being critical for determining a project's overall success within the eyes of its users.

Proposed Social Benefits

Proposed Benefit: Year-Round and Diverse Programming

- **Offers a range of recreational activities throughout all seasons of use.**

Background

Due to the project site originally being an industrial brownfield without usable amenities, there is little existing data on whether the site experienced much social recreational before construction completion. Prior visit and use numbers were not obtained. Due to the metropark being a phased project, attention was paid to the divisions of times open, with Phase I being opened to the public on December 10th, 2020, and Phase II being opened to the public on June 9th, 2023.

Methods

All Google Reviews were gathered, with the final collection date being April 22nd, 2026. In total, 545 reviews were analyzed, with the earliest being from December 11th, 2020, exactly one day after the Phase I project was opened. The latest review was from April 22nd, 2026. The five-star rating average was 4.8.

Figure 1.1: Screenshot of the initial loading page on Google Reviews for Glass City Metropark.

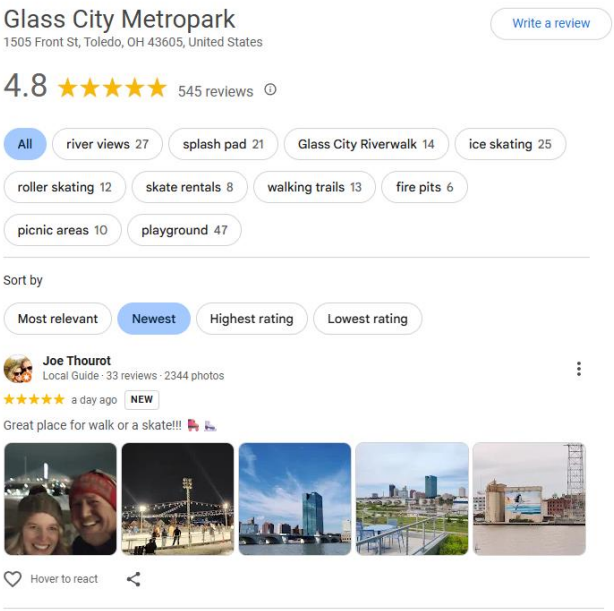
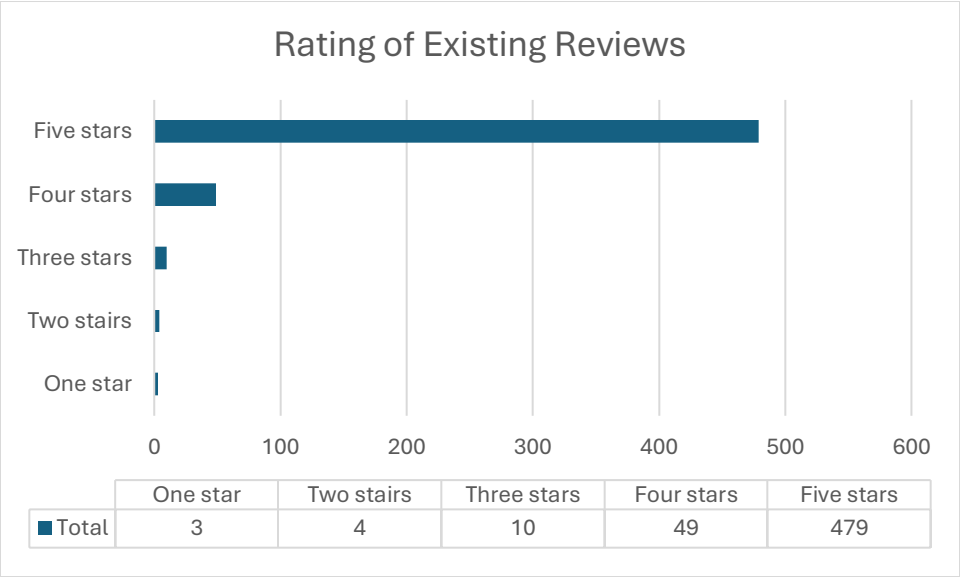
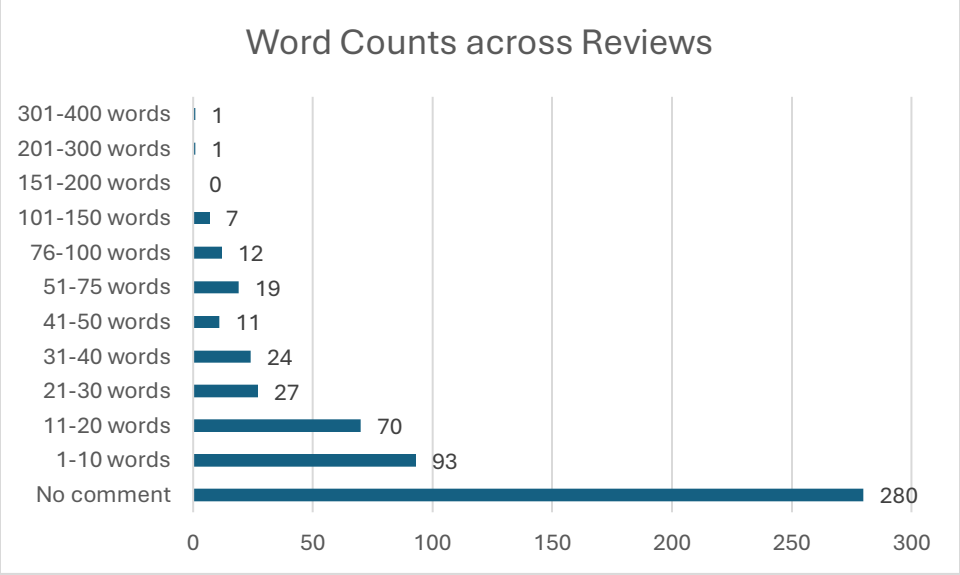


Figure 1.2: Total average rating across 545 reviews by users of Glass City Metropark.



Of the 545 collected reviews, 280 were left without attached words.

Figure 1.3: Word counts across all Google Reviews by users of Glass City Metropark.



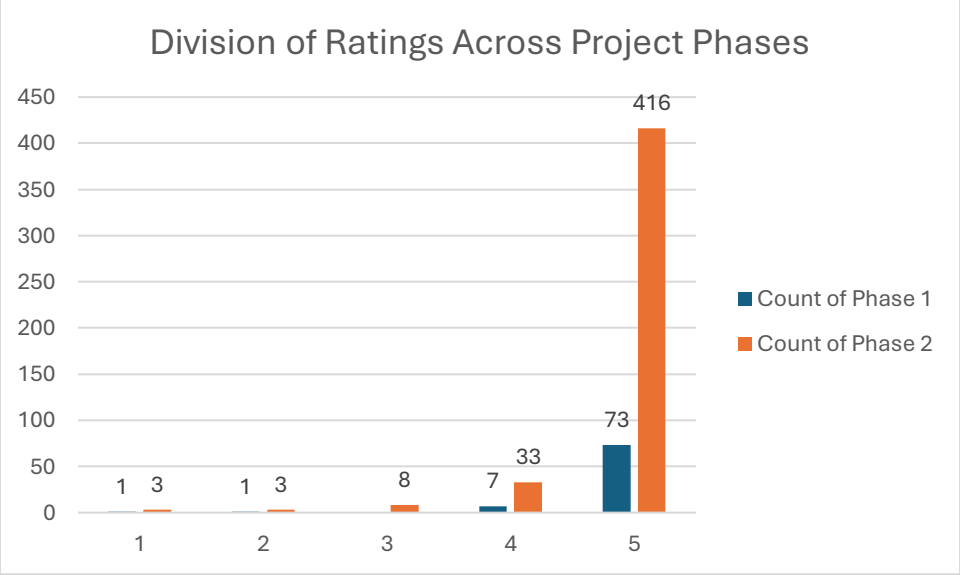
Calculations

Calculations were completed in Excel, utilizing Pivot Tables and graphs to best visualize the collected data. Straight data counts were completed based on data input. Additional data was collected through comparable case studies, research papers, and information provided by SmithGroup during their project brief.

To estimate overall amenity use throughout the site, all reviews with written attachments were consolidated into a third-party cloud program that sought out repeating words (***Figure 2.2)*** and assembled them into a notated list per mention ***(Figure 3.1)***. Particularly of note where reviews mentioned specific elements or amenities by name (***Figure 3.2)***, with the most numerous being skate / skating / ice skating with 64 mentions, playground with 53 mentions, and river with 35 mentions, divided into 25 mentions of specifically the Maumee River and 10 of the riverwalk amenity. This equates to **82.9%** (218 out of 263 reviews with comments) of unique reviews mentioning the use, excellence, or existence of amenities, implying them being a key element and factor of enjoyment throughout the site.

A secondary analysis was done through dividing reviews into those published while the project had released only Phase I (being all reviews before June 9th, 2023) and those in Phase II, where multiple additional amenities were introduced. As seen, the number of reviews increases from 82 left within a two and a half year period to 463 left within a two years period, displaying a dramatic increase in overall users of the site through phasing changes.

Figure 1.4: Division of star ratings with divisions made between reviews made before June 9th, 2023, and reviews made after.



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Limitations

- All Google Reviews are self-initiated, which necessitates outside factors to inspire someone to leave one; this tends towards either highly positive or highly negative responses, which is not indicative of the average experience of the site.
- Reviews can be completed at any time; as such, while it can be consolidated to roughly the correct time period for when the review was left, it is equally likely that the collected dates are inaccurate to when the user actually visited the site.
- The number of reviews (545) is incomparable to the number of estimated visitors to the site within the past two years (500,000), leading to probable differences to the average user.

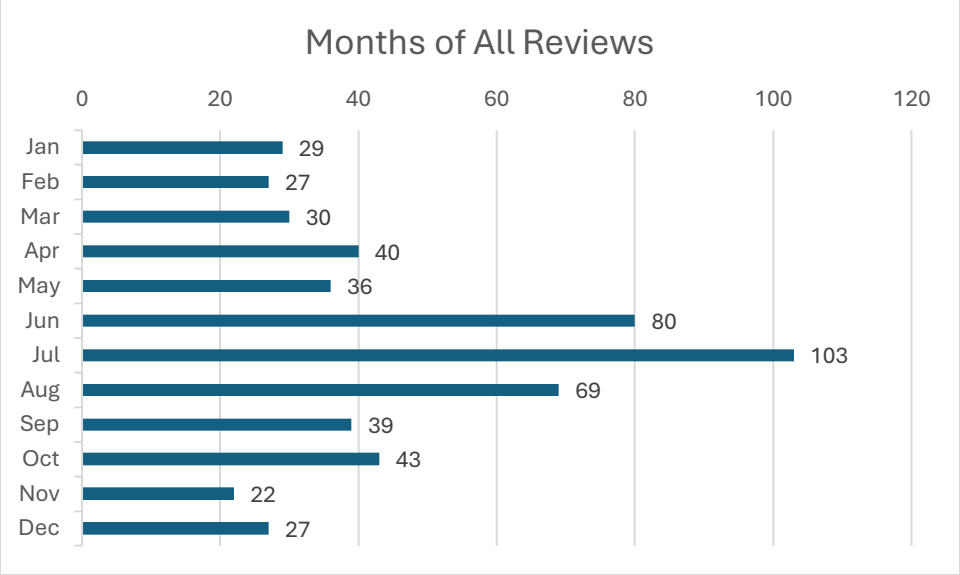
Further Study

Due to all data currently gathered being insubstantial in terms of raw numbers and accurate scaling, additional will need to be gathered. While one visit to the site was made, it was of a limited timeframe and did not involve interaction with users of the site. As such, the suggested continuation of this study would be that of an intrapersonal anonymous survey.

In taking directives from a similar CSB study done at Rainier Beach Urban Farm and Wetlands, they noted an exceptionally higher rate of completion for paper surveys over digital, with a ratio of 57 completed paper surveys and 3 digital surveys. As such, it would be advantageous to offer both options, ideally in combination with an on-site activity, such as one of their numerous festivals or volunteering events. The digital survey can be shared online, such as the existing *Glass City Riverwalk* or *Metroparks Toledo* Facebooks.

To further increase potential answers, Glass City Metropark’s existing Google Reviews were analyzed for periods of high activity, utilizing the days and months of posting. As shown, there is a significant spike during the months of June, July, and August, increasing potential for answers, with the next highest months being September and October.

Figure 2.1: All Google Reviews by users of Glass City Metropark sorted into months of posting.



According to a research study by Brent Chudoba with additional research from PubMed Central, a public-facing survey should be under ten minutes to maximize completion and responses rate, with a potential question range of 11-25, requiring that all be multiple choice instead of open-ended. To ensure ease of the paper survey, it should be a single piece of paper to minimize difficulty for both volunteers handing it out and participants taking it, further improving chances of completion.

With that question limit in mind, the category of social benefits to focus on is the previously analyzed, being ***Year-Round and Diverse Programming.*** Notable questions to consider include:

- How often do you visit the site?
    - With answers divided into first visit, a few times per year, a few times per month, and a few times per week.
- When did you first visit the site?
    - With answers divided into first visit, since the release of Phase II, or prior to Phase II.
- What amenities do you most often use?
- What are your favourite parts of the site?
- Do you feel that the site has a good variety of amenities?
- How would you rate your overall experience at the site?

To consolidate experiences with those of the Google Reviews for attempted clarity, the most-repeated words can be assembled into a word cloud attached to the survey, with a question asking if these words are equivalent to what the survey taker feels about Glass City Metropark. This question could also be limited to the digital version to save on size and ink costs for the paper version.

Figure 2.2: An assembled Word Cloud taken from attached comments to Google Reviews by users of Glass City Metropark.

Sources

"Rainier Beach Urban Farm and Wetlands." *Landscape Performance Series*, 22 July 2025, www.landscapeperformance.org/case-study-briefs/rainier-beach.

Chudoba, Brent. "How Long Should a Survey Be? What Is the Ideal Survey Length?" *SurveyMonkey*, 2019, www.surveymonkey.com/curiosity/survey_completion_times/.

Sharma, Hunny. "How short or long should be a questionnaire for any research? Researchers dilemma in deciding the appropriate questionnaire length." *Saudi journal of anaesthesia* vol. 16,1 (2022): 65-68. doi:10.4103/sja.sja_163_21

Appendices

Figure 3.1: Consolidated words from Google Reviews by users of Glass City Metropark.

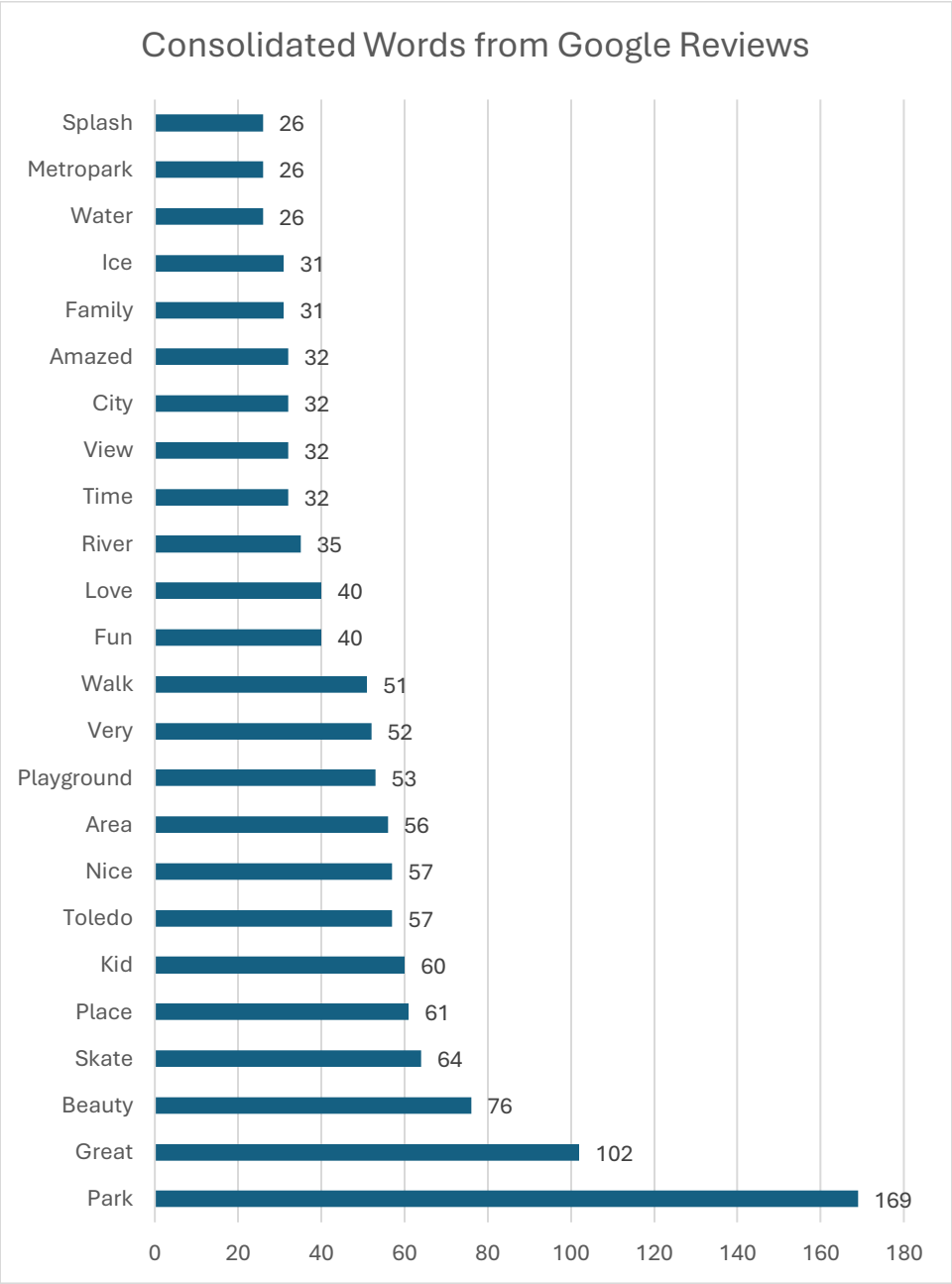


Figure 3.2: Specific amenities mentioned by name in Google Reviews by users of Glass City Metropark.

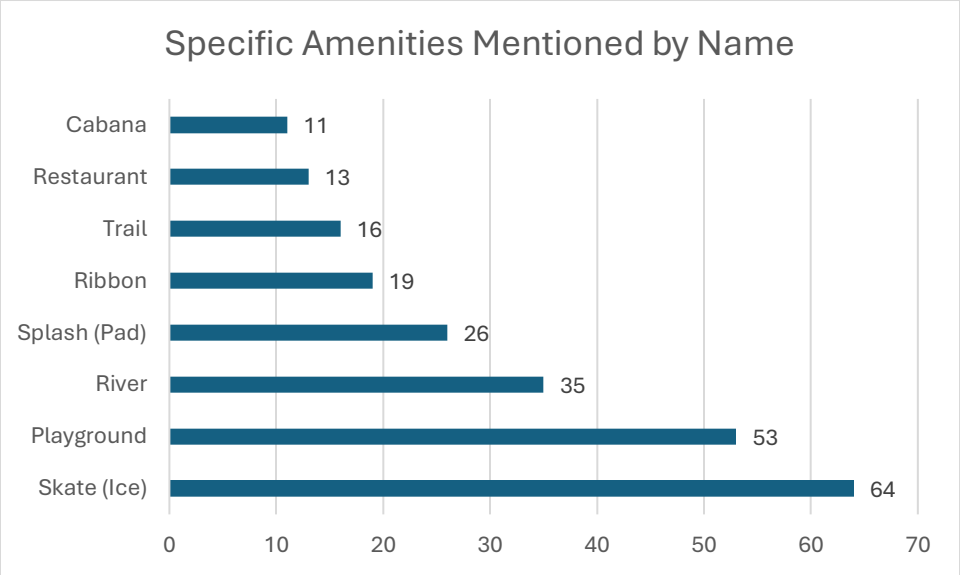
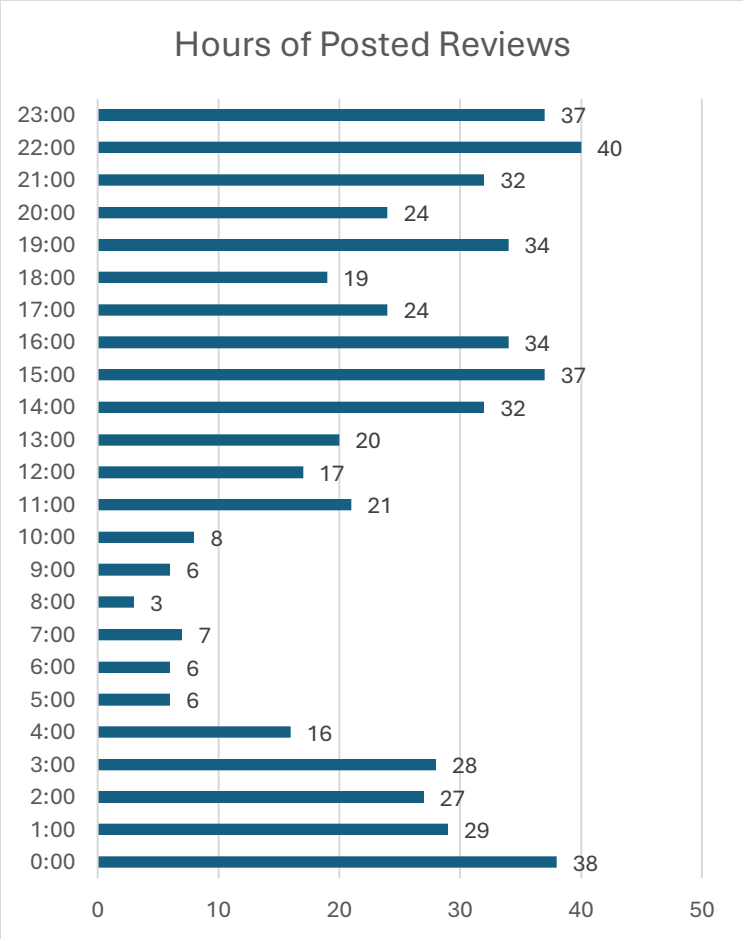


Figure 3.3: Specific hours of posting Google Reviews by users of Glass City Metropark in UTC.



Isaiah Ramsey

Michigan State University

Spring 2026 LA 883

Haoyue Yang

Glass City Metropark Methods

Research Fellow:

Isaiah Ramsey, MED, BLA

Student for Landscape Architecture and Environmental Design

Michigan State University

Research Assistant:

Ava Yon, MED, BLA

Student for Landscape Architecture and Environmental Design

Michigan State University

Haoyue Yang, Ph.D., MLA, LEED GA

Assistant Professor of Landscape Architecture

Michigan State University

This study was conducted as part of the Landscape Performence Assessment Final Project. Students evaluated how the park contributes to economic value. The project followed the structure and methods used in the Landscape Architecture Foundation Case Study Investigation (CSI) program, which evaluates built landscape projects using measurable performance metrics. Students worked collaboratively in small teams to analyze one category of landscape performance and produce a case study report and presentation.

Economic Performance

- **Generates approximately $482,00 in direct annual revenue.**

The goal of this analysis is to evaluate the ability of Glass City Metropark to generate direct operational revenue through its design and programming. This means understanding how different park elements like event spaces, concessions, and recreational amenities contribute to financial performance. The intended outcome is to quantify total annual revenue and identify which design features are most economically productive.

Method:

Revenue data were collected from Metroparks Toledo financial records and staff-provided estimates. Only revenue retained by Metroparks Toledo was included, excluding total gross sales from vendors.

Revenue was categorized into:

- Facility rentals
- Concessions and vendor agreements
- Programs and recreation

This categorization aligns with Landscape Architecture Foundation (LAF) CSI methods, allowing for analysis of how different systems contribute to economic performance.

Calculation:

Specific Revenue Element	Apx. Revenue Generated Annually
Glass City Pavillion	$100,000
Grosbeak Shelter	$4,000
Pollinator Shelter	$1,000
Kayak Share Locker Rental	$10,000
Permit Fees	$50,000
Total	**165,000**
The Garden	$100,000
Hajjar Hospitality (Catering)	$30,000
Brenner 75 Marine	$10,000
Jupmode	$5,000

Total	**$145,000**
Ice Skating Rental & Admission	150,000
Roller Skating Rental	20,000
Modest Program Fees	2,000
Total	**$172,000**
Grand Total	**$482,000**

Approximately $482,000 in direct annual revenue. Programs and recreation generate the most revenue, indicating that they are the primary economic driver within the park.

Limitations:

- Revenue values are estimated and may not reflect exact audited totals.
- Some concession data are approximate and based on agreements rather than fixed returns.
- Revenue is sampled from only 2025.
- The analysis does not account for indirect economic impacts such as nearby business activities.

Sources:

- Metroparks Toledo financial data

- **Generates approximately $0.58 in revenue per visit.**

The goal of this analysis is to evaluate the economic efficiency of the park relative to its level of use. By calculating revenue per visit, this metric assesses how effectively the park converts visitation into financial return while maintaining its role as a publicly accessible space.

Methods:

Total annual revenue / Total annual visits = Revenue per visit

PLACER DATA:

Day	Total Visits
Monday	66887
Tuesday	65522

Wednesday	67204
Thursday	62282
Friday	100796
Saturday	150060
Sunday	115212
Total Visits Annually	**657,963**

$482,000 annual revenue / 657,963 annual visits = **$0.73 per visit**

Revenue per visit was calculated by dividing total annual revenue by total annual visits. Total visits were used instead of unique visitors to reflect actual park usage frequency.

The low revenue per visit reflects the park's design being a public accessible space. However, this does not mean poor performance. It highlights the trade-off between public accessibility and revenue generation.

Limitations:

- Total visits include repeat users and do not represent unique individuals.
- Visitation data are estimated and may vary seasonally.
- This metric does not account for broader visitor spending within the park.

Sources:

- Metroparks Toledo financial data

- **Saves approximately $130,335 annually through reduced mowing and ecological design.**

The goal of this analysis is to evaluate how landscape design strategies contribute to long-term cost efficiency. Specifically, the study examines how reduced mowing and naturalized landscapes lower maintenance costs compared to conventional turf management.

Methods:

Maintenance cost data were used to compare the current reduced mowing strategy with a full-maintenance scenario.

Steps:

1. Calculate cost per acre using mowing data
2. Apply cost per acre to total site area (23.6 acres)
3. Compare full mowing cost to current mowing cost

Mowing cost annually / Acres mowed = mowing rate per acre

Mowing rate per acre **x** Mowable acres = Total mow cost

Total mow cost – Mowing cost annually = Savings

Total mowing cost = $35,036 annually

Total mowing area = 5 acres

Mowing rate = $35,036 / 5 acres = $7,007 per acre

Total mow cost = $7,007 x 23.6 acres = $165,371

$165,371 - $35,036 = $**130,335 saved**

This finding demonstrates that ecological design strategies can significantly reduce long-term operational costs. By limiting mowing to high-use areas, the park avoids over $130,000 in annual expenses.

This shifts the understanding of economic performance from revenue generation alone to include cost avoidance as a critical factor. For landscape architecture practice, this highlights the importance of designing landscapes that are not only functional and ecological, but also financially sustainable over time.

Limitations:

- Assumes uniform cost per acre across the entire site.
- Only mowing costs are included; other maintenance activities are excluded.
- Naturalized landscapes may require alternative maintenance not captured here.

Sources:

- Metroparks Toledo Natural Resources maintenance cost data (2025)
- Glass City Metropark site area data (Phase 1 & 2)

April 27, 2026

Glass City Metropark Landscape Performance Methods

Ava Yon
Undergraduate, Landscape Architecture
Graduate, Master of Arts in Environmental Design
Michigan State University

Economic Benefits

- ***Glass City Metropark contributed to the surrounding property value increase of 23.5% from 2020 to 2026 when adjusted for inflation.***

Background

Toledo, Ohio, carries a long history of industrial activity that drives the workforce in its neighborhoods. East Toledo used to be home to industrial employers such as railroads, oil refineries, utilities, and shipyards (Michaels & Mauter, 2006). Most notably Libbey Glass, a glass manufacturing company that gave Toledo its nickname, Glass City. Glass City Metro park itself used to be a steel mill and power plant (Peng, 2021). Many of these businesses were abandoned in the later half of the 20th century, leaving a long-lived impact on Toledo's neighborhoods and economy (Peng, 2021).

Garfield neighborhood, the home of Glass City Metropark, has since had a consistent history of low incomes, housing burdens, and service fragmentation (University of Toledo, Center for Urban & Regional Studies, 2019). The overall decline in the city has sparked change in within Toledo's neighborhoods. Since the Covid-19 Pandemic efforts to revitalize heavily impacted communities have grown. Glass City Metropark is part of the initiative followed by the Garfield Community Plan (Toledo Design Collective, 2021).

Glass City Metropark, designed by SmithGroup, opened the first phase of the park in 2020 and the second phase in 2023. SmithGroup's design intent was to design the park as a catalyst for new private investment and economic activity in adjacent neighborhoods.

Figure 1.0. Housing directly adjacent to the Glass City Metropark. Image captured on April 10, 2026.

Performance Question

How has the development of Glass City Metropark in Toledo, Ohio affected the local economy through changes in property values?

Study Overview

In conjunction with SmithGroup's design intent, this study aims to evaluate economic activity in adjacent neighborhoods by identifying changes in residential and commercial property values within one block of the park.

Property values are gathered from the Lucas County real estate website, AREIS. The property report cards identify land values and building values, combining them for the total property value. These values are determined by the Lucas County mass appraisal system. This becomes important when looking at property value changes when parcels have drastic changes in the presence or alterations of buildings. In alignment with the parks opening dates, this study uses property values from 2020 and 2026. These values were consistently available and provide insight on property value changes since the first opening of the park.

Overall data relevant to this study includes Toledo parcel boundaries and numbers, zoning ordinances gathered from The City of Toledo website. Additionally, property values are obtained from the AREIS Lucas County real estate website. The Bureau of Labor Statistics is used to understand inflation rates and applications. Lastly, the Zillow Home Value Index is taken from the Zillow housing data website. The structure of this study was guided by a Landscape Architecture

Foundation Case Study Investigation based in Raleigh, North Carolina which evaluated property values (Delcambre & Dominguez, 2023).

Study Area

This study only considered parcels with either commercial or residential zoning codes within one block of the park. This includes regional commercial, multi-dwelling residential, duplex residential, and mixed commercial-residential zones (Table 1.0). Industrial parcels are not included in this study due to their high property values and little to no property value change. Figure 2.0 shows the 323 parcels included in the study area color coded by the corresponding zone ordinance.

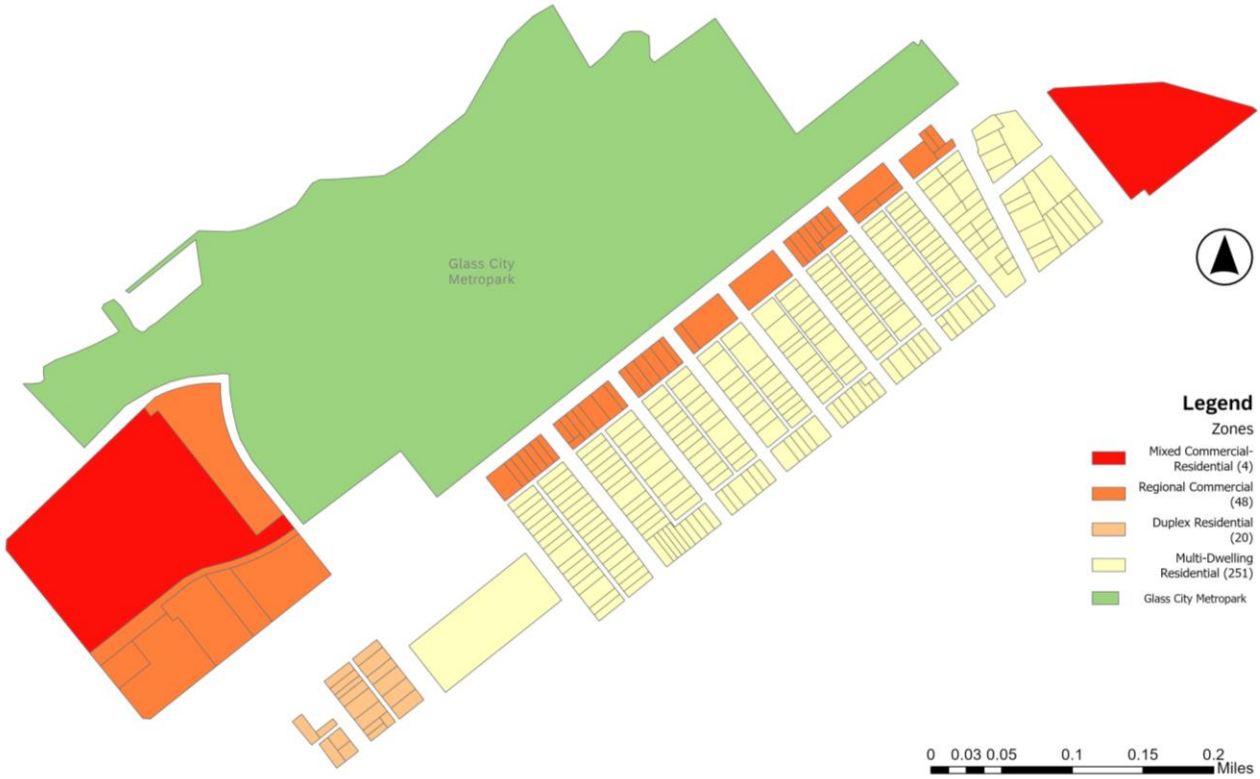


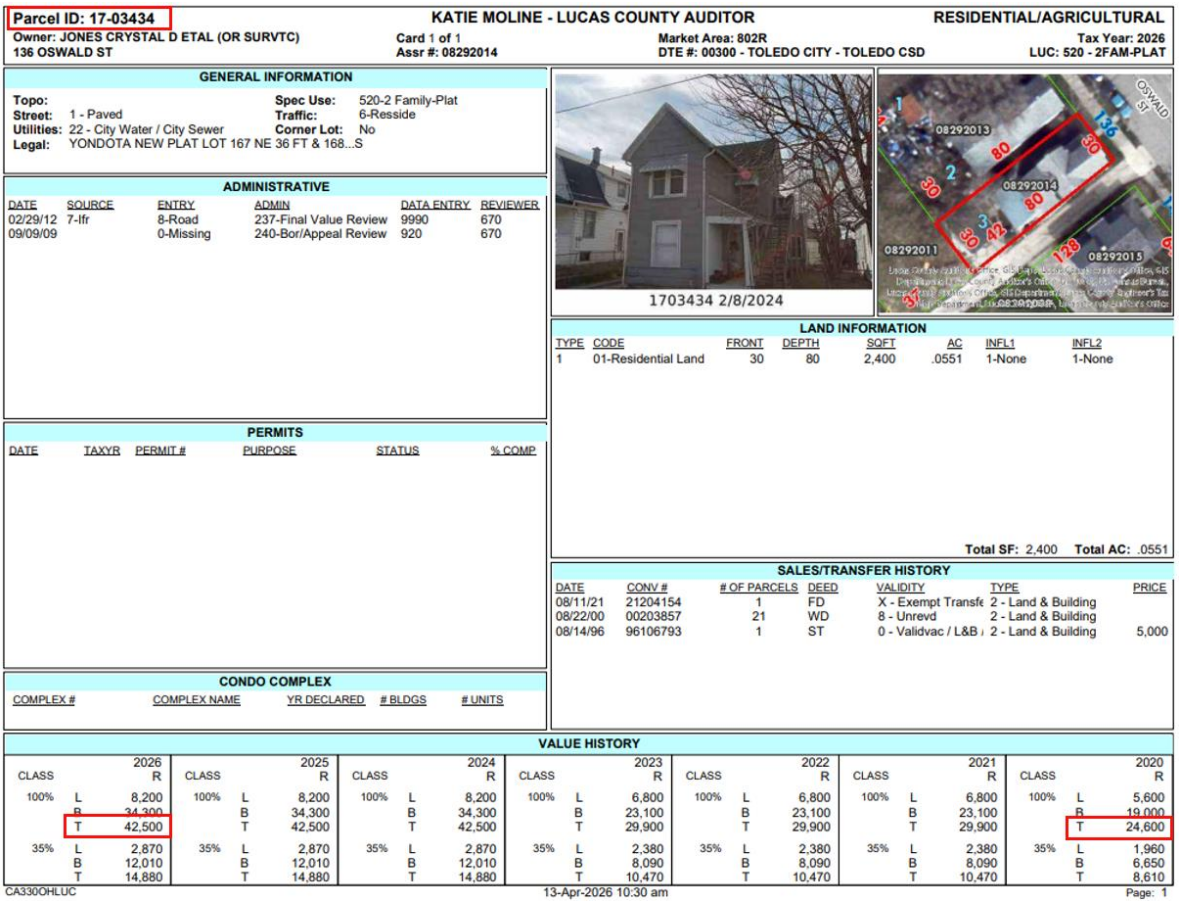
Figure 2.0. The 323 parcels within the study area and their corresponding zones.

Zone Code	Zone	Number of Parcels
CM-PUD	Mixed Commercial Residential	4
CR	Regional Commercial	48
RD6	Duplex Residential	20
RM36	Multi-Dwelling Residential	251

Table 1.0. Number of parcels in each zone within the study area.

Property Value Collection

To determine the property values for 2020 and 2026, a parcel report was downloaded for each parcel from the Lucas County Real Estate Data website, AREIS. Each parcel was searched by parcel ID, which was collected from the study area using s City of Toledo parcel feature layer in ArcGIS Pro. Figure 3.0 shows a sample property report and the values taken from the report outlined in red. Full market property values were documented in Appendix A.



Parcel ID: 17-03434 — KATIE MOLINE - LUCAS COUNTY AUDITOR — RESIDENTIAL/AGRICULTURAL

Owner: JONES CRYSTAL D ETAL (OR SURVTC) — Card 1 of 1 — Market Area: 802R — Tax Year: 2026
136 OSWALD ST — Assr #: 08292014 — DTE #: 00300 - TOLEDO CITY - TOLEDO CSD — LUC: 520 - 2FAM-PLAT

GENERAL INFORMATION

Topo:		Spec Use:	520-2 Family-Plat
Street:	1 - Paved	Traffic:	6-Resside
Utilities:	22 - City Water / City Sewer	Corner Lot:	No
Legal:	YONDOTA NEW PLAT LOT 167 NE 36 FT & 168...S		

1703434 2/8/2024

ADMINISTRATIVE

DATE	SOURCE	ENTRY	ADMIN	DATA ENTRY	REVIEWER
02/29/12	7-Ifr	8-Road	237-Final Value Review	9990	670
09/09/09		0-Missing	240-Bor/Appeal Review	920	670

LAND INFORMATION

TYPE	CODE	FRONT	DEPTH	SQFT	AC	INFL1	INFL2
1	01-Residential Land	30	80	2,400	.0551	1-None	1-None

Total SF: 2,400 Total AC: .0551

PERMITS

DATE	TAXYR	PERMIT #	PURPOSE	STATUS	% COMP

SALES/TRANSFER HISTORY

DATE	CONV #	# OF PARCELS	DEED	VALIDITY	TYPE	PRICE
08/11/21	21204154	1	FD	X - Exempt Transfe	2 - Land & Building	
08/22/00	00203857	21	WD	8 - Unrevd	2 - Land & Building	
08/14/96	96106793	1	ST	0 - Validvac / L&B	2 - Land & Building	5,000

CONDO COMPLEX

COMPLEX #	COMPLEX NAME	YR DECLARED	# BLDGS	# UNITS

VALUE HISTORY

CLASS		2026 R	CLASS		2025 R	CLASS		2024 R	CLASS		2023 R	CLASS		2022 R	CLASS		2021 R	CLASS		2020 R
100%	L	8,200	100%	L	8,200	100%	L	8,200	100%	L	6,800	100%	L	6,800	100%	L	6,800	100%	L	5,600
	B	34,300		B	34,300		B	34,300		B	23,100		B	23,100		B	23,100		B	19,000
	T	42,500		T	42,500		T	42,500		T	29,900		T	29,900		T	29,900		T	24,600
35%	L	2,870	35%	L	2,870	35%	L	2,870	35%	L	2,380	35%	L	2,380	35%	L	2,380	35%	L	1,960
	B	12,010		B	12,010		B	12,010		B	8,090		B	8,090		B	8,090		B	6,650
	T	14,880		T	14,880		T	14,880		T	10,470		T	10,470		T	10,470		T	8,610

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Figure 3.0. A sample property report card used to determine the property values from 2020 and 2026.

Adjustments for Inflation

To accurately compare the property values from 2020 to 2026, inflation must be considered. According to U.S Bureau of Labor Statistics, the inflation rate from 2020 to 2026 was 22.9%. This inflation rate was applied to the 2020 property values before calculating the absolute change and percent property value change. See Appendix A for the full calculation table, including the 2020 property values, 2026 property values, 2020 property values adjusted for inflation, absolute change, and percent property value change for each parcel.

Inflation Rate Calculation
(CPI 2026 – CPI 2020) / CPI 2020 = Inflation Rate
CPI 2020 = 258.8 [1]
CPI 2026 = 318 [2]
Inflation Rate = 22.9%

Finding the Percent Property Value Change

The final metric used to understand the impact of Glass City Metropark is the percent of property value change. This allows us to see the change in values over time. The following sample shows the calculation used to determine that change.

Sample Percent Property Value Change Calculation
136 Oswald St
2020 Value: $24,600
2026 Value: $42,500
Inflation Multiplier: 1.229

Absolute Value Change: [42,500 - (24,600*1.229)] = $12,267
Percent Value Change: { [42,500 - (24,600*1.229)] / 42,500 } * 100 = 40.6%

Findings

Figure 4.0 provides a choropleth map of the 2020 property values when adjusted for inflation. It identifies low property values for most residential parcels, and high property values for mixed-use and commercial parcels. Figure 5.0 visualizes the 2026 property values. It is notable that parcels near the central residential area see property value increases when compared with the 2020 values. Mixed-use and commercial areas remain with high property values. For this study, all property values over $160,000 are symbolized in the darkest green. This symbology choice was made not to skew the visualization of property values since there are few parcels with property values nearing $4 million.

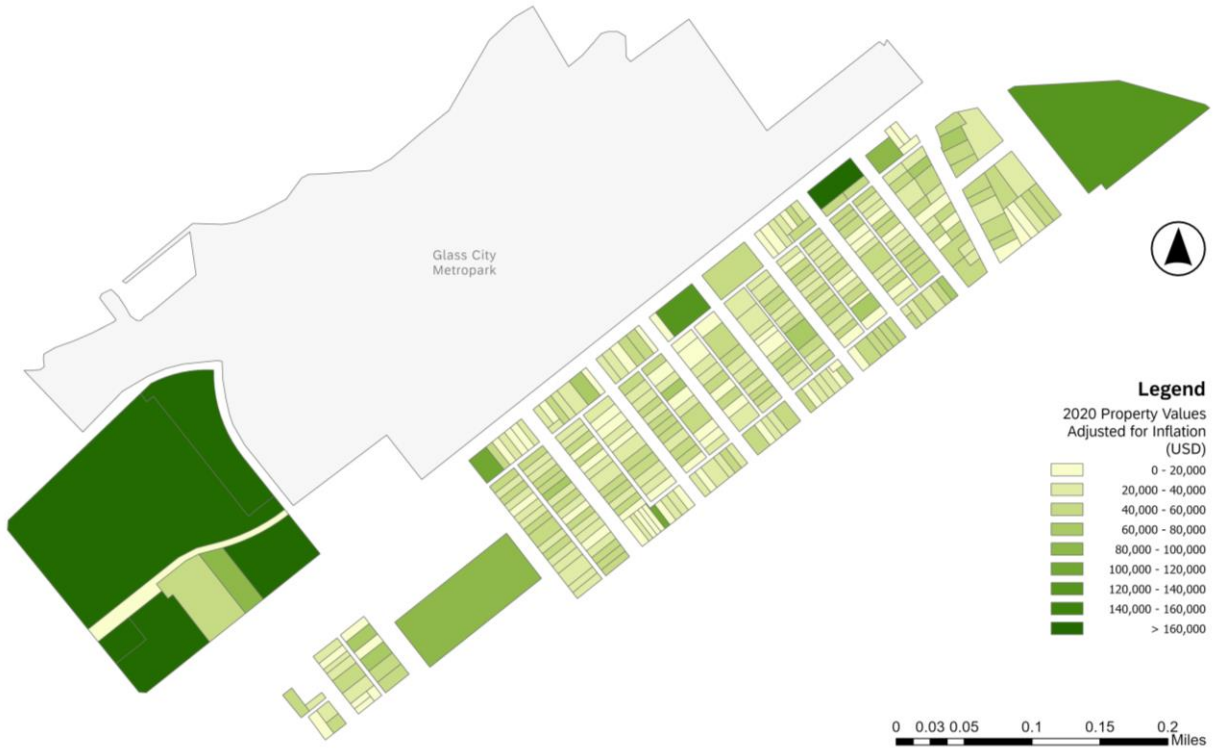

Figure 4.0. Choropleth map of 2020 poverty values (USD) adjusted for inflation for residential and commercial parcels within one block of Glass City Metropark.

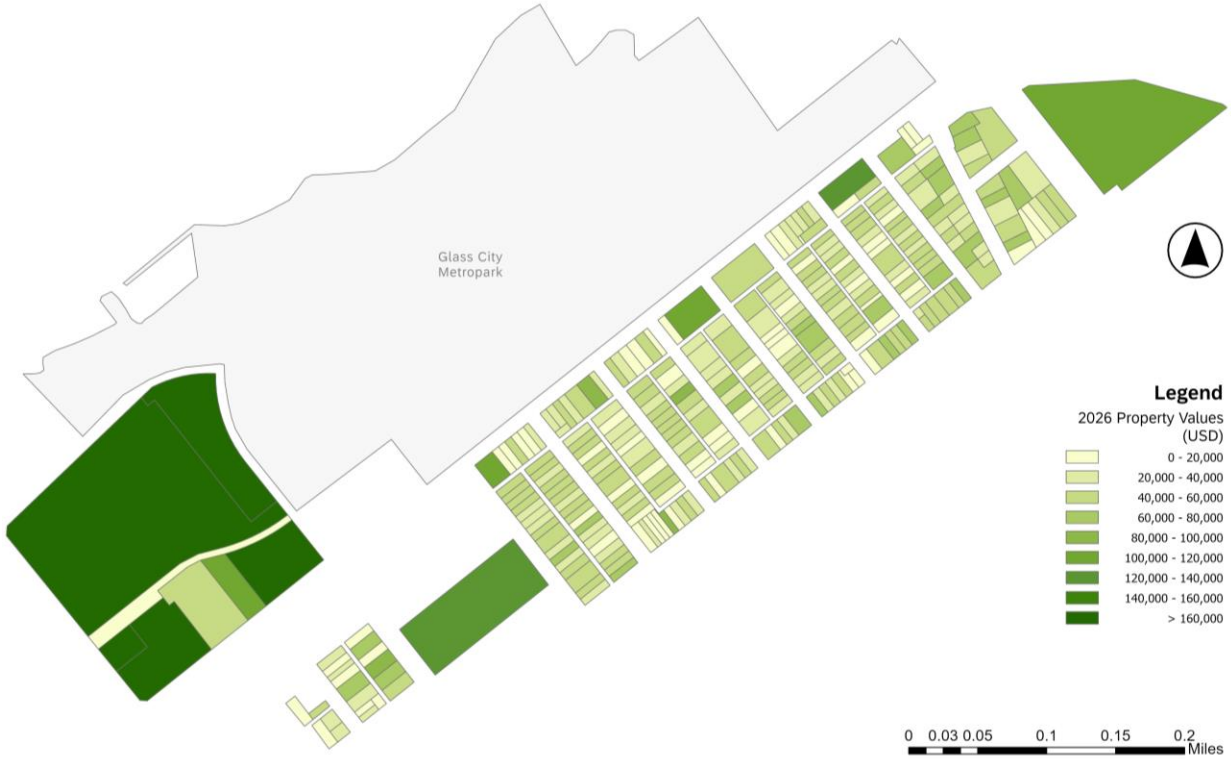

Figure 5.0. Choropleth map of 2026 poverty values (USD) for residential and commercial parcels within one block of Glass City Metropark.

The results of the data collection and calculations find an average percent property value increase of 23.5%. This property value increase supports the implementation of Glass City Metropark to have a positive effect on the adjacent communities. Additionally, it supports SmithGroup's design intent for the park to work as a catalyst for new private investment and economic activity in adjacent neighborhoods. Overall, the findings are positive and open the door to further discussion about urban parks and the changes that come with rising property values.

Figure 6.0 shows the percent property value change for each parcel within the study area. Most residential parcels see an increase in property value. Parcels in yellow represent properties that saw no change or slightly negative change. A pattern can be recognized that these parcels are mostly mixed-use or commercial where the property values were much higher than the residential properties in 2020 and were similar in 2026. Lastly, red parcels are scattered throughout the residential area. Upon investigation, it is found that the majority of these parcels were documented to have a reduction in building value because a building was either removed or demolished. This is where the definition of property value becomes important, as it is the combination of building and land values.

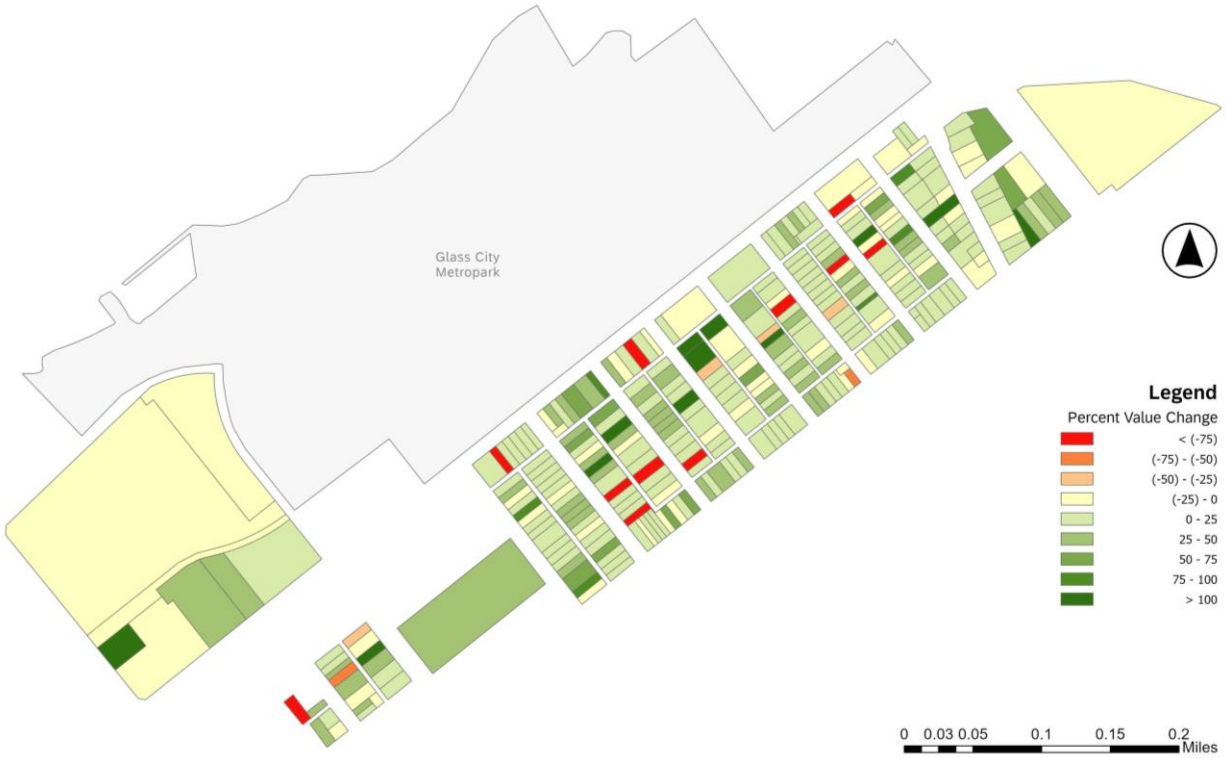

Figure 6.0. Choropleth map of percent property value change from 2020 to 2026 when adjusted for inflation.

Relevance

For additional comparison, this study looks at the Zillow Home Value Index (ZHVI) to identify adjacent economic changes in the City of Toledo. Table 2.0 shows the changes in ZHVI for each zip code within city limits, with the zip code containing Glass City Metropark highlighted in green. The ZHVI identifies average market housing trends and is not a completely equal comparison to property values. However, it reveals that the assessed value of parcels within one block of Glass City Metropark has increased faster than the average market trends.

ZIP Code	2020 ZHVI	2020 ZHVI Adjusted for Inflation (1.229)	2026 HVI	Percent HVI Change
43615	128701	158173	178327	11.3
43613	106026	130306	156540	16.8
43612	74158	91140	117053	22.1
43614	141124	173442	199500	13.1
43605	**45202**	**55553**	**63674**	**12.8**
43606	130481	160361	191112	16.1
43609	47724	58653	69826	16.0
43607	51532	63333	76377	17.1
43623	143218	176015	205185	14.2
43611	101671	124954	152371	18.0
43608	35595	43746	48149	9.1
43604	55675	68425	63243	-8.2
43617	239719	294615	326534	9.8
43610	40934	50308	61334	18.0

Table 1.0. All ZHVI values for the zip codes within Toledo city limits from 2020 and 2026.

Limitations

- Property values collected from 2020 may be impacted by covid-19 pandemic.
- Commercial properties were found to have much larger property values than residential parcels, which may have skewed or lessened the average property value change.
- Parcels with building loss had significantly lower or negative property value change, which may have skewed or lessened the average property value change.
- Baseline property values from years prior to the first opening of the park could strengthen the findings. Since the park had already opened its first phase in 2020, the property values may have already been impacted by the park's development.

Discussion

- Findings from this study support SmithGroup's design intent: Project plays a role as a catalyst for new private investment and economic activity in adjacent neighborhoods.

- Although parcel property values are trending upward, the median property value remains very low, making the neighborhood susceptible to gentrification challenges.

- 23.5% Average increase in property values within one block of Glass City Metropark supports the idea of urban parks as community assets.

References

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Appendix A

Parcel ID	2020 Property Value	2020 Prop Value Adjusted for Inflation	2026 Property Value	Absolute Change	Percent Value Change
1703627	46,600	57271	60,400	3,129	5.5
1703631	49,400	60713	85,900	25,187	41.5
1703434	24,600	30233	42,500	12,267	40.6
1703514	27,200	33429	35,200	1,771	5.3
1703641	6,800	8357	5,600	-2,757	-33.0
1703637	57,100	70176	69,100	-1,076	-1.5
1703547	600	737	700	-37	-5.1
1703504	900	1106	1,400	294	26.6
1703497	33,200	40803	39,500	-1,303	-3.2
1703541	16,100	19787	20,700	913	4.6
1703511	29,500	36256	37,700	1,445	4.0
1703421	45,000	55305	1,000	-54,305	-98.2
1703524	31,100	38222	18,000	-20,222	-52.9
1703517	700	860	900	40	4.6
1703537	6,100	7497	10,000	2,503	33.4
1703521	23,100	28390	38,700	10,310	36.3
1703534	27,700	34043	32,600	-1,443	-4.2
1703621	39,800	48914	50,300	1,386	2.8
1703531	45,800	56288	75,300	19,012	33.8
1703634	800	983	6,500	5,517	561.1
1017171	39,200	48177	51,300	3,123	6.5

400397	40,600	49897	44,500	-5,397	-10.8
1016954	40,900	50266	56,200	5,934	11.8
1017311	30,700	37730	54,100	16,370	43.4
1016864	36,200	44490	50,400	5,910	13.3
1016781	34,300	42155	39,000	-3,155	-7.5
1016957	37,000	45473	56,200	10,727	23.6
1017341	26,900	33060	34,800	1,740	5.3
966821	15,300	18804	37,500	18,696	99.4
1016877	11,200	13765	27,000	13,235	96.2
1887756	346,000	425234	346,000	-79,234	-18.6
400337	34,700	42646	54,300	11,654	27.3
400381	39,300	48300	52,600	4,300	8.9
1887746	468,000	575172	468,000	-107,172	-18.6
1017237	36,600	44981	55,300	10,319	22.9
1016674	35,600	43752	44,800	1,048	2.4
1017094	40,600	49897	66,100	16,203	32.5
739824	48,400	59484	66,700	7,216	12.1
1016987	300	369	700	331	89.9
1017067	500	615	600	-15	-2.4
1016937	36,700	45104	55,400	10,296	22.8
966894	28,200	34658	38,400	3,742	10.8
1016884	44,100	54199	47,300	-6,899	-12.7
1017451	11,800	14502	30,600	16,098	111.0
1016977	1,200	1475	1,400	-75	-5.1
1017027	800	983	1,100	117	11.9
1016907	37,400	45965	55,400	9,435	20.5
1017121	27,600	33920	43,900	9,980	29.4
739864	50,500	62065	65,300	3,235	5.2
1017031	40,800	50143	54,100	3,957	7.9
1017044	35,900	44121	53,700	9,579	21.7
400311	16,300	20033	21,100	1,067	5.3
739987	36,500	44859	56,900	12,042	26.8
1016664	25,000	30725	36,300	5,575	18.1
966867	1,100	1352	1,300	-52	-3.8
1017194	18,500	22737	23,100	364	1.6
739834	24,300	29865	31,400	1,535	5.1
1017107	40,300	49529	46,100	-3,429	-6.9
1017017	25,600	31462	32,900	1,438	4.6
400324	40,500	49775	55,500	5,725	11.5
1016787	14,900	18312	20,300	1,988	10.9
966744	28,700	35272	34,900	-372	-1.1

966891	37,700	46333	52,200	5,867	12.7
1017407	31,300	38468	46,600	8,132	21.1
1887757	142,600	175255	2,062,600	1,887,345	1076.9
1016797	48,400	59484	66,900	7,416	12.5
1017037	20,700	25440	30,000	4,560	17.9
1017374	29,600	36378	46,000	9,622	26.4
1017317	26,000	31954	41,600	9,646	30.2
1016964	33,500	41172	44,000	2,829	6.9
1017324	28,800	35395	37,300	1,905	5.4
1016700	132,200	162474	138,300	-24,174	-14.9
1017351	24,400	29988	35,500	5,512	18.4
966901	15,400	18927	600	-18,327	-96.8
1016834	30,500	37485	45,100	7,616	20.3
400354	25,900	31831	37,400	5,569	17.5
400327	40,300	49529	58,500	8,971	18.1
400394	31,700	38959	47,900	8,941	22.9
1887753	0	0	0	0	0.0
1016997	14,500	17821	19,900	2,080	11.7
1017387	27,000	33183	38,600	5,417	16.3
739867	47,800	58746	65,200	6,454	11.0
966887	36,100	44367	400	-43,967	-99.1
1016756	17,400	21385	26,600	5,215	24.4
1016607	111,600	137156	115,800	-21,356	-15.6
1017447	23,600	29004	38,700	9,696	33.4
739991	20,400	25072	25,500	428	1.7
1017201	1,700	2089	2,400	311	14.9
966911	29,600	36378	35,200	-1,178	-3.2
1017294	22,700	27898	35,800	7,902	28.3
400401	31,600	38836	48,800	9,964	25.7
1017331	800	983	800	-183	-18.6
1017204	33,400	41049	50,500	9,451	23.0
1016744	16,400	20156	38,400	18,244	90.5
1016577	1,000	1229	1,300	71	5.8
1016807	25,100	30848	30,800	-48	-0.2
1016734	5,700	7005	7,000	-5	-0.1
966864	46,000	56534	57,800	1,266	2.2
400364	30,800	37853	39,800	1,947	5.1
1016881	34,400	42278	46,100	3,822	9.0
400344	900	1106	1,400	294	26.6
739931	23,300	28636	49,200	20,564	71.8
1017434	18,200	22368	22,900	532	2.4

1017051	41,400	50881	38,000	-12,881	-25.3
1017301	44,800	55059	55,100	41	0.1
1017081	29,700	36501	44,000	7,499	20.5
1017064	900	1106	1,200	94	8.5
1016994	17,600	21630	27,100	5,470	25.3
1017271	25,200	30971	38,100	7,129	23.0
1016897	33,200	40803	36,700	-4,103	-10.1
1017231	21,200	26055	43,200	17,145	65.8
1017134	26,500	32569	39,000	6,432	19.7
1017234	16,900	20770	19,700	-1,070	-5.2
1017057	28,500	35027	40,900	5,874	16.8
1017177	27,000	33183	37,600	4,417	13.3
1016761	42,500	52233	61,300	9,067	17.4
1017181	22,700	27898	35,100	7,202	25.8
1016574	23,500	28882	24,000	-4,882	-16.9
1016961	44,600	54813	61,500	6,687	12.2
400391	14,300	17575	32,500	14,925	84.9
1016774	15,000	18435	51,200	32,765	177.7
966854	30,000	36870	32,200	-4,670	-12.7
1017124	25,200	30971	36,900	5,929	19.1
1016871	24,700	30356	39,000	8,644	28.5
400387	25,100	30848	30,300	-548	-1.8
1017381	37,100	45596	58,500	12,904	28.3
1016714	65,100	80008	65,100	-14,908	-18.6
1017101	35,600	43752	56,700	12,948	29.6
1016947	40,100	49283	64,800	15,517	31.5
400304	700	860	900	40	4.6
1017344	15,000	18435	56,700	38,265	207.6
966917	1,700	2089	2,400	311	14.9
739997	1,000	1229	11,400	10,171	827.6
739817	7,300	8972	9,700	728	8.1
1016677	31,600	38836	39,900	1,064	2.7
400334	17,200	21139	24,300	3,161	15.0
966904	4,500	5531	5,900	370	6.7
1016671	12,900	15854	20,200	4,346	27.4
1017336	33,300	40926	48,100	7,174	17.5
1016921	24,200	29742	400	-29,342	-98.7
966877	32,300	39697	50,700	11,003	27.7
1016657	19,500	23966	30,000	6,035	25.2
1017391	37,100	45596	54,400	8,804	19.3
1016767	29,500	36256	35,800	-456	-1.3

1016727	5,600	6882	6,900	18	0.3
966844	33,700	41417	50,100	8,683	21.0
400314	33,500	41172	46,500	5,329	12.9
1017274	43,300	53216	65,200	11,984	22.5
400347	41,900	51495	62,800	11,305	22.0
400341	26,200	32200	41,100	8,900	27.6
1017197	31,300	38468	40,600	2,132	5.5
1017397	10,300	12659	15,000	2,341	18.5
1017217	38,900	47808	55,900	8,092	16.9
400307	700	860	1,000	140	16.2
1017047	28,300	34781	43,000	8,219	23.6
1016917	500	615	600	-15	-2.4
966851	30,100	36993	36,600	-393	-1.1
1017327	1,900	2335	2,900	565	24.2
1016647	3,500	4302	5,000	699	16.2
1017277	14,220	17476	21,600	4,124	23.6
1016941	12,780	15707	19,460	3,753	23.9
1016934	20,100	24703	18,800	-5,903	-23.9
400377	46,500	57149	59,400	2,251	3.9
1017427	40,600	49897	1,600	-48,297	-96.8
1016971	5,700	7005	5,900	-1,105	-15.8
966921	1,800	2212	2,500	288	13.0
1017011	29,200	35887	45,700	9,813	27.3
1017061	32,600	40065	49,800	9,735	24.3
1016831	45,000	55305	55,500	195	0.4
1016581	37,200	45719	5,600	-40,119	-87.8
1016581	37,200	45719	5,600	-40,119	-87.8
966897	36,200	44490	48,300	3,810	8.6
739984	36,800	45227	56,900	11,673	25.8
966861	19,400	23843	40,500	16,657	69.9
1016584	33,300	40926	47,100	6,174	15.1
400317	30,000	36870	40,100	3,230	8.8
1017174	33,000	40557	51,900	11,343	28.0
1017257	10,200	12536	35,100	22,564	180.0
1017104	30,500	37485	38,200	716	1.9
966757	19,700	24211	39,200	14,989	61.9
1017364	32,500	39943	50,200	10,258	25.7
1016944	21,000	25809	26,400	591	2.3
1016824	55,800	68578	71,700	3,122	4.6
1017454	1,000	1229	1,300	71	5.8
1017361	41,400	50881	56,000	5,119	10.1

739937	38,900	47808	72,600	24,792	51.9
400284	81,900	100655	107,300	6,645	6.6
1016667	34,700	42646	51,900	9,254	21.7
1016874	28,500	35027	44,000	8,974	25.6
1887748	455,200	559441	635,600	76,159	13.6
1016914	9,000	11061	27,300	16,239	146.8
1017127	35,100	43138	600	-42,538	-98.6
1017377	33,900	41663	53,800	12,137	29.1
1017394	35,400	43507	1,900	-41,607	-95.6
1017131	35,700	43875	39,200	-4,675	-10.7
739827	44,600	54813	51,300	-3,513	-6.4
1017021	37,000	45473	55,900	10,427	22.9
1016567	30,500	37485	48,900	11,416	30.5
1016814	42,300	51987	49,700	-2,287	-4.4
1017414	9,700	11921	20,000	8,079	67.8
1016731	5,700	7005	7,100	95	1.4
966841	16,800	20647	26,500	5,853	28.3
1016594	4,100	5039	5,300	261	5.2
739851	35,700	43875	42,700	-1,175	-2.7
966827	51,400	63171	82,300	19,129	30.3
1887755	67,700	83203	115,900	32,697	39.3
400321	22,800	28021	31,200	3,179	11.3
1017157	4,100	5039	19,700	14,661	291.0
1016847	35,500	43630	47,600	3,971	9.1
1017071	35,500	43630	16,900	-26,730	-61.3
1017137	28,400	34904	42,500	7,596	21.8
400367	41,500	51004	62,700	11,697	22.9
966747	43,600	53584	60,300	6,716	12.5
1017384	37,000	45473	55,200	9,727	21.4
1017424	29,300	36010	42,000	5,990	16.6
1017281	47,900	58869	65,800	6,931	11.8
1017267	30,700	37730	23,500	-14,230	-37.7
1017117	44,900	55182	60,500	5,318	9.6
1017314	700	860	1,000	140	16.2
1016794	38,800	47685	50,900	3,215	6.7
1017411	25,000	30725	28,700	-2,025	-6.6
1017087	31,200	38345	40,800	2,455	6.4
1016621	42,700	52478	55,500	3,022	5.8
966924	1,800	2212	2,600	388	17.5
1017167	17,300	21262	22,700	1,438	6.8

1016867	35,500	43630	53,700	10,071	23.1
1017004	34,700	42646	41,600	-1,046	-2.5
1017154	20,600	25317	16,100	-9,217	-36.4
1016904	33,100	40680	49,000	8,320	20.5
1016754	50,300	61819	65,800	3,981	6.4
1017417	1,200	1475	1,400	-75	-5.1
1016861	42,200	51864	47,800	-4,064	-7.8
1016777	20,500	25195	31,500	6,306	25.0
966847	15,200	18681	24,200	5,519	29.5
1017007	32,500	39943	1,300	-38,643	-96.7
1016751	39,900	49037	55,800	6,763	13.8
966754	32,600	40065	41,000	935	2.3
1017224	25,600	31462	30,000	-1,462	-4.6
1017304	17,200	21139	23,100	1,961	9.3
1016841	33,300	40926	45,700	4,774	11.7
1017014	26,400	32446	34,500	2,054	6.3
1017221	33,900	41663	52,200	10,537	25.3
1017041	19,400	23843	25,300	1,457	6.1
966751	41,800	51372	56,700	5,328	10.4
1017421	28,800	35395	42,800	7,405	20.9
1016851	21,600	26546	29,800	3,254	12.3
739841	47,000	57763	64,900	7,137	12.4
739994	900	1106	1,400	294	26.6
1016931	24,800	30479	34,200	3,721	12.2
1017247	47,800	58746	56,500	-2,246	-3.8
1016587	5,900	7251	7,000	-251	-3.5
739947	19,800	24334	24,100	-234	-1.0
400371	20,500	25195	30,000	4,806	19.1
1016984	49,600	60958	74,000	13,042	21.4
400361	24,500	30111	42,800	12,690	42.1
1017161	11,300	13888	19,000	5,112	36.8
1017254	6,000	7374	23,900	16,526	224.1
1017114	54,000	66366	74,800	8,434	12.7
1017077	700	860	800	-60	-7.0
1017143	31,400	38591	54,200	15,609	40.4
1867714	73,600	90454	122,700	32,246	35.6
400297	700	860	1,000	140	16.2
1017457	17,700	21753	37,800	16,047	73.8
400301	31,400	38591	47,600	9,009	23.3
1017431	42,600	52355	58,100	5,745	11.0
1017284	1,300	1598	1,400	-198	-12.4

1017357	33,600	41294	42,500	1,206	2.9
1017024	27,300	33552	40,100	6,548	19.5
1016801	22,200	27284	30,300	3,016	11.1
1016784	38,800	47685	47,900	215	0.5
966837	28,700	35272	53,200	17,928	50.8
1016697	42,500	52233	47,900	-4,333	-8.3
1016901	36,700	45104	45,000	-104	-0.2
739861	34,800	42769	39,200	-3,569	-8.3
1016894	27,500	33798	51,600	17,803	52.7
1017091	15,000	18435	23,300	4,865	26.4
1016887	16,200	19910	17,400	-2,510	-12.6
1017261	7,700	9463	30,400	20,937	221.2
1016791	15,800	19418	25,200	5,782	29.8
1017347	65,000	79885	98,500	18,615	23.3
1016857	40,600	49897	68,400	18,503	37.1
966857	25,200	30971	39,900	8,929	28.8
966914	88,300	108521	92,200	-16,321	-15.0
1016681	38,400	47194	1,200	-45,994	-97.5
1017401	13,000	15977	26,000	10,023	62.7
1017367	27,900	34289	35,900	1,611	4.7
400331	52,200	64154	57,600	-6,554	-10.2
1017371	33,400	41049	52,600	11,551	28.1
1017287	23,000	28267	29,300	1,033	3.7
1016661	200	246	300	54	22.1
1017084	27,000	33183	34,900	1,717	5.2
400404	38,700	47562	58,200	10,638	22.4
1017054	37,300	45842	50,000	4,158	9.1
1016844	27,100	33306	40,800	7,494	22.5
1017214	19,800	24334	31,300	6,966	28.6
966871	33,500	41172	52,400	11,229	27.3
1016891	23,600	29004	39,600	10,596	36.5
1016924	36,200	44490	52,000	7,510	16.9
400357	900	1106	1,300	194	17.5
1016654	5,100	6268	7,400	1,132	18.1
1016771	45,700	56165	62,100	5,935	10.6
1016747	27,200	33429	39,500	6,071	18.2
1017184	43,200	53093	64,900	11,807	22.2
1017354	3,900	4793	6,500	1,707	35.6
400384	25,800	31708	32,100	392	1.2
1017147	29,400	36133	39,700	3,567	9.9
739844	34,000	41786	47,000	5,214	12.5

1017227	33,300	40926	31,500	-9,426	-23.0
1017001	21,400	26301	34,000	7,699	29.3
1016991	39,200	48177	58,600	10,423	21.6
966881	30,700	37730	46,200	8,470	22.4
1017441	1,200	1475	1,400	-75	-5.1
1017034	37,300	45842	53,600	7,758	16.9
966874	4,100	5039	25,500	20,461	406.1
400351	26,600	32691	31,000	-1,691	-5.2
966737	27,800	34166	53,500	19,334	56.6
966741	25,600	31462	56,800	25,338	80.5
1600036	521,200	640555	532,800	-107,755	-16.8
1627988	106,100	130397	106,100	-24,297	-18.6
1887745	1,410,200	1733136	1,410,200	-322,936	-18.6
1800053	39,786,500	48897609	39,857,000	-9,040,609	-18.5
1887749	301,600	370666	301,600	-69,066	-18.6
1800086	35,100	43138	55,800	12,662	29.4