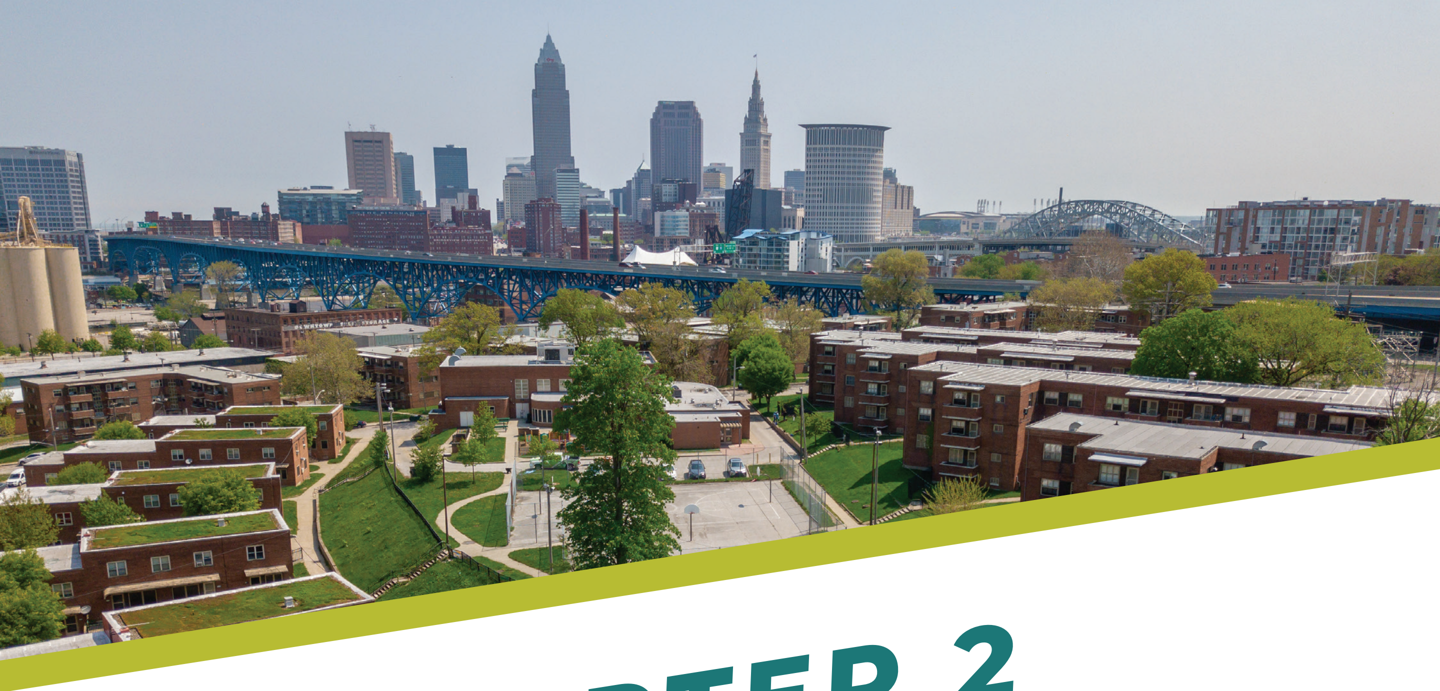

# CHAPTER 2

## Enhancing urban park and green space systems: Access, equity, biodiversity, and connectivity

**Above,** Lakeview Terrace, Ohio.

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What if parks could help our communities withstand climate change by replacing pavement with grass, trees, and modern green infrastructure elements that absorb storm water and keep the neighborhood cooler and more comfortable on hot summer days? What if every community had a well-connected park and green space system that provided benefits such as habitat and connectivity for species and recreation opportunities for people? What if every student had access to a fun, exciting green playground instead of an asphalt or dirt lot (figures 2.1 and 2.2)? What if every person, in every city and town, had a park within a short

**Figures 2.1 and 2.2.** The playground at PS 33 Edward M. Funk Elementary School in Queens Village, New York, *top*, was once just a blank concrete lot, subject to flooding during storms and scorching heat in summer. In 2010, the school community got together to redesign their outdoor space and dreamed up a welcoming, healthy playground, *bottom*, that's open to all.

© The Trust for Public Land.

walk of home? What if those parks were designed and built to enhance quality of life for everyone in the community?

This vision of a greener, more equitable future for every community is within reach. Achieving it will require cooperation among experts, elected leaders, and concerned citizens, along with strategic public investments—all of which can be informed and driven by data and the community conservation processes we are using today. By using these processes, we can guide planners and park professionals to site and construct parks that work better for everyone.

## Benefits and challenges

Imagine life without access to your favorite park or open space: no place to get fresh air, exercise, reconnect with nature, or commune with your friends. No place to sit in the cool shade of a tree on a hot summer day. For too many people, this is the daily reality. In the United States, more than 100 million people—one in three Americans—do not have a park within a 10-minute walk of home (The Trust for Public Land 2015).

In some cities, it's even worse. In Los Angeles, two out of three kids don't have access to a park (figure 2.3). Research shows that close-to-home parks improve health and strengthen communities. A study by the UCLA Center for Health Policy Research (Babey et al. 2013) found that when teens have parks nearby, they use them more frequently for physical activity, which can help lower obesity and depression rates, among other benefits. This research led to policy recommendations for decision-makers to help create access to parks and physical activity opportunities for teens. The use of geographic information systems (GIS) is a key driver in studies such as this that help direct billions of dollars in federal, state, and local funding for parks and open-space purposes that provide critical community benefits.

These benefits are often invisible or overlooked. Studies show parks provide recreation opportunities, improve mental and physical health, keep neighborhoods cooler on hot days, absorb storm water, provide access to nature and beauty, and protect wildlife habitat. Parks can improve academic outcomes and pro-environmental behaviors and create stronger connections between people and nature. The Children and Nature Network is a resource for research on these benefits. Investing in parks yields great economic returns (see chapter 6 for examples), and parks build social cohesion in communities by providing gathering places that create the opportunity for positive interactions and connection to place (figure 2.4). Parks are

**Figure 2.3.** In Los Angeles, California, two out of three kids do not have access to a park.

© The Trust for Public Land.

often thought of as "nice to have" amenities when they are critical infrastructure for healthy, happy communities.

In some neighborhoods, even if parks are close by, people don't feel safe visiting them, or they're not well-maintained or are too crowded. They may be surrounded by busy streets with dangerous intersections. Other parks aren't open to the public or have limited hours of operation. Park amenities might not meet the neighborhoods' needs and desires: no picnic tables in neighborhoods where multigenerational families want to gather and share a meal, no soccer fields for soccer-enthused kids, no dog parks where people can let their pets run free. Elsewhere, one park may be overused, overloved, and undermaintained, while nearby alternative parks go basically unused.

**Figure 2.4.** Brooklyn, New York—the New York Trust for Public Land opening ceremony of a new student-designed community playground at PS 156/392 in Brooklyn on September 20, 2019.

© Joe Martinez, courtesy of The Trust for Public Land.

Parks and green spaces offer countless benefits. But for generations, low-income communities and communities of color have received a disproportionately small share of investments in parks and open spaces—and these disparities have real consequences for public health, climate resilience, and community cohesion. The causes of park inequity are vast and systemic—but its effects are measurable, and with increasingly sophisticated command of spatial data through GIS, even mappable.

These are challenging issues for park and recreation departments, “friends of” park and volunteer groups, and other organizations. GIS is critical to help manage these issues, pinpoint areas of need, and offer insights into how parks of certain types provide specific benefits.

Parks and green spaces come in all shapes and sizes: small neighborhood playgrounds, large regional parks, greenways along rivers or streams, and trails, to name a few. These varied features are opportunities to create connected, well-functioning park and green space networks within communities to serve people and nature

**Figure 2.5.** Locals come in droves to celebrate the opening of Olympic Sculpture Park in January 2007. The park is in Seattle's Belltown neighborhood, close to downtown. Artwork in the Olympic Sculpture Park, a new venture between The Trust for Public Land and the Seattle Art Museum, transformed a brownfield site into a world-class sculpture park in Seattle, Washington.

The Trust for Public Land © 2007 Benjamin Benschneider. All rights reserved.

alike (figure 2.5). Iconic landscape architects such as Fredrick Law Olmstead and Ian McHarg studied, socialized, and popularized this concept of connection in cities from New York to Los Angeles and across the world. They drew beautiful park systems on paper—but most of their designs were never realized. Today, however, these plans are still important greenprints for what an integrated, well-functioning park system can be. It's never too late to reenvision and redesign our communities to support our quality of life and the environment.

In cities, park systems play a critical role in the green infrastructure system that enables human and natural communities to thrive. Connected park systems are havens for wildlife and enable animals—and people—to move safely and healthily through an urban environment. GIS can identify where to build new parks or restore existing sites to maximize connectivity through an entire system.

## Addressing park system challenges with GIS

Data and geospatial modeling are essential tools for grappling with the scale of these park system issues. But the availability of the right data and information varies place by place, city by city. I'll provide an overview of a few standard datasets in this chapter and other datasets you'll need to seek out or create to shed light on the issues outlined earlier in the chapter. I'll cover data sources, approaches, and methods for mapping, modeling, and analyzing park system issues for your community. In this chapter, I'll focus on methods for analyzing park system access, equity, biodiversity, and connectivity. For more information on using GIS to analyze and model park systems as green infrastructure solutions for climate resilience, see chapter 3.

### Gathering support for park system improvements

For these efforts, you can tap into an experienced network of organizations and agencies working hand in hand to create, design, and construct new parks, restore or renovate existing parks, create or update park master plans, engage the community, and support park operations and management. For example, the National Recreation and Parks Association, The Trust for Public Land (TPL), and the Urban Land Institute joined forces to create the 10-Minute Walk™ campaign, a national movement to improve park access and equity. Regional coalitions bring partners together across city and state lines. Chicago Wilderness uses data, science, and community engagement to advance the protection and connection of nature and communities in four states. Local organizations such as the Prospect Park Alliance in New York City focus support for local parks, plus the neighborhoods they serve.

Through existing partnerships, you'll find data, research, technical support, advocacy, and other supporting information to help frame approaches to using GIS data and analysis for action in your community. Before you get started on your project, look into what is already happening in your community and how to support, maximize, and contribute to ongoing activities.

Some park agencies have robust GIS units that provide data, tools, and applications to solve park issues, and may even make data publicly available through open data portals or hubs. But this type of GIS capacity in park and recreation departments is the exception to the rule. For the most part, park departments either have no GIS capacity or must rely on shared services from a city- or county-wide GIS department. Many park departments don't have the GIS data and analytical capacity needed to be data-driven in their daily decision-making. GIS-based analytics for park systems are usually tied to episodic master planning processes or updates. Some park departments also hire GIS consultants. When agencies and organizations have access to, and are working from, the same maps and data-driven models, it's easier to unite various decision-makers, funders, and communities behind a shared strategic park plan or vision. This approach takes data and information out of the silos within departments and organizations and makes it available and actionable for all.

## Tip

Try configurable ArcGIS web apps such as Park Locator and Park Finder to create an app that provides citizens with information on where parks and recreation centers are located and information about those places.

### How to approach mapping and modeling park and green space issues with GIS

The first step is to define the questions you need to answer.

**Some common questions**

- Where are all the parks and green spaces in the community my organization serves?
- How many people have access to these parks and green spaces within a certain distance or walk time?
- Do some populations or demographics have more access than others? You can tag individual parks with information on the population that has access within a certain distance.
- Is there an adequate number of parks and green spaces in my community, and do they have the right amenities or provide the right ecological benefits and habitat needed by wildlife?

- Are there equal opportunities for people to access park and recreation services? Does the supply meet the demand? This is often called a level of service analysis, or LOS.
- Where should parks be renovated to provide climate resilience, ecological integrity, social equity, and health benefits?

Next, determine how the results of your analysis will be used. Will it become part of a report or master plan? Will it be used to make the case for new parks in a city council meeting or news article? Is it a static printed map of park locations, or do you need an app in which users explore and interact with the data? Are you using the data to benchmark how well your community is providing parks versus another community? Understanding how the data and analytical results will be used, and the outcomes you and your partners seek, will help guide the approach you take and the products you create.

### Data

Many national and global data resources include park locations, but most are incomplete, especially at the local scale. And many municipalities don't have park data digitized in a GIS format.

### Where do you find park and green space data?

It's important to inspect any dataset and do spot checks to ensure the park data is complete, or have a park professional assess the data.

Start by contacting your local park department, council of governments, or regional planning organizations to see if they have a GIS layer for parks they can share. GIS data is becoming more freely available but sometimes agencies charge a minimal fee to package and deliver that data to you.

If the data doesn't exist locally, check the TPL ParkServe database, which measures park access and equity nationwide. It includes local park data for more than 14,000 cities and towns that are classified as urbanized areas by the US Census Bureau. ParkServe data is incorporated into the United States Geological Survey (USGS) Protected Areas Database of the United States (PAD-US) data product, available through the USGS Gap Analysis project web pages or through ArcGIS Online (figure 2.6). You can also download the ParkServe data from TPL. Local park data has been integrated into Esri® Vector Basemaps, so if you need only to visualize park locations, versus analyzing data, use that basemap for cartography. The USGS PAD-US database is a great resource for comprehensive US protected lands data.

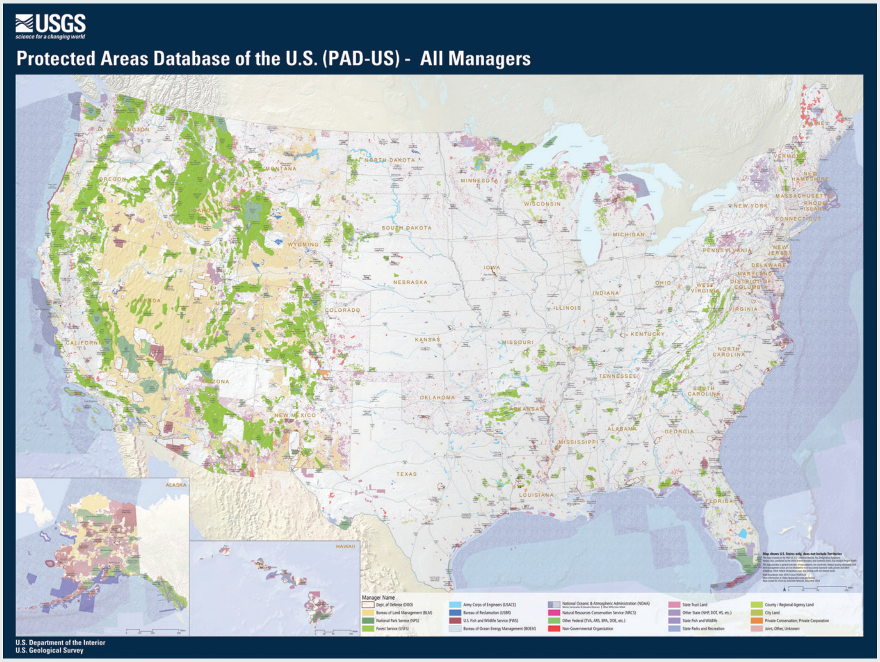


**Figure 2.6.** PAD-US map of protected areas symbolized according to the manager of each area.

US Geological Survey Gap Analysis Project, 2018, Protected Areas Database of the United States: US Geological Survey data release, https://doi.org/10.5066/P955KPLE

For the United States, ParkServe is a great resource, but it doesn't include every city or town in the country. If your community isn't included in the ParkServe database and you've already reached out to your local park agency, check ArcGIS Online for park data and Open Street Map (OSM). OSM is an open-source base data map that is free for all to use and contribute data to. It's especially useful when you need base data for projects working outside the United States. If you can't find park data, you may need to create the data by digitizing from hard-copy maps or using online maps and tools to locate and digitize park data. You can also collect data by directly visiting these sites and collecting data using handheld global positioning system (GPS) devices.

## Tip

Be sure to check the disclaimers of all data products for potential limitations of use.

**Where do you get demographic data?**

Demographic data describes socioeconomic characteristics of population such as age, race, and ethnicity. This data is important in GIS analysis for conservation and parks because it tells a story about who is being impacted by land protection decisions and can provide insights on equity and environmental justice issues. This data is available from the US Census Bureau as the decennial census; the American Community Survey (ACS), a Census Bureau program; and from third-party providers, including Esri. The decennial census provides counts of population and housing that are used to direct federal funds, whereas ACS data describes changes in the socioeconomic characteristics of communities. Demographic data sources differ in their methodologies and approaches to develop the data and deliver at varying scales. It's important to know what demographic variables you want to consider and the scale (i.e., state, county, city, census tract, block group, and so on) for which you need to produce analytical results before choosing a data source.

Working with the raw data from the US Census Bureau can be complicated and time consuming but may be suitable when you need to analyze just a few variables. It can also provide more attributes, such as households without a car. But if you want to analyze many attributes across multiple geographies, which requires downloading and preparing large collections of data, consider using ArcGIS or another product that has the data aggregated and synthesized for ease of use. Census.gov has helpful “how to” resources, as do Esri Press and many universities.

Through ArcGIS Living Atlas of the World, you can access ready-to-use ACS census data to be used in ArcGIS Pro and ArcGIS Online, ArcGIS configurable mobile apps and dashboards, and ArcGIS StoryMaps stories. You will need to determine whether the attributes you need are included in the ACS dataset, or whether you’ll need to pay a fee to third-party data providers to find attributes not included in the ACS product. Sometimes buying a dataset saves time and money compared with preparing the data manually depending on the scale and complexity of your project.

You may be able to find resources in which data is already collected and aggregated, such as the Environmental Protection Agency’s Environmental Justice Screen, or EJSCREEN, which combines environmental and demographic data into maps and reports that are useful in park system planning and decision-making (figure 2.7).

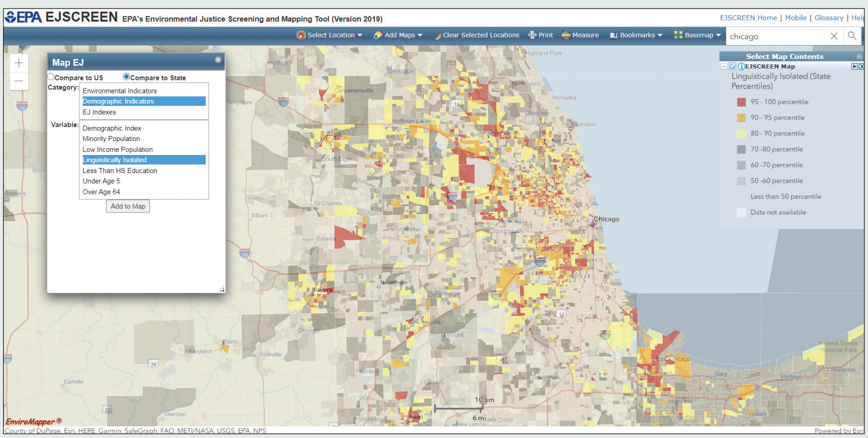


**Figure 2.7.** EJSCREEN interactive map shows linguistic isolation communities. Other data to explore includes demographic characteristics, along with environmental justice information such as public health and environmental indicators.

United States Environmental Protection Agency. EJSCREEN. https://www.epa.gov/ejscreen August 25, 2020.

## Creating new data

The Internet of Things (IoT) sensors, video, phone apps, satellite, and other technologies are advancing quickly and can create real-time data to help park managers make informed decisions. For example, advancements in video allow park managers to combine video technology with machine learning to detect not only how many people are using a park, but a user's approximate age, the amenities they use, and how they move through the park. Anonymized cell phone data shows where people travel from to visit a park, how long they stay, and what time of day they are there. (See chapter 10 for more information on Resilient Solutions 21 and TPL's Public Land VIBE project.) This data also shows what areas of a park people don't use, which can help park managers understand how the park should be improved: Are underused areas poorly lighted, unsafe, or not easily accessible? Companies such as RESOLVE and Esri's Conservation Solutions are incorporating satellite data with artificial intelligence (AI) machine learning algorithms that detect the speed and trajectory of big-game herds on the move and link those movements to nearby poachers. Park managers deploy park security immediately, in real time, to these areas to stop poachers in their tracks. This is a promising area of data creation and analysis. See chapter 10 for more information on these and other technologies of the future.

**Where do you find biodiversity data for urban or city green space planning?**

Biodiversity is one of the key indicators of a healthy and thriving ecosystem. Protecting habitats that support biodiversity is one of our most powerful tools to support climate resilience and avoid ecosystem collapse. New parks, open spaces, trails, blueways (water trails for water recreation, such as boating or swimming), and greenways in the urban environment are important for creating and linking habitats that support biodiversity. Biodiversity is a key factor in landscape and regional planning and will be discussed in other chapters in the book. In this chapter, we'll focus on how biodiversity data can be integrated into urban green space maps and plans.

You can find biodiversity data from the local or state department of natural resources, the city, the county, local universities, local land trusts or conservation organizations, and the local agricultural extension office, to name a few. There are many biodiversity datasets available. Be sure to search for data that is relevant to your analysis goals and locally sourced, if possible. A few examples of biodiversity data available include ecology; biology; species occurrence and abundance; observance data from bio blitz or local crowdsourcing events; Natural Heritage Inventory data; wildlife corridors; trees, avian, riparian, and marine data; and much more, depending on the location of your city or town (figure 2.8).

**Figure 2.8.** Maguire primrose (*Primula maguirei*)—NatureServe global conservation status: critically imperiled (G1); ESA listing status: threatened.

Photo by Larry England, US Fish and Wildlife Service.

If your goal is to site new land protection opportunities in an urban environment that provides habitat and connectivity for wildlife, the GIS data must be at a resolution that supports site selection at that scale.

But most biodiversity data is created or aggregated at a 30-meter resolution, which potentially will not translate to accurate site selection of parcels smaller than 100 acres. Most available or vacant parcels in cities and towns are going to be smaller than 100 acres. So, 30+ meter data will reveal that a geographic area or a large parcel is potentially of value. Data at this resolution is better suited to help inform land trusts and park agencies where further investigation or site visits are needed. But that doesn't mean the right data at the right resolution doesn't exist: many universities have departments that focus on biodiversity issues and can help find the right approach to identify or create data for your project. Also consider data that could be used as bioindicators to assess environmental quality and changes over time. Bioindicators include biological processes, species, or communities. A good example of a species bioindicator is cutthroat trout. It has a temperature sensitivity to warm waters,

**Figure 2.9.** Florida scrub jay (*Aphelocoma coerulescens*)—NatureServe global conservation status: imperiled (G2); ESA listing status: threatened.

Photo by Mike Carlo, US Fish and Wildlife Service.

and its presence or absence can be used as an indicator for changing or warming water temperatures (Holt and Miller 2010).

NatureServe, a global organization focused on biodiversity data, created a series of datasets that power the Map of Biodiversity Importance tool or MoBi. MoBi is available through NatureServe's website and through ArcGIS Living Atlas. This data includes a rich library of species data, status (e.g., imperiled), range size, and degree of protection (figure 2.9). This data was aggregated and made publicly available, at 30-meter resolution, to support local and regional land protection planning. Figures 2.10 and 2.11 show imperiled species data for 2008 and 2020, respectively. NatureServe says the data is best used "in conjunction with field surveys and/or documented occurrence data, such as is available from the NatureServe Network." (MoBi data is important for regional and landscape planning and is referenced in other chapters.)

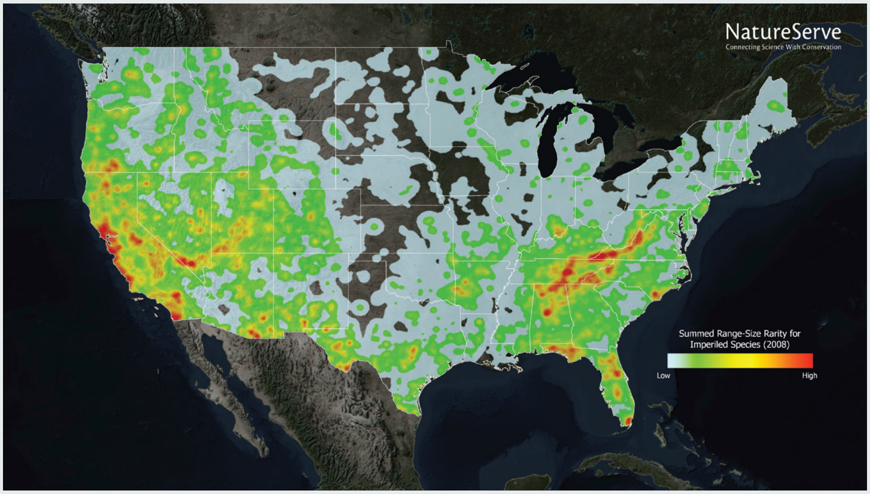


**Figure 2.10.** NatureServe Rarity-Weighted Richness Model of Imperiled Species 2008. Rarity-weighted richness of globally critically imperiled (G1) and imperiled (G2) species in the lower 48 United States, calculated using documented species occurrences from the NatureServe network (circa 2008) generalized to a hexagon grid.

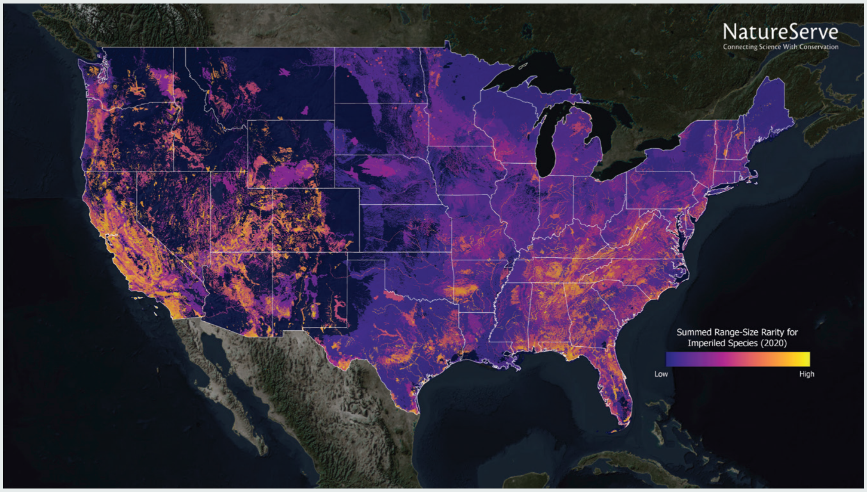


**Figure 2.11.** Rarity-Weighted Richness of Imperiled Species from NatureServe's *Map of Biodiversity Importance 2020*. Summed range-size rarity of imperiled species in the lower 48 United States (i.e., species that are protected by the Endangered Species Act and/or assessed as critically globally imperiled [G1] or imperiled [G2] by NatureServe), calculated using predictive models of species habitat developed for the Map of Biodiversity Importance project (2020).



Other sources include the USGS Gap Analysis Project, or GAP, which maps species range and distribution, and this data informs the MoBi data. The National Center for Ecological Analysis and Synthesis at UC Santa Barbara has also created a database of species lists, abundance, and habitat type for urban species in more than 150 cities around the world.

**Where do you find data for a connectivity analysis at the city or town scale?**

Connectivity has different meanings depending on the subject. For example, landscape connectivity is defined as the extent to which movements of genes, propagules (pollen and seeds), individuals, and populations are facilitated by the structure and composition of the landscape (Rudnick et al. 2012). Chapter 4 provides a deeper overview of landscape connectivity approaches and examples. Urban connectivity includes both socioeconomic and ecological characteristics operating together to provide urban system and ecosystem services. Urban connectivity can include more natural features such as riparian areas along rivers, streams, and waterways. It can also include built features, such as bike lanes and built trail systems and everything in between. A well-connected urban green space system ideally includes, among other things, parks, open spaces, trails, and natural areas that wildlife and people can use to move about the urban area through an interconnected system. The *Esri Green Infrastructure Initiative* booklet is a valuable resource that describes connectivity concepts and approaches to analysis.

Common datasets to use when analyzing urban connectivity are parks, trails, bikeways, greenways and other protected lands, riparian areas, hydrology features such as rivers and streams, satellite imagery, vacant and city- or county-owned parcels, private lands managed with a conservation intent such as conservation easement, Esri Green Infrastructure intact cores (minimally disturbed natural areas), and community forests (forests permanently protected and owned by a local government or nonprofit and managed to benefit the community), among others.

## Analysis/modeling methods for park and green space systems: Park access, equity, biodiversity, and connectivity

Most conservation and park groups need to answer a baseline set of questions. This section provides an overview of select approaches and methods that the GIS analyst can use to address these common questions.

## Park and green space access

Understanding where parks and green spaces are located and whom they serve is an important step in identifying park access issues. Knowing the numbers (i.e., how many people are served) is important, but understanding exactly where park gaps are located makes it possible to invest first where parks are needed most.

To generate defensible statistics, you need the right modeling approach. For instance, consider two different analysis approaches to building buffers, or "service areas," around parks to determine how many people live within walking distance.

The first is the circular buffer approach, in which you generate a circular feature around the centroid of a park using a chosen distance as a radius—say, half a mile—and then count every person who lives

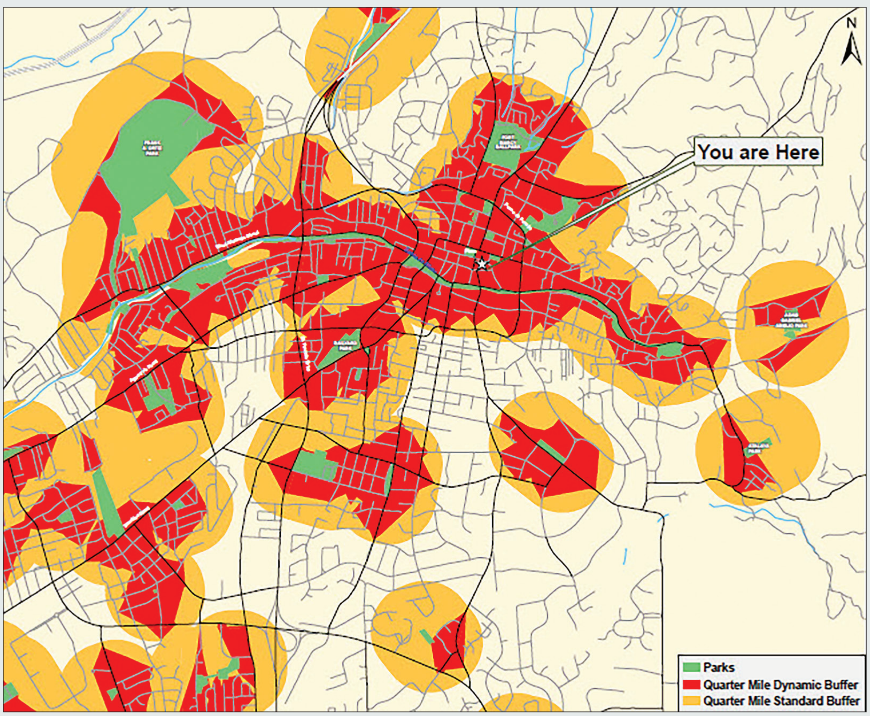


**Figure 2.12.** Circular buffers in orange and network buffers in red.

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within that radius. The second approach uses ArcGIS® Network Analyst to develop a walkable service area using inputs such as distance (e.g., a half mile), road or sidewalk networks, or barriers such as impassable highways or water features.

In figure 2.12, you see the difference between a circular buffer and a service area approach for Santa Fe, New Mexico. In this analysis, the circular buffer analysis (in orange) returned a result of 60 percent of the population served by parks—but by not registering obstacles to walkability, this approach “pretends” that people walk to the park in a straight line, through buildings, across freeways, and over rivers. The Network Analyst service area approach, on the other hand, enables the user to include more nuanced parameters that better depict how a person might walk, drive, or bike to a park. In Santa Fe, the Network Analyst service area analysis (in red) returned a result of 31 percent served. That’s a big difference. The circular buffer approach therefore overcounts the number of people who have access to a given park by including people who may be cut off by physical barriers. I recommend using the service area approach when analyzing park-by-park access, as it is a more accurate representation of park access and need across a city.

## Tip

Quality assurance/quality control (QA/QC) is an important step in any analysis. Visually inspect the results to determine whether the model produced service areas for all the parks in your study area, and flag any outliers or services areas that don’t look correct.

For a step-by-step tutorial on creating park service areas in ArcMap, find the ArcGIS Blog post “Measuring Access to Parks” by Rhonda Glennon.

For a step-by-step tutorial on creating service areas in ArcGIS Pro, search for the “Service Area Tutorial” in the Analysis section. This example uses fire stations but the same concepts apply to creating service areas for parks.

### Park and green space equity

Once you have analyzed park and green space access, you can include demographic data layers to understand equity.

Identify the community characteristics that you want to analyze, and choose the source dataset that includes these attributes. Common variables considered for assessing a community's park need include percentage of children under age 18, population density, percent minority population, and percentage of low-income households.

Next, set up a model or workflow in GIS to use the park service areas to calculate how many people are served and not served by the park system and the demographic profile of each group. In this model, it is important to clip and normalize the demographic data to calculate more accurate statistics. For example, an intersect of the service area with census block groups and a sum of the population of those block groups would, in most cases, dramatically overcount the number of people served. Clipping and normalizing the attributes for those block groups yields more accurate results. Normalize by calculating the area percentage of each block group that is overlapped by the park service area(s) and multiply demographic statistics by that factor for an estimated result. Note that census and demographic data are estimates but these types of analysis approaches will generate defensible statistics to inform park equity issues.

### Example modeling approaches to assess park needs

- Visualization: Overlay parks and the service area layers with the prioritized demographic layers to visualize where parks are needed most, based on certain demographic characteristics that are visible in the park gap areas (figure 2.13).
- Create a model that assigns relative weights to each demographic variable to reflect local demographic priorities (e.g., population density weighted higher than low-income households).
- Classify and rank demographic data to generate scores on a scale that reflects park need (e.g., 0 to 5 or 0 to 3). The scores correlate with low need (0) to high need (5) for each demographic

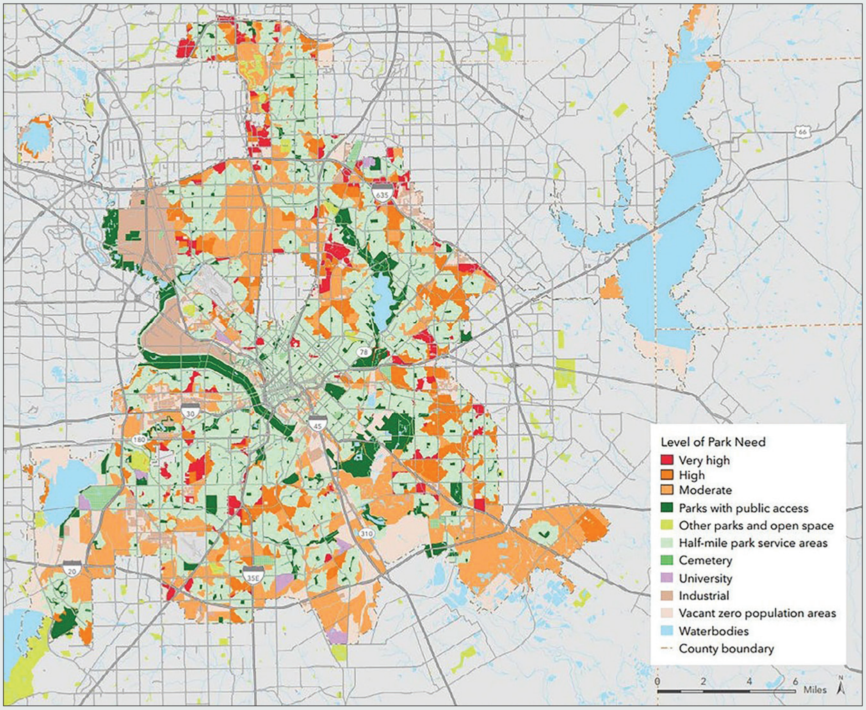


**Figure 2.13.** The map identifies where parks are needed most in Dallas. The red and orange areas show where people don't have access to a park within a 10-minute walk and where there is high population density, a high percentage of low-income households, and a high percentage of kids under 18 years old.

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characteristic. For this method, you will need to convert the vector demographic data into raster layers to, in this case, create a ranking or prioritization that is normalized across multiple data layers.

- To generate statistics, use the calculation tools in ArcGIS Pro or ArcMap, or create a model or workflow that captures the process when you need to update statistics with new data. Creating models and workflows will enable you to create statistics for many geographies (i.e., county, city, school district, by park, census tracts, and block groups) and combine statistics for the study area.

- For QA/QC, click on individual parks and compare the number of people served against the base demographic data to spot-check results. Review the attribute table to check numbers, such as population served for a given park, and compare against demographic data.
- Using the tabular data, calculate how many people are served by parks in your study area versus those who are not. Useful tools include zonal and summary statistics. Remember to normalize by area using the method described previously. You can add this as a data point on your map or in your web app.

**Define the product**

A printed static map tells the story of park access visually by including base data, parks, and the park access service areas along with the demographic park need layer.

An interactive web app, on the other hand, enables more investigative power of the data. For example, users can get statistics for individual parks or for the entire park system. You can enable styling or symbolization of data in web apps to display different attributes such as park size or park manager and demographic characteristics such as age, income, and race. You may choose to include data analysis results using StoryMaps to walk the audience through a story about park access and equity in your community and why it's important to direct resources where they are needed most. These are just a few examples of how interactive web apps make your data more actionable.

At learn.arcgis.com, a tutorial on "Assessing Access to Public Transit" offers a step-by-step guide, using ArcGIS Pro, to identify areas in a city in which bus stops are needed based on socioeconomic criteria. You can adapt this approach to identify where parks are most needed based on demographic information.

**Green space systems for connectivity and biodiversity**

A few simple approaches to visualize connectivity issues in your city or town are as follows:

- Visually inspect the park system data (parks, trails, greenways, open spaces) with a satellite imagery basemap to identify areas that represent gaps in the park system. Sketch circles or lines on the map that show gaps and where more in-depth analysis or field observations could determine the feasibility of creating connections in those locations. Remember, connectivity doesn't always need to involve public landownership. Public/private partnerships play a big role in successful connectivity initiatives by using conservation tools such as easements and cooperative agreements, among others.
- Overlay the sketched map from the previous step with a parcel or landownership data layer. Identify parcels that could close the connectivity gaps, such as vacant lots, city- or county-owned lands, storm water management lands, utility rights-of-way, flood zones, stream corridors, potential trails or greenway easements on private properties, and lands owned by hospitals, schools, libraries, and churches. All of these are opportunities to collaborate on creating a connected park system that benefits humans and natural communities alike.

The green infrastructure framework by Esri provides a powerful set of data, tools, and approaches to aid connectivity analysis. The Green Infrastructure Collection in ArcGIS Living Atlas is a good starting place to find data to incorporate into your analysis (figure 2.14). Esri is also working on methods to create connected corridors at the local level. You can submit your data through the green infrastructure framework on esri.com, and your contributions will be included in a growing map of green infrastructure assets and priorities nationwide, and even globally in some cases.

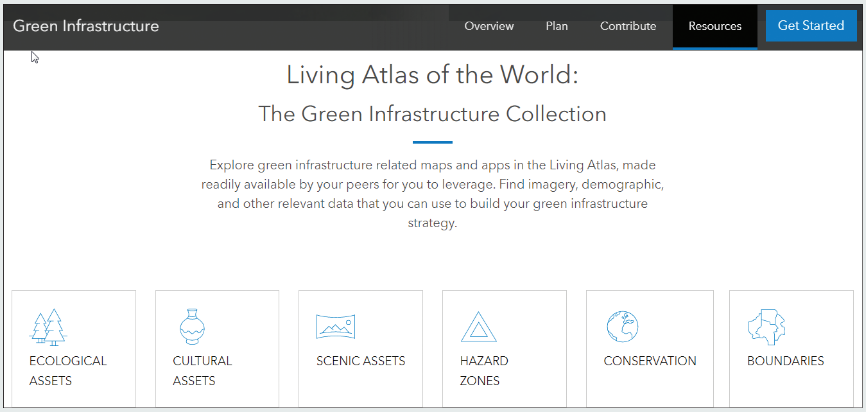


**Figure 2.14.** Green Infrastructure data from ArcGIS Living Atlas.

© Esri.

## Translating results into action

Understanding park system issues with spatial data might be a new concept to members of your community. Visualizing the spatial distribution of parks overlaid with other GIS data is a simple technique, but it yields big insights around park equity, connectivity, green infrastructure, and biodiversity. You don't have to be a GIS technician or expert to enhance the power of data to meet the mission and goals of your organization. Simple data visualization is a powerful tool to support implementation, strategic decision-making, policy changes, and advocacy for the places we love and want to protect, restore, or enhance.

Empowering your elected officials with information on park system needs is the first step toward change. For example, knowing how many people have access to parks in your community and the demographic breakout of those communities is a first step to understanding what types of problems exist. One problem could be that children and teenagers lack access to safe parks close to home. By using demographic data to analyze where high percentages of children and teens live in relation to parks, planners and decision-makers will know where kids don't have access and start brainstorming how to address these needs. The maps may show vacant lots that could be turned into parks or school playgrounds that can be opened to the community for public use. Maps convey the spatial relationship between people and parks and help guide investments and resources (figure 2.15).

**Figure 2.15.** Participatory design at McKinley School in Newark, New Jersey, in 2003.



Furthermore, the ability to analyze park issues at different scales enables granular insights about where resources are needed most to address the issues. When you produce a map that shows park access by city council district in a city, such as the one for Dallas, Texas, in figure 2.16, you'll see disparities in park access by district.

These maps show where parks are lacking, and when you add more layers, they also show where park gaps overlap with other social factors, such as low-income neighborhoods or communities of color, where tree cover is needed, and where park system connectivity could benefit habitat and biodiversity. A flood zone data layer can help point to where green infrastructure can reduce the risk by absorbing storm water. These maps provide data to our elected officials so they can direct resources and funds to the places that need them most.

The more we democratize parks and green space data and make it publicly available, the more good it will do. Making data and analytical outputs available for download in a variety of configurations and file formats makes it easier for GIS practitioners and research professionals to put it to use. ArcGIS Online and ArcGIS® Hub℠ make it easy to set up and share data for your organization or agency. *ArcWatch* (2017) provides steps on how to share your data.

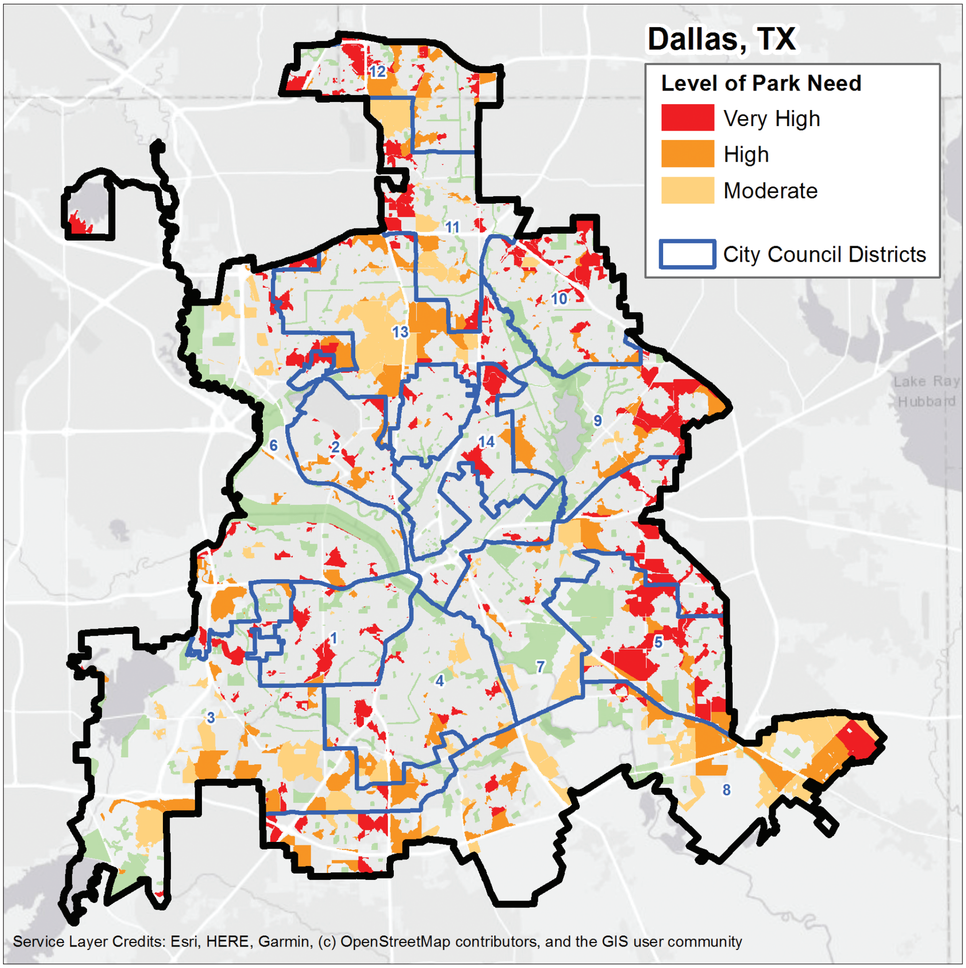


**Figure 2.16.** Park need areas in red, orange, and yellow.

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### The ParkServe platform

Created in 2018 by TPL, the ParkServe platform established the first data-driven park access baseline in the country. Now, this data is the foundation for a national movement to improve park equity.

Park planners, advocates, and citizens can access their community's park data through the ParkServe web app. Users can zoom into individual parks and find out how many people live within a 10-minute walk of that park and the population's demographic characteristics. GIS users can download the data outputs to view and analyze information at scales ranging from states to counties to zip codes.

The ParkServe platform has enabled conservation and park organizations to achieve more specificity than a national benchmark. Cities and towns are using the platform to inform the strategic siting, construction, renovation, and management of parks across the country.

## Examples of how green space analysis results are valuable

Cities and towns across the country are turning to data to understand how their park systems are serving the community and nature. Many are working together, sharing methods and approaches to increase park and green space access, protect and restore nature, and address equity issues. Mayors and city officials realize that green space systems play a key role in the quality of life in their communities and are factors in attracting new residents.

Community organizing groups are using data to highlight systemic inequities and make the case for more parks and nature in neighborhoods. Organizations are developing innovative ways to increase green spaces in neighborhoods that are already, for the most part, built out. In Los Angeles, an organization called Lot to Spot is using GIS data to pinpoint where vacant or underused lots can be turned into parks, community gardens, or gathering places. In California, representatives are using park equity maps to prioritize state-level park funding for smaller communities that have the highest need.

Cities are using GIS data and analysis results to make the case for park ballot measures that provide much needed funding to build new parks, restore old parks, provide programming through parks and recreation facilities, and for operations and management. Since 1998, cities in the United States have created more than $80 billion in park funding through local ballot measures (The Trust for Public Land n.d.]. For a specific example, in 2016, TPL established a partnership with the City of Dallas to reimagine how parks, trails, and green spaces can improve equity and quality of life for the city's most vulnerable residents. Working with stakeholders, they developed a GIS-driven decision support tool—using advanced analytics to combine health, social, and environmental data with community-articulated priorities—to guide strategic green investments in the city. In 2017, Dallas city residents passed two bond measures providing $311 million in funding for parks across the city. Since then, the percentage of city residents with a park or trail within a 10-minute walk from home has increased from 58 to 71 percent, with an additional 251,000 people now served by a close-to-home park.

Organizations such as the National Recreation and Parks Association use GIS data to support advocacy, policy change, and research. Urban Land Institute uses data to find solutions to community park issues and provide technical assistance. Many universities are using park data in research ranging from park equity, climate change, urban biodiversity, park visitation, operations, and management to community health and many other topics.

## How GIS improves urban green space systems and park equity

NatureServe's MoBi biodiversity data and other high-resolution sources provide invaluable information to understand where land protection in the urban realm will benefit species. Methods and approaches to mapping urban park system connectivity provide a way to connect all the green spaces into a system that benefits both people and animal species. The ability to generate walkable service areas for green spaces and parks using GIS has made for more accurate and authoritative statistics on park access and equity, more reflective of what people experience when using their park system.

Integrating demographic data such as population, age, income, and race with GIS-derived service areas is key to understanding disparities in park access, investment, and quality within and between communities. GIS is the only platform that does all this with out-of-the-box tools, and it delivers results through a variety of products, from digital maps to interactive web apps and StoryMaps stories.

With new advances in technology and IoT, park agencies and organizations can capture information on how the park system is performing to understand trends and where resources should be directed to increase, manage, or distribute green spaces for people and nature. Your analysis can support a new vision for an equitable, natural, connected park and green space system in your community and provide the data and tools needed to educate and inspire action.

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