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GP RED Research Brief

#13-C

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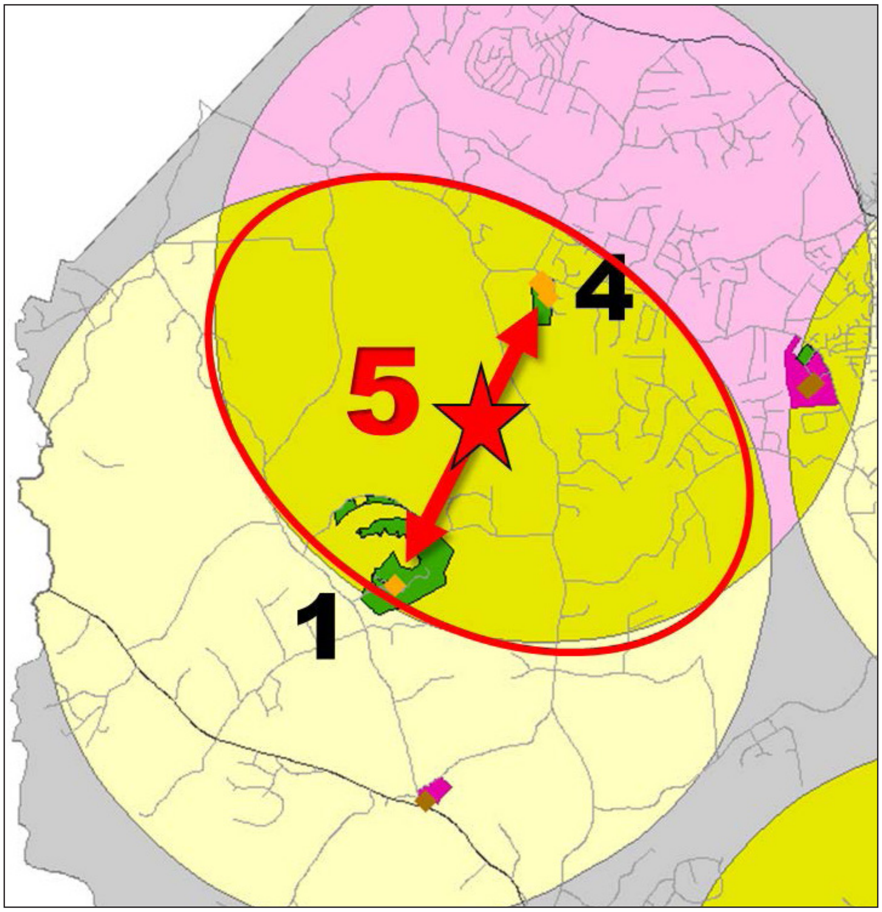
MEASURING PARKS, TRAILS, AND OTHER PUBLIC GREENSPACE AREAS – VOLUME III

Analyzing Park Systems with Aggregated Data and Spatial Analysis



NOTE: This volume is the third in a 3-part series on the measurement and analysis of parks and other public greenspaces. The first volume discusses a number of variables that can be used to describe, measure, and analyze individual parks and greenspaces. The second illustrates how data from park audits can be applied to generate performance measures for parks and greenspace. This final volume discusses ways in which the measures for individual parks can be combined to analyze a park system and measure its performance on various indicators.

Each volume builds on the previous one, so it is suggested that the reader begin with volume one and continue with the remaining two in sequence, but that is not completely necessary for each individual volume to be useful as an independent report.

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Introduction

Previous volumes in this GP RED Research Brief series **Measuring Parks, Trails, and other Public Greenspace Areas** present a methodology for assessing parks based on their features, which can be categorized as components – the basic elements of a park that are intended to support a particular activity or set of activities, and modifiers, which are comfort and convenience features that enhance the effectiveness of the park's components by improving the quality of the overall park experience. Modifiers serve as catalysts that encourage people to visit the park more often, stay longer, and enjoy a more meaningful experience.

Performance measurements such as those described in the previous volumes serve to evaluate individual parks and compare them against a norm or standard, or against other parks. This volume explains how such measurements can be combined to measure the performance of a system or collection of parks across a selected geographic area or region. Proximity and access are part of this performance equation. Recent studies have established a positive link between access to greenspace and public health (Sallis et al., 2012; Kaplan, 1995; Boone et al., 2009), and active transit (such as walking or biking) to and from the greenspace location is an important aspect of this association (e.g., Heinrich et al., 2007; Tilt, 2009; Wang et al., 2013).

Landscape Performance at the System Scale: Aggregated Measures for a Specific Geographical Area and the Role of Proximity

The LOS Concept

Level of Service (LOS) is a concept commonly associated with the transportation field, where it is used to measure the quality of user experience for a given transportation facility, such as a segment of roadway between two specific points. While the measure blends multiple factors such as congestion and road surface quality into a single rating, it can be strongly influenced by the roadway's capacity to accommodate traffic demand. When applied to parks and recreation, the LOS concept has traditionally also tended to be expressed in terms of capacities. The most common measure is acres of parkland or numbers of specific park features, such as tennis courts, per population. For example, 10 acres per 1000, or one tennis court for every 2,000 residents.

In the past, the National Recreation and Park Association (NRPA) published such measures as standards for various features but has since stopped promoting their use and recommends that each community determine its own standards for what is needed through needs assessments and public process. While these measures are no longer promoted as national standards, they are still measurements often used to determine local policies, goals, and LOS.

A limitation of these measurements is that they are purely quantitative and typically measure only the existence, i.e., presence or absence, of features without accounting for their quality, functionality, or other measures of how well they satisfy their intended purpose. Items in the GRASP® methodology described in the previous volumes, on the other hand, take into account the degree to which existing parks and the features within them meet expectations for functionality, comfort, convenience, and overall quality. This data blends the capacity and user experience of a park to produce measures more aligned with the intent of LOS as it originated in the transportation field.

Access as a Measure of LOS – the Role of Proximity

A park provides little service to those who cannot get to it, so another measure of LOS commonly used in the parks and recreation field is the proximity of a park to those it is intended to serve. Proximity is typically measured by either travel time or physical distance. For example, guidelines might call for a park within a 10-minute walk or within a quarter mile distance from home. Even though the validity of 10 minutes as the definitive walking time or a quarter mile as the precise walking distance from home to a park for achieving a given outcome has never been based on empirical research, these metrics have become normative standards for planning and policy purposes.

While proximity remains the primary measure of accessibility in the parks and recreation field (see Figure 1), park professionals have begun to expand the concept of access to include consideration of not only mobility barriers, such as those addressed by the Americans with Disabilities Act (ADA), but cultural and sociological barriers that may discourage or prevent individuals from using the park as well. This report focuses on proximity but recognizes the importance of other variables. As the literature on those grows, they may be covered in future Research Briefs.

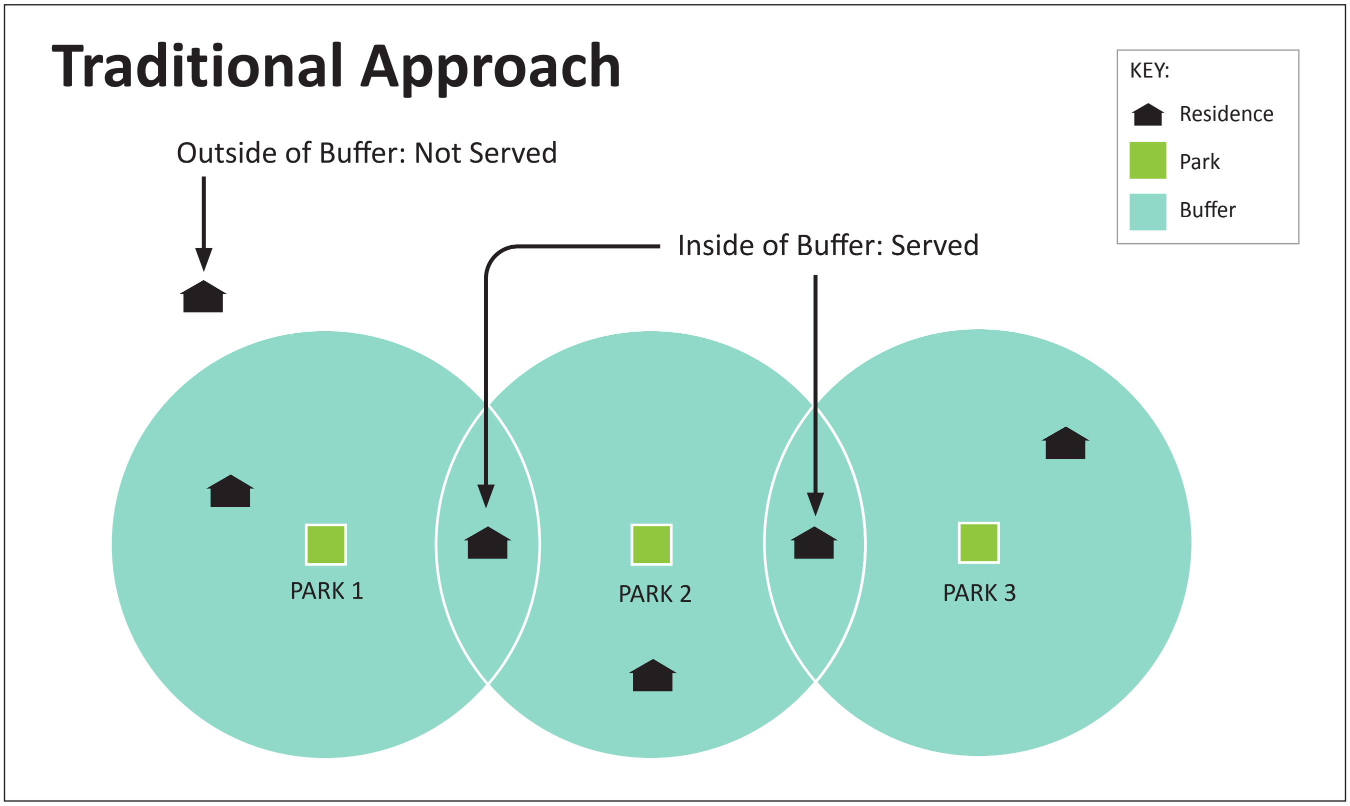

Figure 1. *Traditional application of service buffers for park system master planning*

While there are various ways to measure walking distances to parks and other greenspace features, there is no adopted standard. GP RED's *Research Brief #1: Walkability Standards: a test of common assumptions related to walkable access* (Layton, 2014) provides a discussion of norms and other considerations, but the range for what is considered a walkable distance typically falls between 400 meters and one kilometer (0.25 miles to 0.621 miles), as shown by the sample of studies summarized in Table 1.

Table 1. Comparison of Buffer Methods and Access Distances in Studies

Study	Buffers		Access Distance Referenced	Notes
	Euclidian	Network		
Brownson, et al. (2009)	X		400 to 3200 Meters	400 Meters = 0.25 Miles, 3200 Meters = 1.98 Miles
Chang and Liao (2011)	X	X	Varies	Gravity model uses whatever distance exists
Cho & Choi, (2005)		X	Varies	Gravity model uses whatever distance exists
Dills, et al. (2012)		X	1 Mile	1 Mile = 1609 Meters
Forsyth, et al. (2007)	X		1.00 Kilometer	1 Kilometer = 0.62 Miles
Giles-Conti, et al. (2006)			10-15 Minute Walk	0.25 Miles = 402 Meters (Buffers referenced but not reported)
Godbey (2009)			1 Kilometer	1 Kilometer = 0.62 Miles
Heinrich, et al. (2007)	X		0.80 Kilometers	0.8 Kilometers = 0.50 Miles
Nichols (2001)	X	X	0.50 Miles	0.5 Miles = 805 Meters
Oh and Jeong (2007)	X	X	1.00 Kilometer	1 Kilometer = 0.62 Miles
Smoyer-Tomic, et al. (2004)	X		0.80 Kilometers	0.8 Kilometers = 0.50 Miles
Talen (2010)			5 Minutes (1/4 Mile)	0.25 Miles = 402 Meters (Buffers referenced but not reported)
TPL (2004)	X		0.25 Miles	0.25 Miles = 402 Meters

Similarly, there is no consensus on how distance should be measured. A common type of buffer referred to as Euclidian (Smoyer-Tomic et al., 2004) or "straight-line" (Cho & Choi, 2005) is formed by the direct distance on the map from an object, such as a park or one of its components to locations around it. Another type preferred by some researchers is the network buffer, which is measured along the actual network of streets to the park's access point. This addresses a disadvantage of the radius method, which assumes parks to be open to access at all points along their boundaries (Nichols, 2001).

However, not everyone agrees that network buffers are always preferable. Smoyer-Tomic et al. (2004) used Euclidian buffers because digital representations of street networks may lack the detail to account for sidewalks, shortcuts and other aspects of travel by foot or bike. Dills et al. (2012) add that pedestrians may sometimes choose routes based on walkability perceptions rather than the shortest distance. In general, Euclidian buffers are likely to over-sample a service area, while network buffers may under-sample them (Layton, 2014).

Whatever the method used to determine access, it should be one of the considerations when measuring the LOS provided by a system of parks and other greenspaces. In measuring the LOS provided by a park system as opposed to an individual park, it is the value of all parks and features that an individual has access to that matters, rather than the value of a particular park. For that reason, the LOS provided by a park system should be measured at an individual's location wherever they are, rather than at a particular park. Thus, LOS across a park system varies depending on an individual's specific geographic location when accessing the parks and facilities within the system. Stated more concisely, *LOS is the value offered by the park system to you wherever you happen to be.* It is location-dependent and measured at your location.

Ideally, other variables would be incorporated into the LOS equation to address the individualized nature of LOS. These might include characteristics of the individual and their perceptions of value. People from different ethnic, cultural, or racial backgrounds assign different values to the types of features and activities available. Scholarly research should continue to examine these variables and develop ways to incorporate them into techniques that measure the perceived LOS offered by a park system to a particular individual at any given location. Just as GIS has allowed for more sophisticated approaches to measuring LOS as described in this report, evidence and technology may be blended in the future to generate a LOS score for an individual based on their preferences and geographic location. But for now, the methods presented here are limited to the quantity and quality attributes evaluated in tools such as the GRASP®-IT audit tool.

In the GRASP® methodology, scores for various features are used in aggregate to determine a Level of Service (LOS) value for any given location within a study area or jurisdiction. This is done by assigning a value (as explained in previous volumes) for a park or other feature to

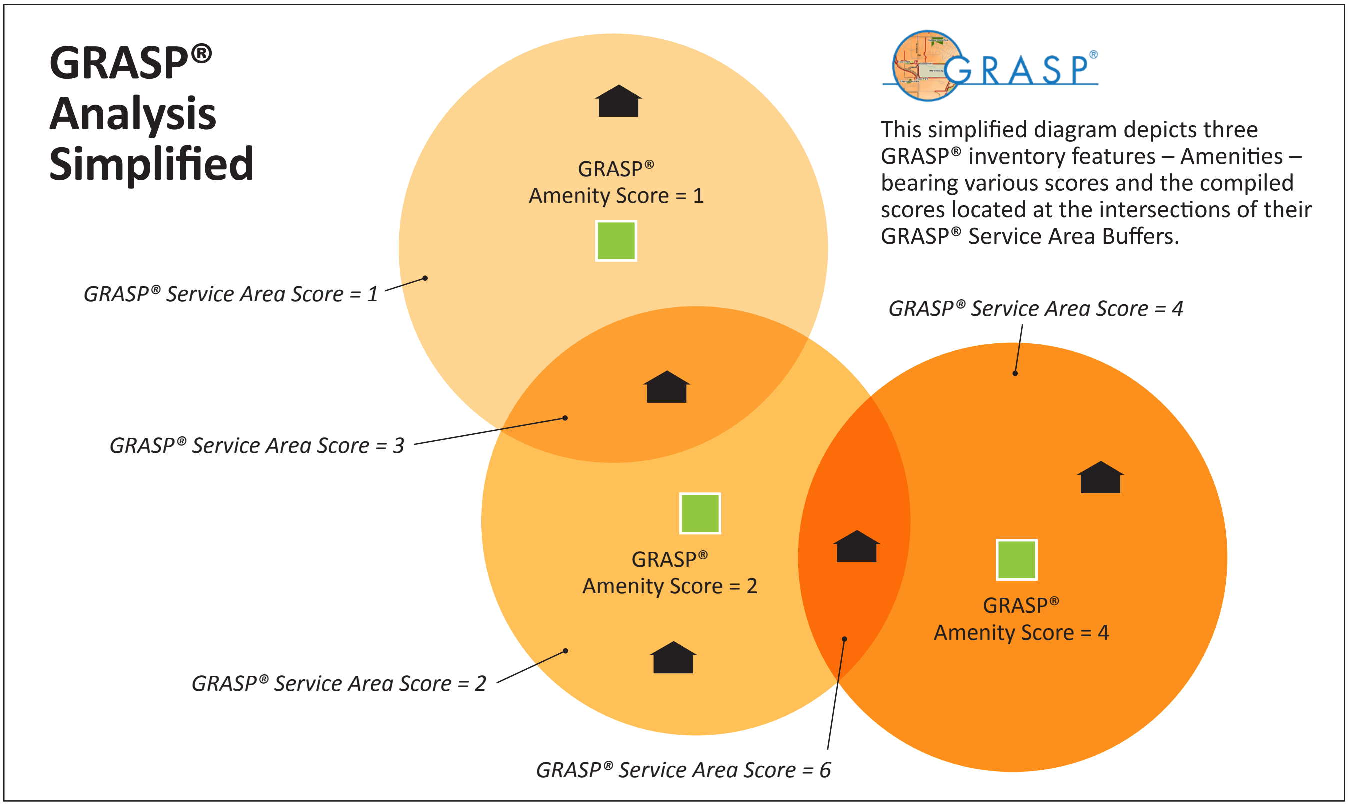

Figure 2. *Simplified diagram of Composite Values Methodology (CVM)*

a buffer area from which the intended users of the park of are primarily expected to come. When buffers from all of the parks and facilities are overlaid on one map, gradients emerge representing the sum of all parks and features accessible from any given location (Figure 2.). In the GRASP® system, such maps are referred to as *Perspectives*, and the process for generating them is called *composite values methodology, or* CVM (Penbrooke & Layton,2007). See the appendix of this volume for examples of different types of perspectives.

Measuring LOS at the Community Scale

To demonstrate, the GRASP®*Active* scores for parks in Cary, North Carolina described in Volume II can be used to create a Perspective that shows the GRASP®*Active* LOS available at any given location across the city.

The first step in the process is to determine the GRASP®*Active* score for each of Cary's parks using data generated with the GRASP®-IT audit tool and the formulas presented in Volume II. Table 2 shows these values, along with a recoded score for the park that groups the values into three categories of low, medium, and high with corresponding values of 1, 2, and 3.

The values are then assigned to a ½ mile Euclidian buffer surrounding each park in the GIS. The buffers are combined to create a map displaying the composite values that result when the buffers are overlain on one another (Figure 3). The yellow background on the map indicates Cary's geographic corporate extents at the time of collection. The shades on the map represent composite GRASP®*Active* values from all parks whose buffer overlays any given location. Total values range from zero (no shading) to 8. Additional performance measures for the entire system of parks can be extracted from the GIS using this information. For example, 30.30 square miles of Cary's total land mass of 55.60 square miles (55%) falls within a buffer, meaning that anyone living within that area can be considered to have walkable access to parks with features supporting physical activity. Figure 4 shows areas with value at or above the median score of 2.

Table 2. GRASP®*Active* Values for Parks in Cary

Location	Classification	Log10	Recoded Log10	
Dorothy Park	Mini Park	0.54	1.00	
Heater Park	Mini Park	1.03	1.00	
Black Creek GW Trailhead	Special Use Facility	1.03	1.00	
Rose Street Park	Mini Park	1.27	1.00	
Urban Park	Mini Park	1.55	1.00	
Lexie Lane Park	Neighborhood Park	1.79	1.00	
Annie Jones Greenway 1	Special Use Facility	1.88	1.00	
Cary High School	Special Use Facility	2.54	1.00	
Preston Soccer Fields	Special Use Facility	2.60	1.00	
Lions Park	Neighborhood Park	2.62	1.00	
MacDonald Woods Park	Neighborhood Park	3.13	1.00	Lowest Third
RS Dunham Park	Neighborhood Park	3.14	2.00	
Annie L Jones Park	Neighborhood Park	3.32	2.00	
Koka Booth Amphitheatre	Special Use Facility	3.37	2.00	
White Oak Park	Neighborhood Park	3.48	2.00	
Green Hope Elemen School Park	Neighborhood Park	3.50	2.00	Median = 3.53
Davis Drive Park	Special Use Facility	3.56	2.00	
Walnut Street Park	Special Use Facility	3.58	2.00	
Green Hope High School	Special Use Facility	3.62	2.00	
Sears Farm Road Park	Neighborhood Park	3.76	2.00	
Marla Dorrel Park	Neighborhood Park	3.78	2.00	
Robert V Godbold Park	Neighborhood Park	3.90	3.00	Highest Third
Harold D Ritter Park	Community Park	3.98	3.00	
Davis Drive School Park	Special Use Facility	4.05	3.00	
Hemlock Bluffs Nature Preserve	Special Use Facility	4.23	3.00	
Cary Tennis Park	Special Use Facility	4.48	3.00	
North Cary Park	Community Park	4.55	3.00	
Mills School Park	Special Use Facility	4.56	3.00	
WakeMed Soccer Park	Special Use Facility	4.95	3.00	
T E Brooks Park USA Baseball	Community Park	4.96	3.00	
Middle Creek School Park	Community Park	5.14	3.00	
Fred G Bond Metro Park	Metro Park	5.46	3.00	

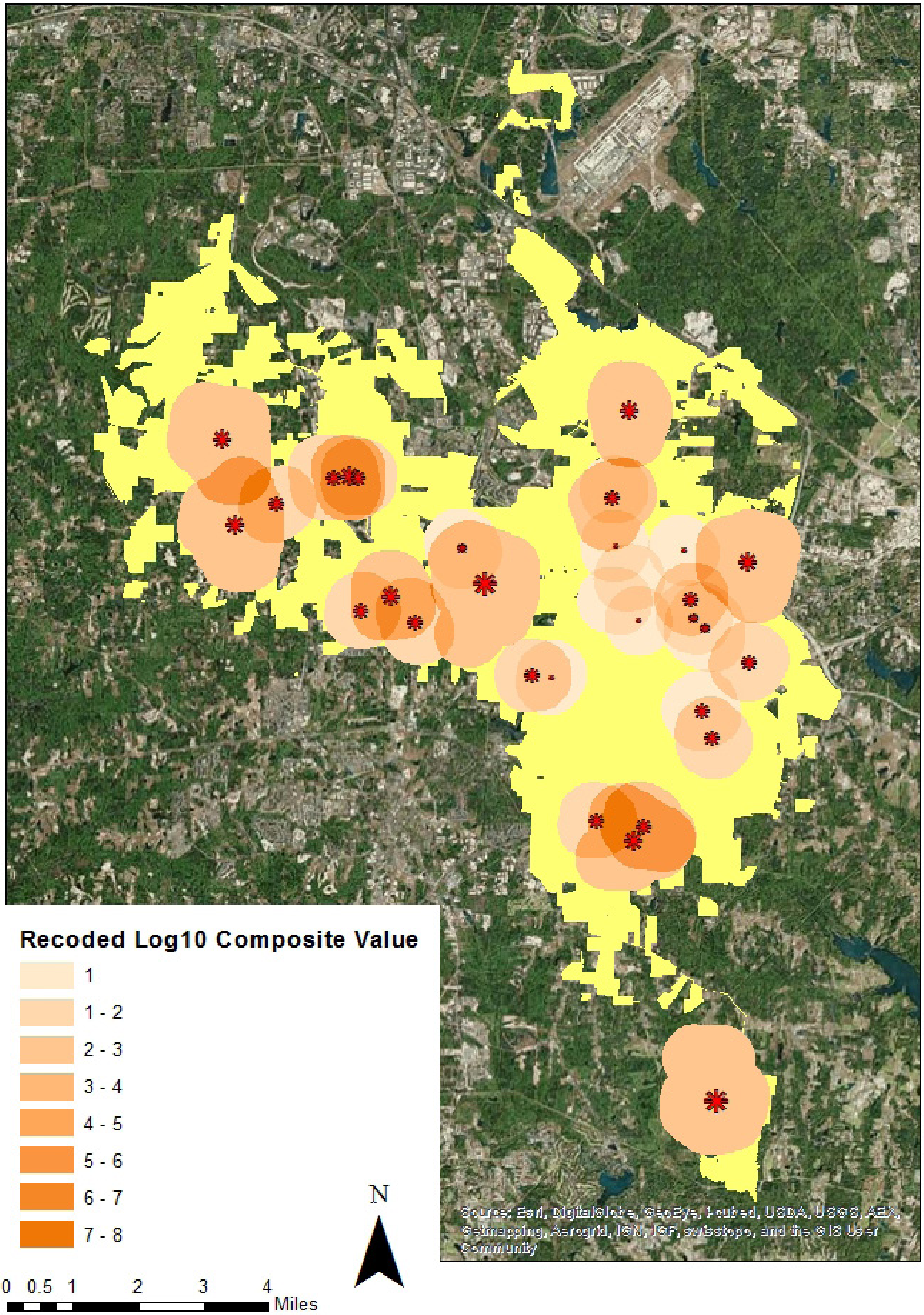

Figure 3. *Composite Map of Recoded Log10 Values for Physical Health*

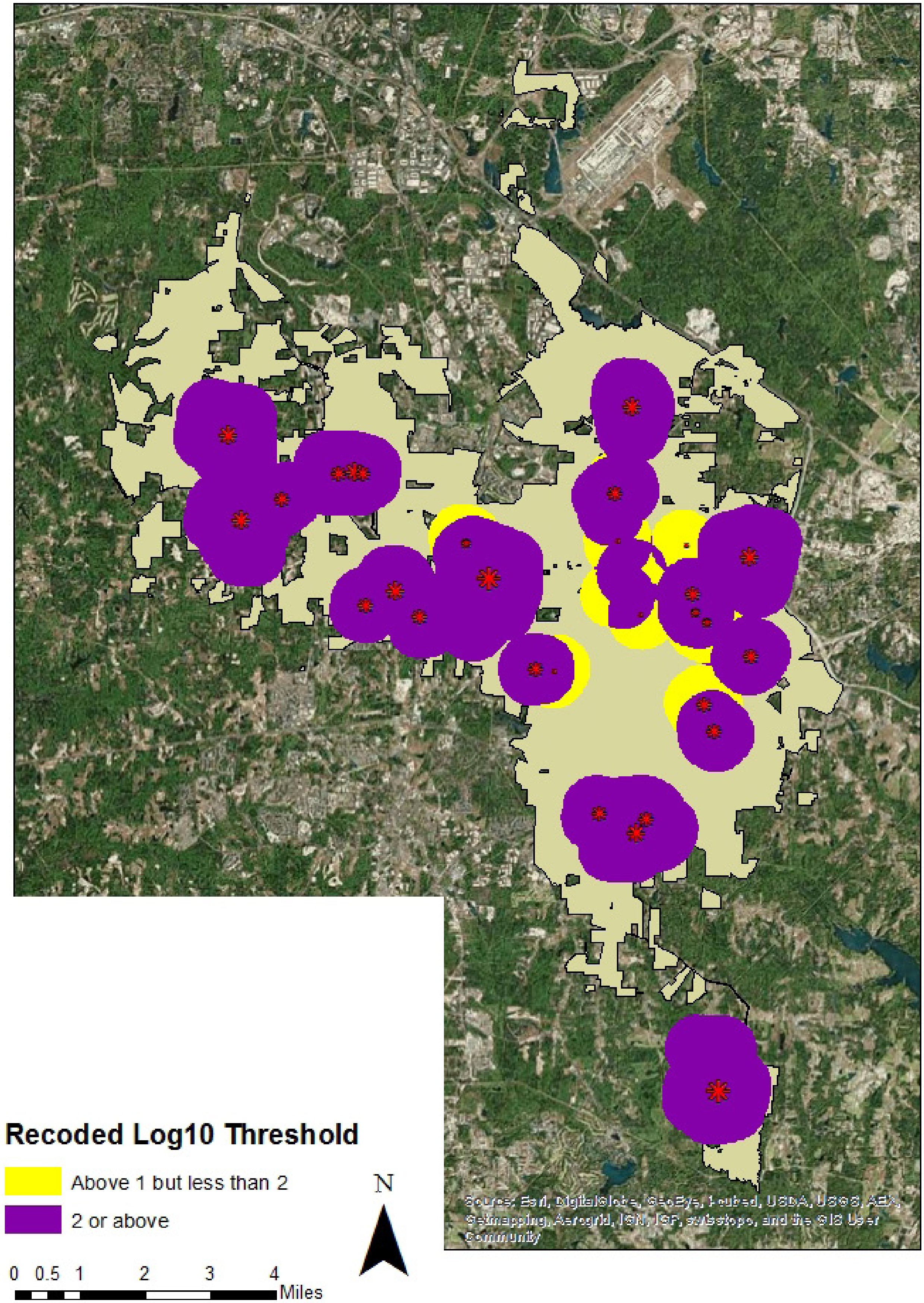

Figure 4. *Areas At or Above Median Recoded Log10 Value*

A wide variety of possible performance metrics are available once scores have been assigned to parcels and imported into the GIS. For example, census data could be imported to determine the number of people living within proximity to a certain threshold of physical activity within a prescribed area, or conversely, determine how many do not have proximate access to it.

Generalization and Transferability of the Metric

Metrics such as the GRASP®*Active* scores shown in this example also allow comparison of one park's relative rank to another in terms of its potential performance. Other formulas can be developed that measure other performance types, depending on what variables are used and how they are incorporated. However, to date there is no standard for comparison of the resulting scores. One way to address this would be to perform the equation on a broader sample of parks from a wider range of locations and look for normative values among the results. This could then establish a threshold or target value for whatever performance score is being measured.

Limitations and Conclusions

The performance metrics described here are only examples of the many types of performance measures that could be developed to analyze park systems for planning, administration, research, or other needs.

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←Components

Components are elements of greenspace that support, encourage, or facilitate an activity or experience. The activity or experience can be active or passive, structured or unstructured, group or individual. The playground shown here is an example of a component.

Modifiers→

Modifiers are elements within greenspace that support, facilitate, or enhance the comfort and convenience of using greenspace components. This includes shade, restrooms, and pleasant surroundings.

Scoring of Components

Score of 1: Playground is old, unsafe, obsolete, not up to expectations

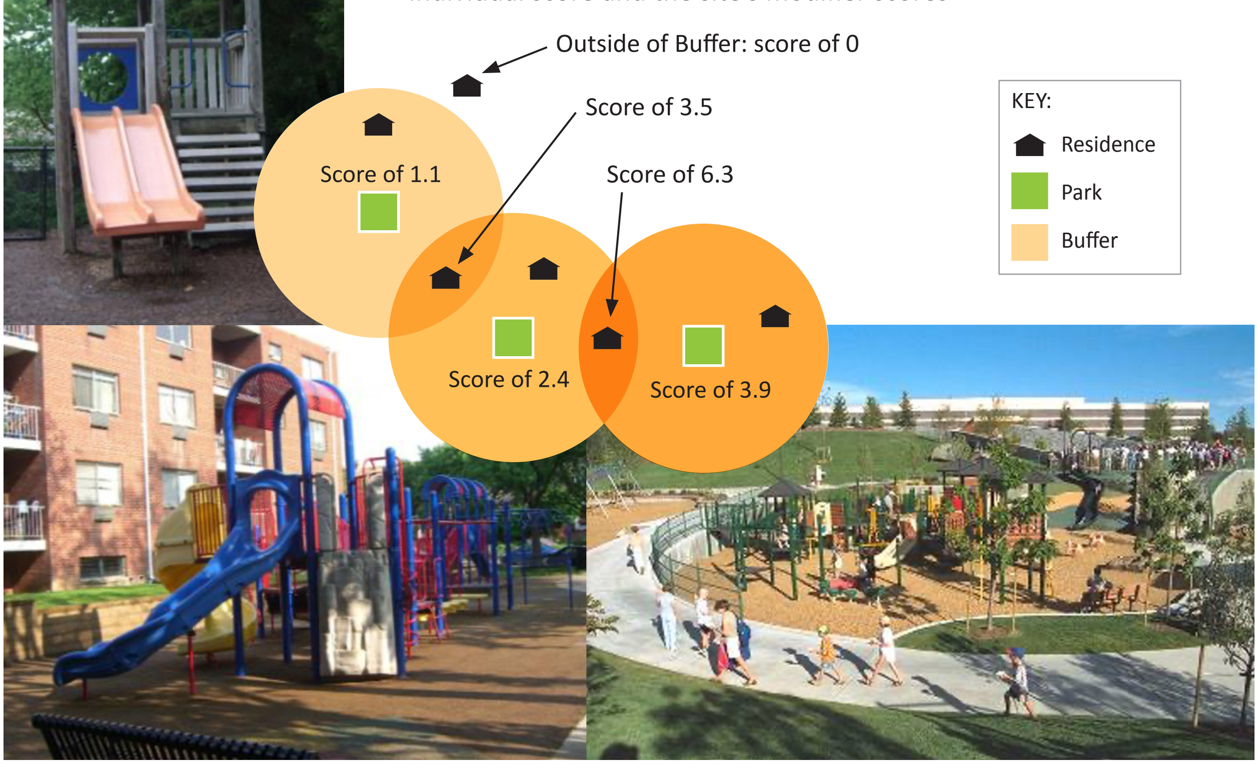
Score of 2: Meets expectations for size, condition, type of equipment

Score of 3: Has unique features or qualities beyond those expected

Scoring of Modifiers

Composite Values Mapping

Each component receives a total score based on it's individual score and the site's modifier scores



Appendix B. Sample Perspectives