Equitable Park Access in King County:
An Analysis for King County Department of Natural Resources and Parks

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RECOMMENDED COURSE OF ACTION

In order to move towards the goal of equitable park access in King County it is the recommendation of this capstone project that the King County Department of Natural Resources and Parks employ the methodology outlined in this paper for analyzing equitable park access as well as any future analysis of park amenities. This would be accomplished through the use of an access score and incorporating the existing ESJ scoring currently used. It is also advised that economic factors be considered in either access scores or demand for parks, but not both. Lastly, given the results of this analysis, it would be beneficial to generate a parks site selection using the layers of this study. The goal of a parks site selection would be to address the inequity of park access in the southwestern part of the County in the areas around Burien, SeaTac and Tukwila and work towards incorporating this park need in King County's Capital Facilities Plan.

Introduction

The purpose of this capstone project is to analyze the distributional equity change dynamics of parks in King County, Washington in 2000 and 2010. Emphasis is given to establish a methodology using GIS technology that examines park access for people of color, low-income and limited English proficiency by census block group. While this methodology may be utilized to study equity issues for other park amenities, for the purpose of this paper, only park access for the demographic of interest is being examined. The park access and equity maps and graphs in this report illustrate how the Department of Natural Resources and Parks (DNRP) in King County is meeting their goal in providing access for all people to parks and natural resources. In addition this project takes into consideration the dynamics of car ownership in relation to equitable access to parks and provides an implementation plan to the DNRP for consideration in order to help inform high value regional investments in equitable park resources.

Background

In 2008 King County launched its Equity and Social Justice initiative to address equity issues throughout King County. In 2010 the King County Council established Ordinance 16948 which reinforced the "Fair and Just" principle of the King County Strategic Plan. The "Fair and Just" principle states that the County serves all residents "by promoting fairness and opportunity and eliminating inequities" (King County 2014). This principle is important to King County as it is the foundation that shapes how the County achieves equitable opportunities for all people and communities (King County 2014).

In addition to its Equity and Social Justice initiative King County joined the Sustainability Tools for Assessing & Rating Communities (STAR) network as a pilot community in November 2012. The STAR Community Rating System's intent is to recognize sustainable communities and set targets for moving forward and measuring progress throughout. The goal of the rating system is to encourage sustainable community conditions and acts as a framework for local sustainability (STAR Communities 2014). The County is considered a Reporting Community as it continues to work towards certification.

Ordinance 16948 or the Equity and Social Justice (ESJ) ordinance "establishes definitions and indentifies the specific approaches necessary to implement and achieve the "fair and just" principle that is embedded as a core element of the goals, objectives and strategies" of the King County Strategic Plan (King County 2012). The Strategic Plan was adopted by the King County Council on July 26, 2010 and was created over the course of 18 months after being developed through collaboration with citizens and elected officials. The goals of the plan are; justice and safety, health and human potential, economic growth and built environment, environmental sustainability (King County 2014).

The following Figure 1 illustrates how inequities found in King County are linked to underlying conditions or determinants of equity which are located in the middle of the "Stream". To the left side of the stream are systems that produce an inequitable distribution of the determinants of equity among communities while to the right are areas in which government have typically focused on at the individual level. Park access contributes to physical activity, a healthier environment and arguably a safe neighborhood all of which are social, economic and physical conditions that allow people to reach their full potential (King County 2014.)

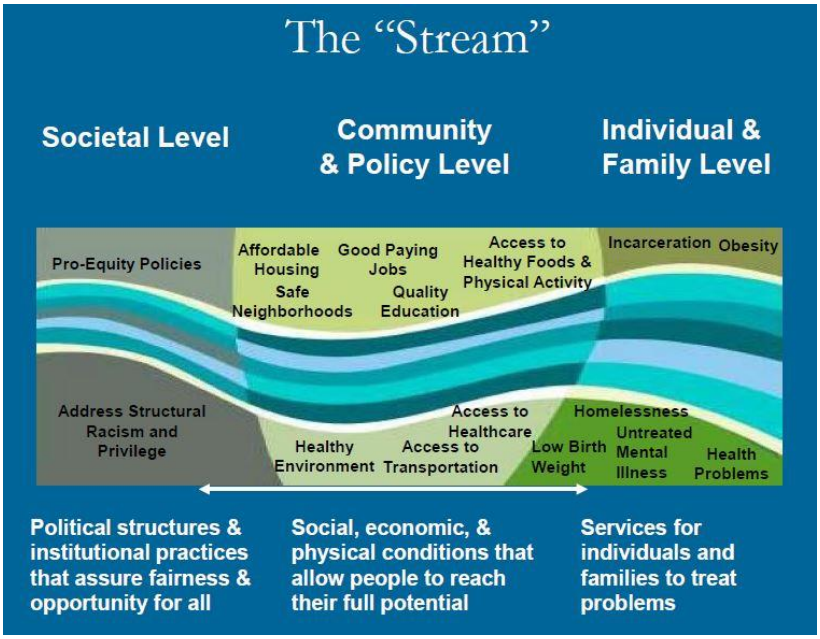

Figure 1: The Stream

The passage of Ordinance 16948 made it possible to include all agencies and branches of the County government and require them to report annually on ESJ measures to King County elected officials, employees and the public (King County 2014). The fourteen ESJ measures are:

1. Community economic development
2. Community and public safety
3. Law and justice system
4. Early childhood development
5. Education
6. Equity in county practices
7. Food systems
8. Health and human services
9. Healthy built and natural environments
10. Housing
11. Job training and jobs
12. Neighborhoods/social networks
13. Parks and natural resources
14. Transportation

DNRP is an active participant in the implementation of this initiative and reviews their programs and services for distributional equity (King County KingStat 2014). DNRP is also committed to continuous improvement to institutionalize equity in all of its services. Regarding parks and

equity, DNRP "facilitates discussions with the division and employees and the role they can play in consideration of ESJ principles in decision-making" ("Equity and Social Justice 2011 Work Plan for DNRP").

Recently, "DNRP completed an equity assessment for its major lines of business utilizing GIS to map how selected services and facilities relate to basic demographic conditions. The intent of the comparison is to help identify and address the relative fairness in distribution of benefits and burdens across their service areas, with the goal of reducing racial or income-based inequity associated with facilities and programs" (King County 2014). This capstone project's intent is to expand on DNRP's assessment of equitable park access by developing upon the methodology and addressing car ownership. Also, by comparing 2000 and 2010 demographics and park data, an additional objective is to determine if or how demographics and access to parks in King County has changed during that time period.

King County offers 26,000 acres worth of recreational experiences and is responsible for 200 parks which include ball fields, playgrounds and pools, forests, meadows and other Northwest ecosystems (King County 2014). DNRP's mission includes environmental stewardship to maintain sustainable and livable communities. In addition, the DNRP strengthens communities by providing regional parks (King County 2014). Of the 14 ESJ measures, this project aims to gauge how DNRP is meeting *Determinant 13- Parks and Natural Resources*. This is done by comparing park access for people of color, low-income and limited English proficiency in 2000 and 2010 and assessing whether there has been progress in equitable access or not.

The importance of parks has long been understood as a contributor to the physical and aesthetic quality of neighborhoods. In addition, park access has also been linked to overall community health and obesity rates. According to Zhang *et al.,* "having good access to green space, especially parks, in urban areas, is associated with increased physical activity" (Zhang *et al.,* 2011). The spatial configuration of parks, the number of parks and their spatial distribution across neighborhood areas/local regions represent the basic park access potential for local residential populations. "Thus, it is not surprising that the spatial accessibility of neighborhood parks, mainly based on park proximity and location and size, is commonly used to evaluate the contribution of parks to physical activity" (Zhang *et al,.* 2011). Given the importance of parks to our physical and emotional health, equitable access should be a principal focus for DNRP when evaluating needs and putting aside future resources for the residents of King County.

As well as contributing to an increase in physical activity opportunities, parks also contribute to people's overall level of happiness. The social-ecological systems table (Figure 3) outlines the social, biophysical and economic aspects at the various scales: United States, Washington State, King County (focal scale), communities and neighborhoods.

From the top scales, the United States and Washington State, the demographic can be significantly impacted by decision-making at the Federal and State level and whether or not programs and policies will be supported. For example, how taxes will be used to support low-

income housing, education, English as a second language programs or public parks. The effects from these decisions may lead to a shift or trend in demographics.

At the focal scale, King County, and the lower scales, communities and neighborhoods, equitable park access is desired by King County decision-makers and equity measures are being incorporated into their planning to make that possible. Parks and open spaces, if sufficiently and properly distributed, provide pollution abatement, cooling, and stormwater runoff control. They also have the potential to increase property values both in residential and commercial properties. Overall, access to parks at these levels, contribute to people's happiness and health. Figure 2 (below) illustrates parkland and population increases throughout King County from 2000 to 2010. However, the question this project addresses is whether or not those increases were equitable.

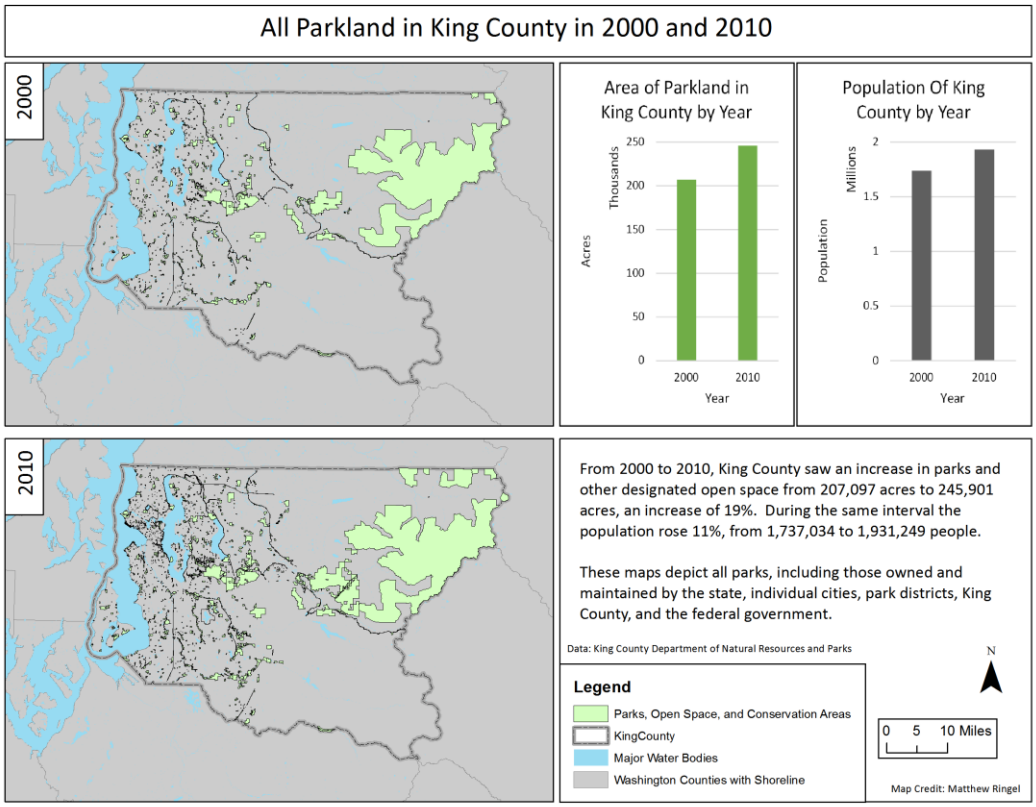

Figure 2: Park and Population Changes from 2000 to 2010

According to Chris Walker in The Urban Institute's "Public Value of Urban Parks", the traditional value of parks is for their aesthetic and recreational merits, however, the value of parks is now understood to be broader. Policymakers and the public are beginning to think of parks in terms

of “youth development, public health, and community building” (Walker, 2004). Walker goes on to explain about the “new view” of urban parks and their contributions which include the following:

- “helping youth choose rewarding paths to adulthood by providing programs and opportunities to build physical, intellectual, emotional, and social strength;
- helping new entrants to the workforce find productive jobs by offering decent, entry-level employment opportunities in the community;
- helping community residents improve their health by providing a place to enjoy fresh air and exercise; and
- helping citizens join together to make their communities better, by encouraging them to participate in park planning and management” (Walker, 2004).

This is not an all-inclusive list of the contributions parks can make to a community, but recognizes that parks are important to achieving greater urban policy objectives which aid in strengthening the communities where the parks are located. This “new view” is important as it addresses amenities that everyone should have equitable access to (Walker, 2004).

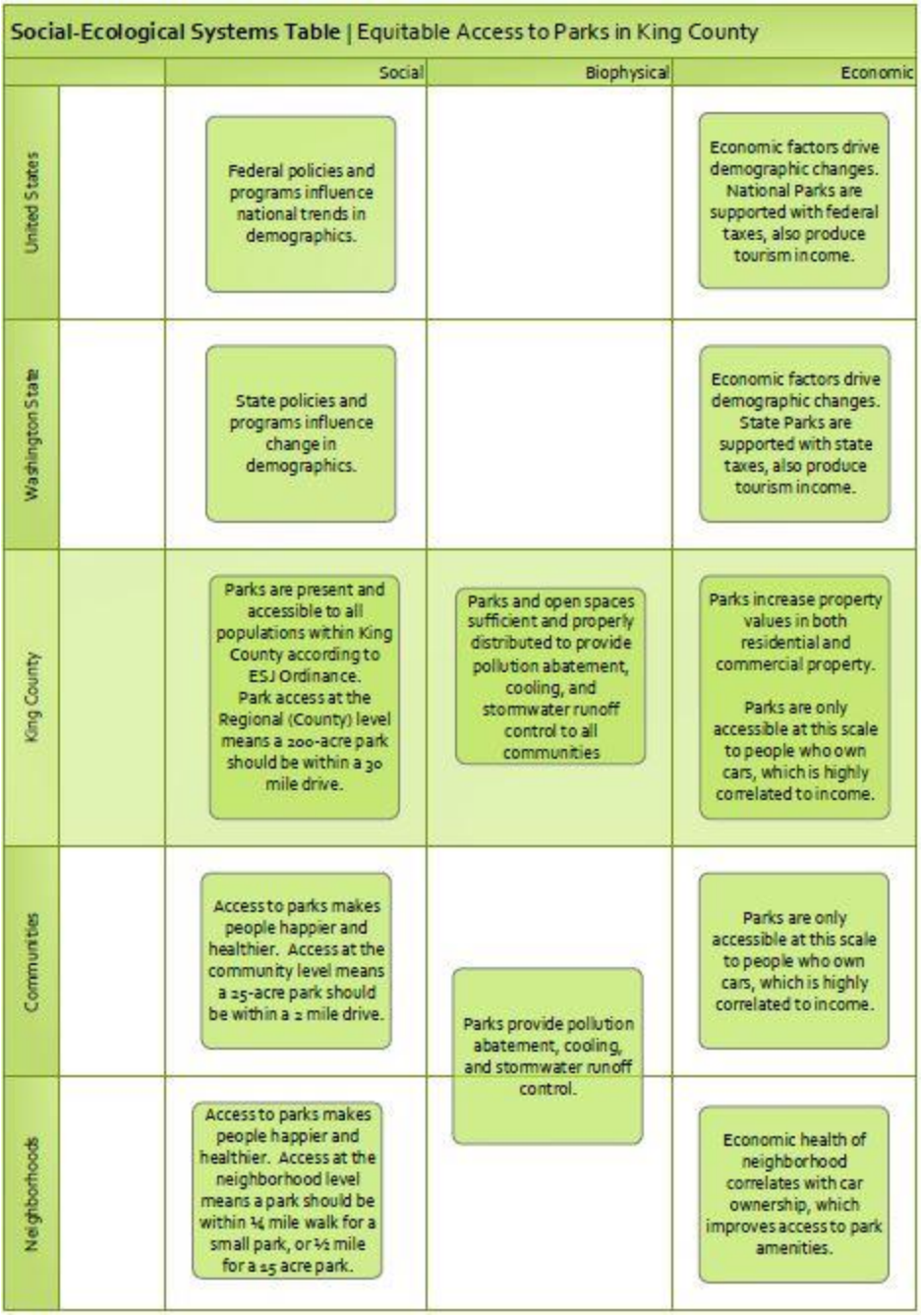

Figure 3: Social-Ecological Systems Table

Car ownership plays an integral part in this system and will be discussed more in relation to the thresholds matrix in Figure 3. At the county and community level parks are only accessible largely to people who own vehicles and vehicles are highly correlated to income. At the neighborhood level the economic health of the neighborhood correlates with car ownership. However at this level, which is often urban, there is a higher density of the focus demographic (low income, limited English proficiency and people of color) who often do not own vehicles

and thus have limited access to parks. Therefore it is important for King County to invest in access to neighborhood or small urban parks intended for this underserved population.

Even when one does not reside near a park or necessarily use a park, Walker notes one study that shows they are still valued as, "three-quarters of the respondents who said that they did not themselves use parks nonetheless reported receiving benefits from them, with many of those benefits tied to opportunities for children" (Walker, 2004).

"Creating equitable access to parks and nature is also essential for effective regional growth planning and for fostering a commitment to stewardship of the region's natural resources" (Coalition for a Livable Future n.d.). A park's proximity is essential to equitable access. Proximity is key to regular park usage and for a community to receive direct benefits. For the purpose of this analysis, a thresholds matrix (Figure 4) was developed to visualize the thresholds in our social-ecological system. The controlling variable of this system was determined to be access to parks. From researching equitable access to parks, proximity was found to be a significant controlling variable that determines the thresholds existing in the social, economic and biophysical aspects. Elements that contribute to equitable access to parks are distance to parks and car ownership.

Appropriate equitable access was determined to be parks within a certain size and distance from our three scales of interest: King County, community and neighborhoods. According to the ESJ ordinance, parks should be present and accessible to all populations within the County. For the purpose of this analysis it has been determined that parks should be of a 200 acre size and within a 30 minute drive at the county scale. At the community scale, access to parks should be within a 2 mile drive from a 25 acre park. Lastly access to parks at the neighborhood scale means the ability to walk ¼ mile to a small park or ½ a mile to a 15 acre park. Connecting to the social aspect as a loss or gain in the communities and neighborhoods scales is significant as greater access to parks increases overall happiness and quality of life.

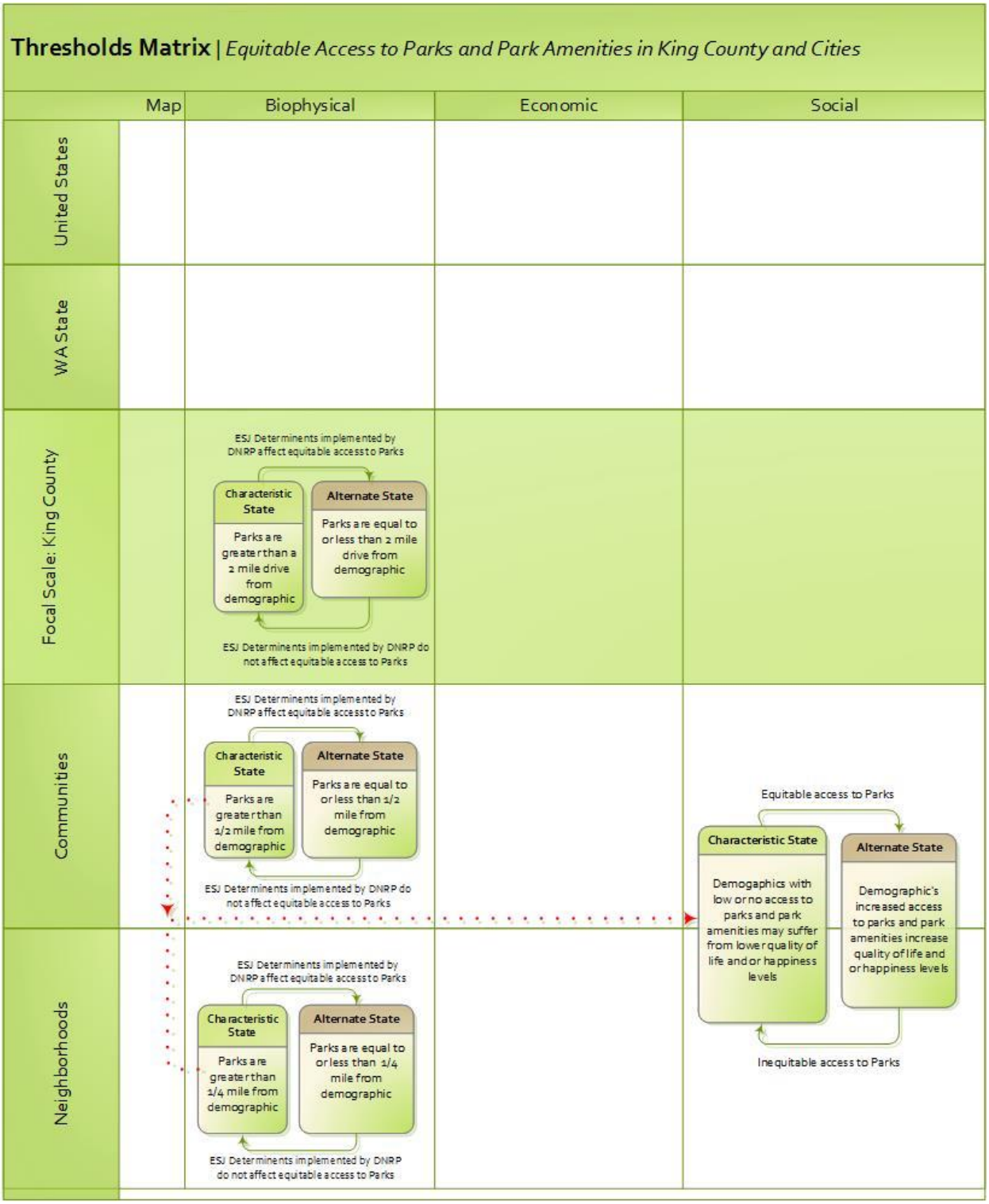

Figure 4: Thresholds Matrix

Problem Statement

Based on the ESJ ordinance, DNRP is tasked with providing and measuring equitable services and access for all people and communities throughout King County. DNRP would like to improve their methodology to assess equitable park access and include car ownership in the analysis. DNRP would also like to expand upon their current measures to evaluate equity for various other services and facilities using existing GIS data.

Project Goals

The first goal of this project is to collect appropriate data for our analysis in a geodatabase and design a methodology to measure park access in comparison to our demographic of study in both 2000 and 2010. The methodology should incorporate a distance threshold in relation to park access, as well as car ownership and is justifiable in how it represents equity.

A second goal will be to provide static maps illustrating park access in comparison to underserved populations in King County. Underserved populations for the purpose of this study are people of color, low-income and limited English proficiency. This will be a comparison of park and census data in 2000 and 2010 to determine if there has been improvement or if more work on providing equitable park access should be done. In addition, two web maps will be combined in ArcGIS Online to create a story map illustrating different range service areas from parks in King County based on 2000 and 2010 parks data (Figure 5).

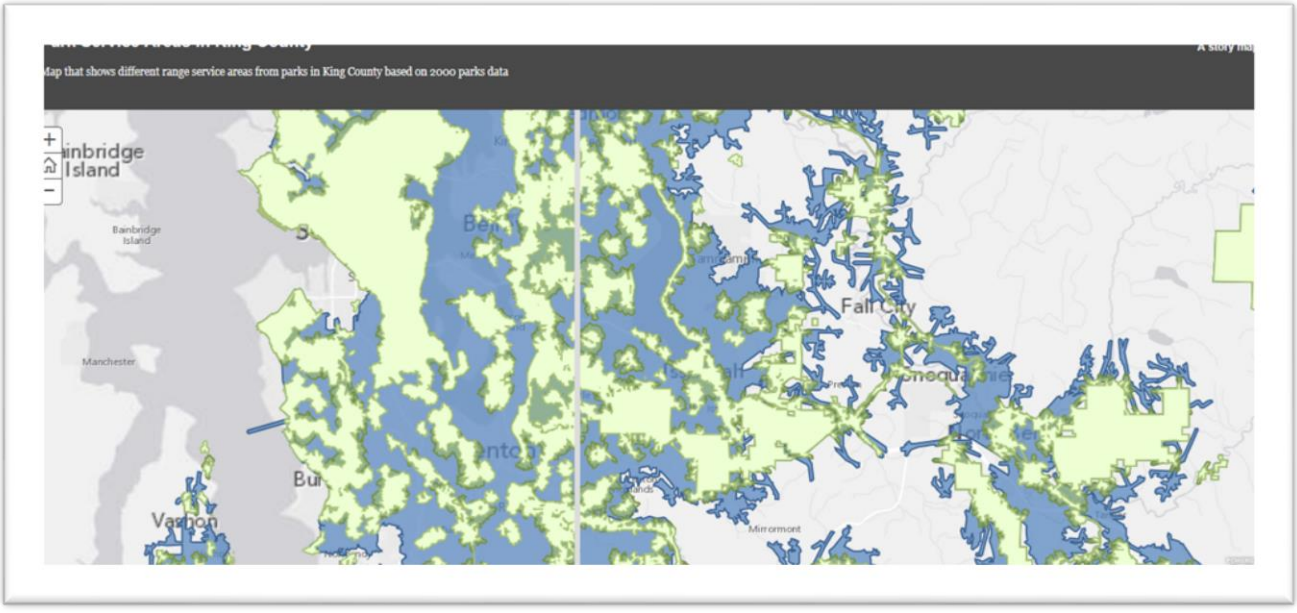

Figure 5: Story Map

Lastly, a goal of this project will be to offer an implementation plan. This plan will outline which areas in unincorporated King County, given their demographic of interest, are currently underserved in access to parks and if there are any trends from 2000 to 2010. Furthermore, existing King County GIS data will be surveyed and appropriate data will be suggested for further study on equitable access given the methodology developed for this project.

Objectives

In order to achieve the first project goal, the primary focus was to establish a geodatabase and develop a robust methodology once the social-ecological system was outlined and the thresholds were determined. Regarding appropriate thresholds, it was decided that general guidelines were appropriate given the varying scales of the analysis (county, community, and neighborhood) and were based on recommended guidelines by the National Recreation and Parks Association (NRPA).

Having done extensive research on equitable park access, social and health benefits to society relating to park access, as well as available spatial data availability, our third goal will be achieved through an implementation plan and course of action which will be recommended to the project sponsor.

Scope

The scope of this project originally included an analysis of our demographic and access to park amenities such as indoor park facilities and also athletic fields. However, midway through the project it was determined that developing a strong methodology and focusing on equitable access to parks would be the best use of time. Defining equitable access in terms of proximity and size of park was challenging. After significant research it was decided that the National Recreation and Parks Association (NRPA) standards for park acreage was the best guideline. It should be noted that this document titled the "Yellow Book" was last revised in 1983 and many cities and communities choose a different methodology for their standards such as a "percentage of land area in a proposed subdivision to be dedicated for parks and/or open space" (MRSC 1994). It should be noted that this project's analysis is at the County level and the guidelines will be applied at the County scale. Lastly, this project takes into account that access means something different for those who own a vehicle and those who do not which is a significant factor in equitable access.

Data and Data Limitations

Data requirements included King County census data on the demographic of interest- people of color, low-income and limited English proficiency, car ownership, and park data all at the

census block level both in the year 2000 and 2010. Software utilized was ArcMap 10.2 to complete the spatial analysis. One primary limitation regarding data was a lack of 2010 census data for car ownership in order to perform a comparison from 2000 to 2010 and implement car ownership for equitable access to parks, however, a way to incorporate car ownership into this analysis is offered should that data become available in the future.

Out of Scope

For the purposes of this project several items were deemed to be out of scope. First, it was decided that specific amenities to a park that different demographics may demand such as whether or not picnic shelters or certain field types exist would not be considered. Second, this project did not encompass an analysis on any park siting recommendations.

Deliverables

Deliverables to Project Sponsor include the following items:

- ESRI Map Package and editable map layout
- Geodatabase
- Social and ecological map
- Social and ecological systems table
- Social and ecological thresholds matrix
- Business case for future implementation

Various methods of analysis regarding equitable park access were researched, but not pursued for several reasons. Including the current methodology used by DNRP which does not take into account population density, the following studies and methods were explored:

The Delaware Department of Natural Resources and Environmental Control, Division of Parks and Recreation (DPR) analyzed communities served by parks to determine future recreational facilities needs throughout the state in 2013. The method employed by DPR was to create travel buffers to measure population served by parks through walking, transit or driving and calculate travel sheds, but did not encompass census demographic data other than population by census tracts (McGlone 2013). For our purposes this methodology was not sufficient as our project was not incorporating access to parks via transit.

Another method of analysis employed by the Puget Sound Regional Council (PSRC) was for their opportunity mapping wherein they used distance to nearest park for each census tract as one component of their Environmental Opportunity score (Puget Sound Regional Council 2014).

However, this analysis was applied solely to urban areas. One would expect the distances to parks to be greater in less urbanized areas, without reflecting less "opportunity" as it is traditionally understood. Additionally, this analysis does not take into account how much park space is available. For example, a very small park such as a single basketball court which is close to a high density urban area would provide a high opportunity score while not providing actual opportunity to serve many people.

Lastly, methodology employed by Ming Wen et al. in a study of spatial disparities in the distribution of parks and green space for black, Hispanic and low-income residents across the entire United States (excluding Hawaii and Alaska) was considered. The study employed several access measures to determine spatial access to parks measured by population-weighted distance to the seven closest parks and then performing a linear mixed regression model to examine associations (Ming Wen 2012).

Design and methods

Scale

The scale of this analysis presents unique challenges. Any methodology used to measure park access on the scale of King County needs to take into account everything from a playground on the corner of the block at the finest scale to large designated wilderness areas at the coarsest scale. Each of the types, or scales, of access represents a different kind of opportunity. A person who owns a car and lives within walking distance to a small park, within a longer walk to a neighborhood park, and within a short drive to a community and regional parks has more opportunity than someone who doesn't own a car and doesn't live within walking distance to any parks. Thus, any analysis of equitable access has to take into account more than simply the distance to the nearest park because that same distance could mean access to one person and no access for another.

With the goal of the analysis being to capture the finest scale access of nearby parks, the analysis needs to be done at the finest scale possible in order to properly represent those places that do not have as many types of access as others. However, in also capturing equitable access, and not just equal access, the socio-economic status of those with and without access should be considered. Therefore, the finest scale that the analysis can be performed at is the census block group level. Census block groups have aggregated income and ethnicity data that will make the analysis more robust.

Opportunity Stacking

The first step in creating the park access score was to create a network dataset. A network dataset is a necessary component of a service area analysis. A car transportation network shape file was downloaded from the King County GIS Data Portal and converted to a network dataset using ArcMap's New Network Dataset wizard.

Once the network dataset was created, the next step was to create the service areas for each type of access. Service areas were created using the Network Analyst extension in ArcMap and are specifically designed to assess accessibility. Service areas were created for each of the four levels of park opportunity recommended by the National Recreation and Parks Association seen in Table 1, with each lower level of opportunity being inclusive of the park sizes at the higher levels (NRPA 2014). That is, the first level of access, being able to walk a quarter-mile to a park is not limited only to mini-parks, but is applicable to a park of any size. The second level of access, being able to a walk a half-mile to a park of at least 15 acres in size, applies to parks of any size, as long as they are greater than 15 acres. In this way, if a person can walk a quarter-mile to a single park that is at least 15 acres they will be considered to have both the lowest two forms of access. This is in comparison to a person who lives more than a quarter-mile but less than a half-mile from the same park. This other person has access to the park, but must walk approximately twice as far. This logic captures the difference between someone looking for a destination for short walk, perhaps while pushing a stroller and someone looking for specific amenities, such as a ball field, which are only available at parks larger than mini-parks. See Figure 6 and Figure 7 for the service areas created for walking distances. The driving distance service areas are not shown.

Table 1: NRPA recommendations for park quantity and accessibility

Park Type	Acres/1000 Population	Minimum Size	Service Area Radius
Mini-Park	0.25-0.50	1 acre or less	.25 mile/5 minute walk
Neighborhood Park	1.0-2.0	15 acres	.5 mile/12 minute walk
Community Park	5.0-8.0	25 acres	1-2 miles/5 minute drive
Regional Park	Variable	200 acres	30 miles/1 hour drive

After computing all four different types of service areas a spatial join was used to sum the four different types of park access for each census block group. A census block group is considered to have access if the block group's centroid is within the service area. This makes the analysis more accurate for smaller, more regular block groups and less accurate for larger or irregularly shaped block groups. For example, a block group could be shaped such that the centroid does not fall within the block group itself. For these areas this type of analysis will not accurately represent the block group's access. Additionally, there is the potential for some block group's

access to be overestimated if the service area overlaps nothing but the centroid and to be underestimated if the service area overlaps most of the block group, but does not contain the centroid itself. For an example of the latter, consider the block group adjacent to the northeastern border of King County. This block group contains large tracts of protected federal land (with hiking trails and other recreation options). However, the service area does not contain the centroid of the block group, and therefore the block group is considered to have low access.

This methodology can be visualized as stacking up these four different kinds of park access opportunity on each census block group. An area with more park access opportunities is represented by overlapping (stacked) service areas. This represents the difference between having many different kinds of park access, and a simple binary "park/no park" type of access which is often the result of a simple buffer analysis or one that uses distance to nearest park. By representing the different types of access, one can begin to see true differences in park access equity.

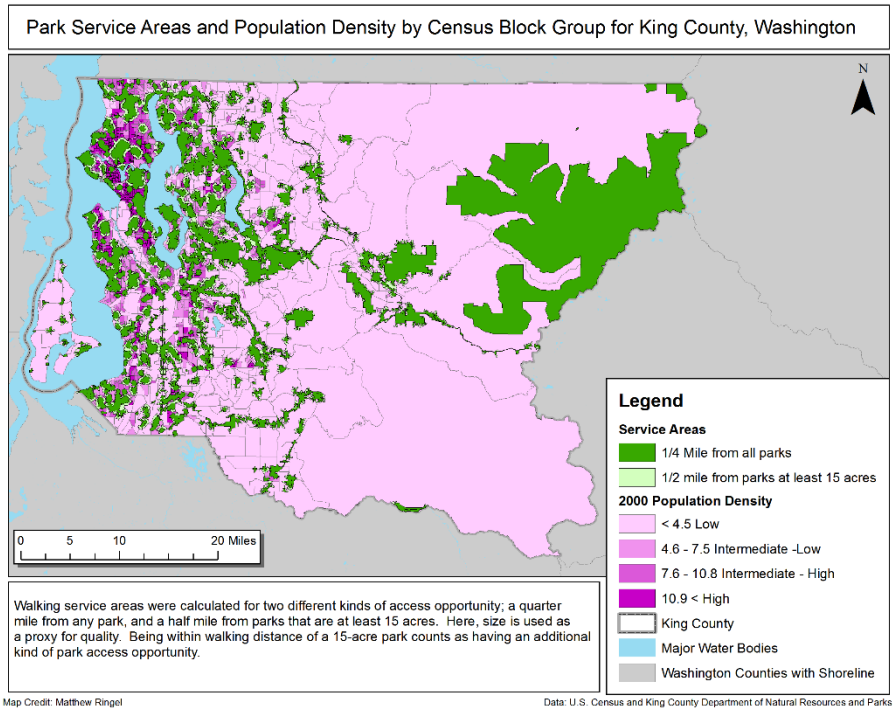

Figure 7: Service area calculations for walking distances to parks for 2000 park data

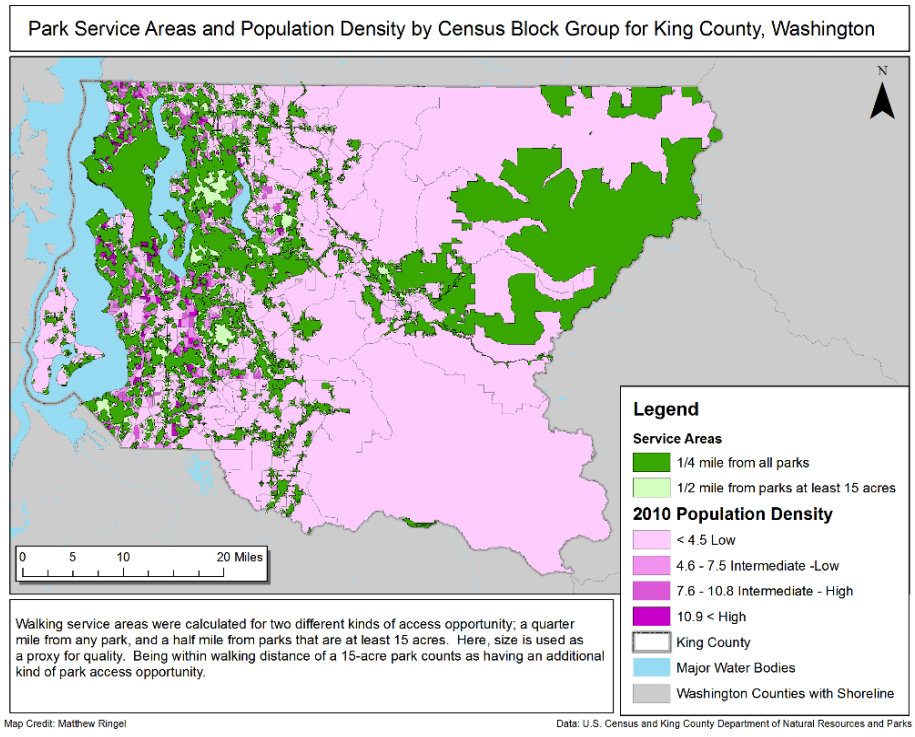

Figure 6: Service area calculations for walking distance to parks for 2010 park data

The resulting score for each census block, deemed a Park Access Score, has a theoretical range of zero to four. In the case of King County, all areas of the county are within a 30-mile service area of a park with an area of at least 200 acres. Thus, the actual Park Access Score range is one to four, where a score of one represents a census block group that is not within a quarter-mile of any park, is not within a half-mile of a park of at least 15 acres in size and is not within 2 miles of a park of at least 25 acres in size. The Park Access Scores for 2000 and 2010 are shown in Figure 8 and Figure 9.

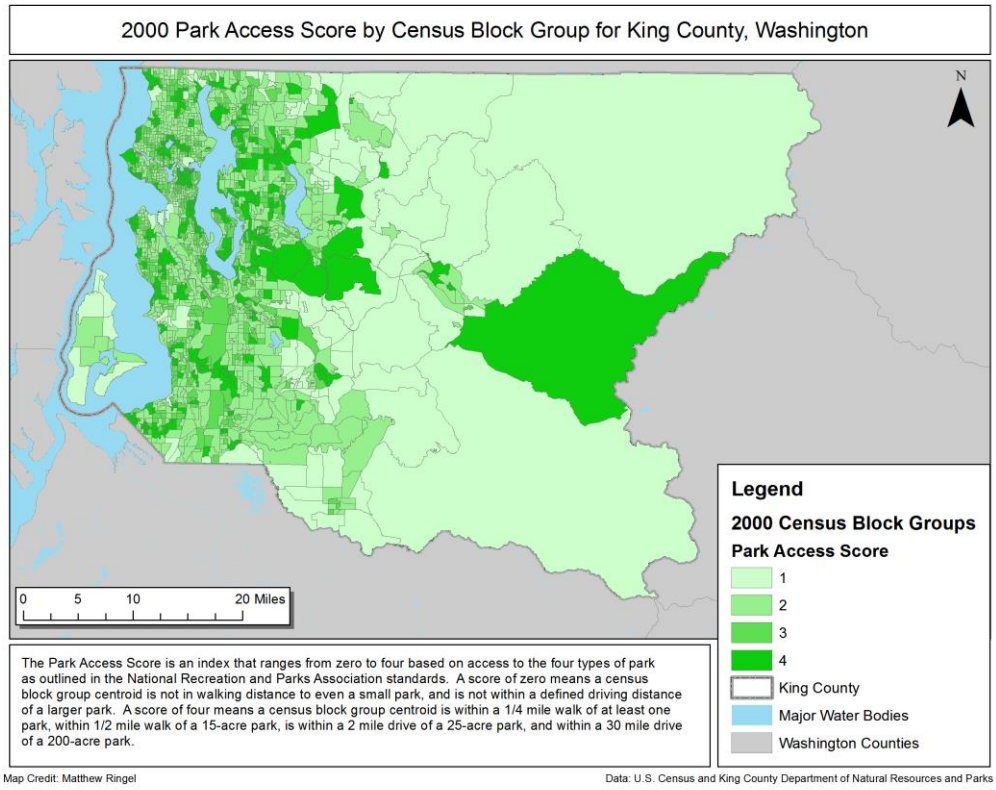

Figure 8: Census block group Park Access Scores for 2000

Once the Park Access Scores were calculated for each census block group they were combined with demographic data obtained from King County Department of Natural Resources and Parks. Previous equity and social justice analyses done by the Department have used a consolidated demographic score called an Equity and Social Justice Score, or ESJ Score). The Equity and Social Justice Score combines equal weights of income, people of color, and English proficiency. A higher score indicates that a census tract has more people of color, is lower income, and lower English proficiency whereas a low score indicates fewer people of color, higher income, and higher English proficiency. More details about how this score is calculated can be found in Appendix A.

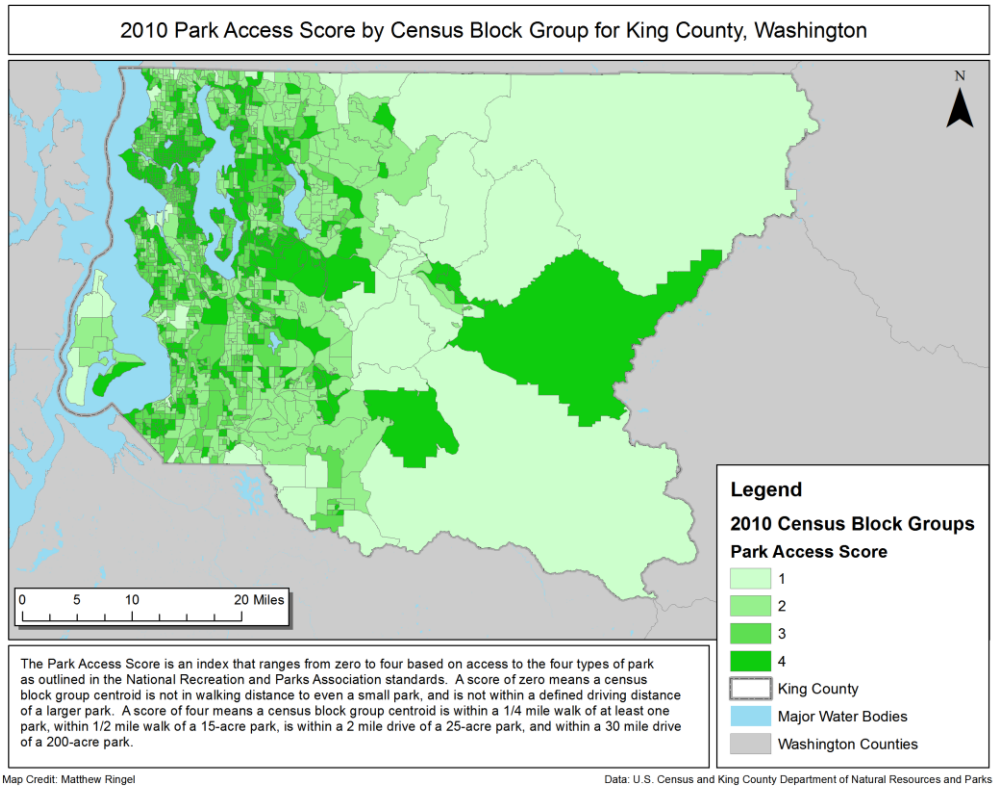

Figure 9: Census block group Park Access Scores for 2010

Results

DNRP is tasked, by the Equity and Social Justice Ordinance, to improve levels of equity and social justice in the siting and delivery of parks and related services. In order to determine the improvement in park access equity, Park Access Score data and ESJ Score data were tabulated and displayed to show trends in park access.

Year-to-year

In Figure 10 the total population of each census block group Park Access Score is displayed. The number of people with low access to parks (Park Access Score of one or two) decreased from 2000 to 2010 while the number of people with high access (Park Access Score of three or four) increased. The mean Park Access Score for all census block groups went from 2.57 in 2000 to 2.96 in 2010.

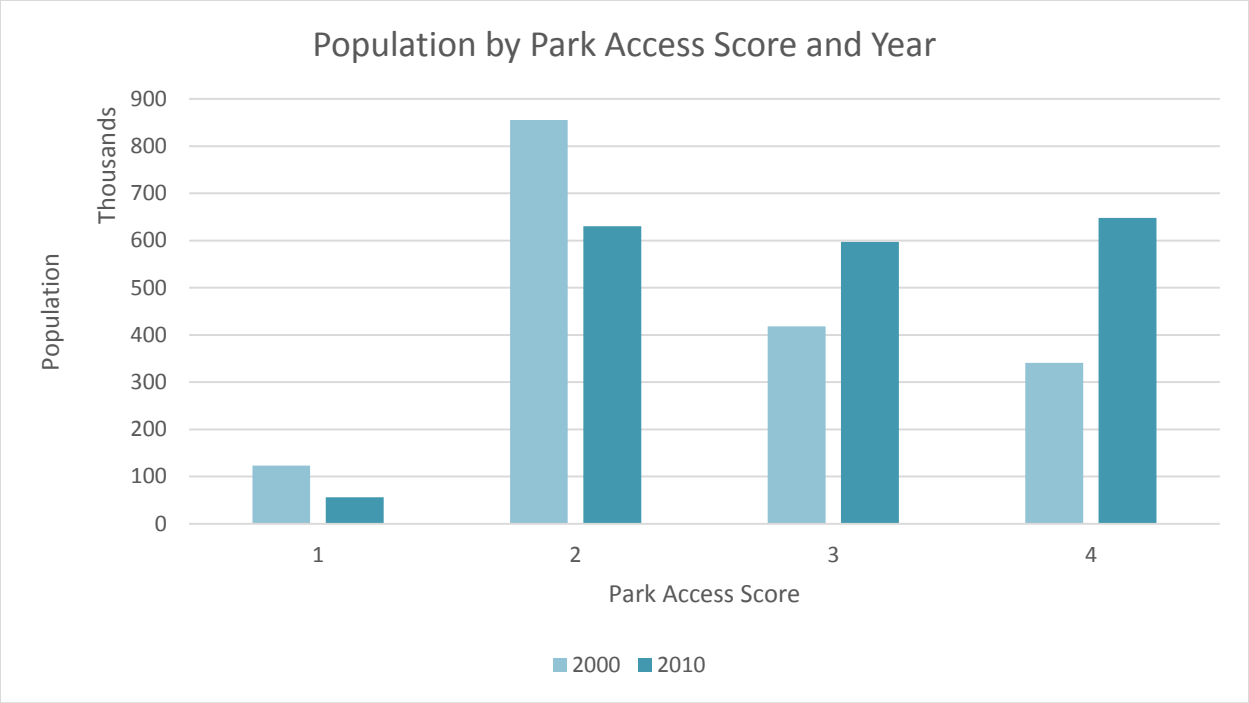

Figure 10: Population by Park Access Score and year

Park Access Distribution by ESJ Score in 2000

In 11 the population in 2000 is summed for each census block group and each discrete Park Access Score then displayed by ESJ Score bin. The ESJ Scores were split into quartiles, which was functionally the same as natural breaks using four classes instead of five. The linear distribution and discrete steps of the ESJ Score data made quartiles a better fit than natural breaks with five classes, as the variance in class size is lower using quartiles. The existing work by King County using ESJ Scores classified them into five classes using natural breaks, which is usually preferred because it produces a median class whose members are near the median, with the other four classes being either above or below the median. By sacrificing the median class and going to four classes the numbers assigned to each class are more similar, justifying the use of quartiles.

Of those with the lowest Park Access Score, the dominant ESJ Score is also low, indicating that this group is comprised mostly of high income, high English proficiency, and a lower percentage of people of color. The Park Access Score with the largest corresponding population is two. Within this population there is no discernible trend of corresponding ESJ Score. The highest two Park Access Scores have roughly equal populations, again with no discernable demographic trend. That is, while Park Access Scores are not evenly distributed among the population of King County, the uneven distribution is not at the expense of those with high ESJ scores.

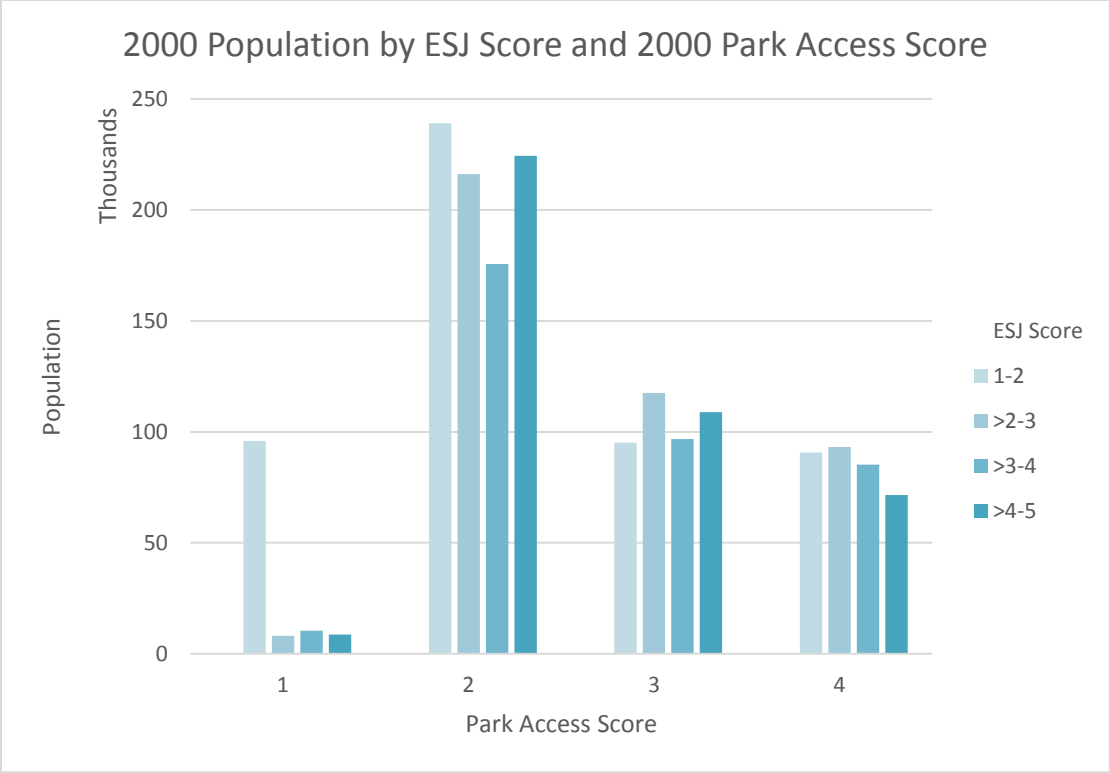

Figure 11: Population in 2000 by ESJ Score and Park Access Score

Park Access Distribution by ESJ Score in 2010

In **Error! Reference source not found.**12 the population in 2010 is summed for each census block group and each discrete Park Access Score then displayed by ESJ Score bin. The same ESJ Score quartiles are used as in the previous figure as this classification produces classes with a low variance in members. The lowest Park Access Score population shows the same trend as in 2000 but is much less pronounced. Park Access Scores of two, three, and four, however, show marked difference from 2000. Whereas in 2000, the population with Park Access score of two was much greater than any other score, 2010 has scores of two, three, and four with roughly equal populations. There are discernible demographic trends, however, within the two highest categories of park access. Among the population that has the highest Park Access Score, four, there are much more people with a low ESJ score than a high ESJ Score. This indicates that the people with the best park access tend to be predominantly white, high income, and English proficient. As stated earlier in this section, the mean Park Access Score for all census block groups in 2010 is 2.96. This indicates that people with a Park Access Score of three are above the mean, but barely. Of these people, most of them have a high ESJ Score, with the number of people dropping off as the ESJ Score decreases.

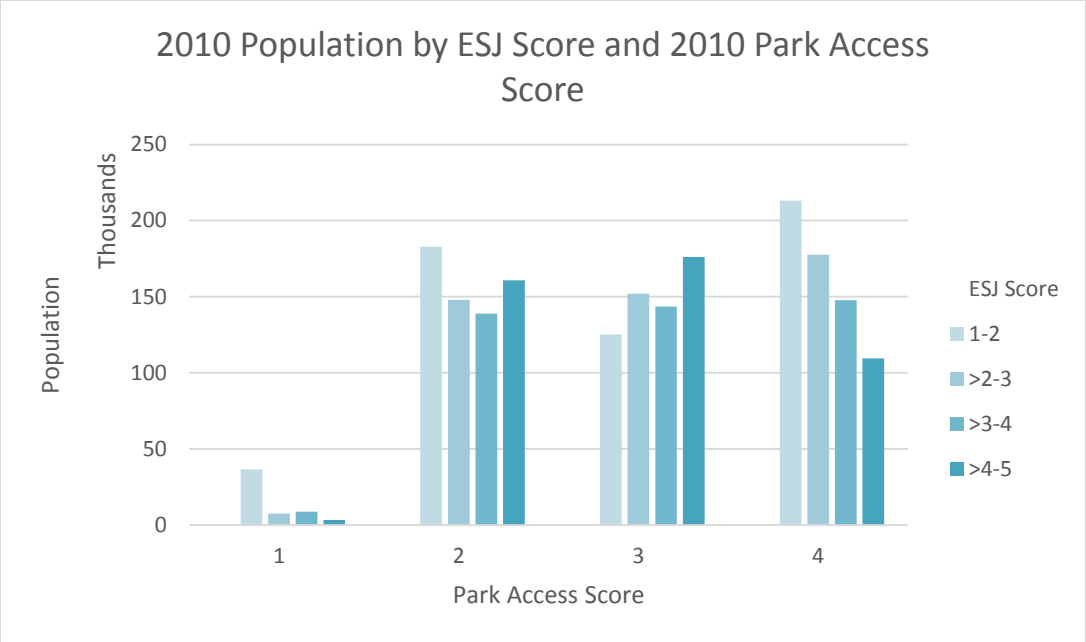

Figure 12: Population in 2010 by ESJ Score and Park Access Score

Disentangling Demographic Changes from Increase in Park Service

The previous results show the combined effects of two simultaneous dynamics within King County. The first dynamic includes all the demographic changes due to immigration to King County, emigration from King County, intra-county migration, births, deaths, and changes in income. The second dynamic is the increase in parks within King County at all levels, from neighborhood parks to federally protected wilderness areas. In **Error! Reference source not found.**13 the population from 2000 was held constant and tabulated according to the Park Access Score at the 2010 service level. Comparing this figure to 11 shows the change in population with different Park Access Scores due only to the increase in parks. The number of people living in census block groups with a Park Access Score of four increased by 76% while the number of people living in a census block group with a Park Access Score of one decreased by 60%. The total number of people in census block groups of different Park Access Scores is summarized in Table 2.

Table 2: Population by Park Access Score for 2000 and 2010, holding Population at 2000 Levels

Park Score	Population 2000	Population 2010	Percent Change
1	123,132	48,692	-60%
2	855,051	558,353	-35%
3	418,297	529,071	26%
4	340,554	600,918	76%

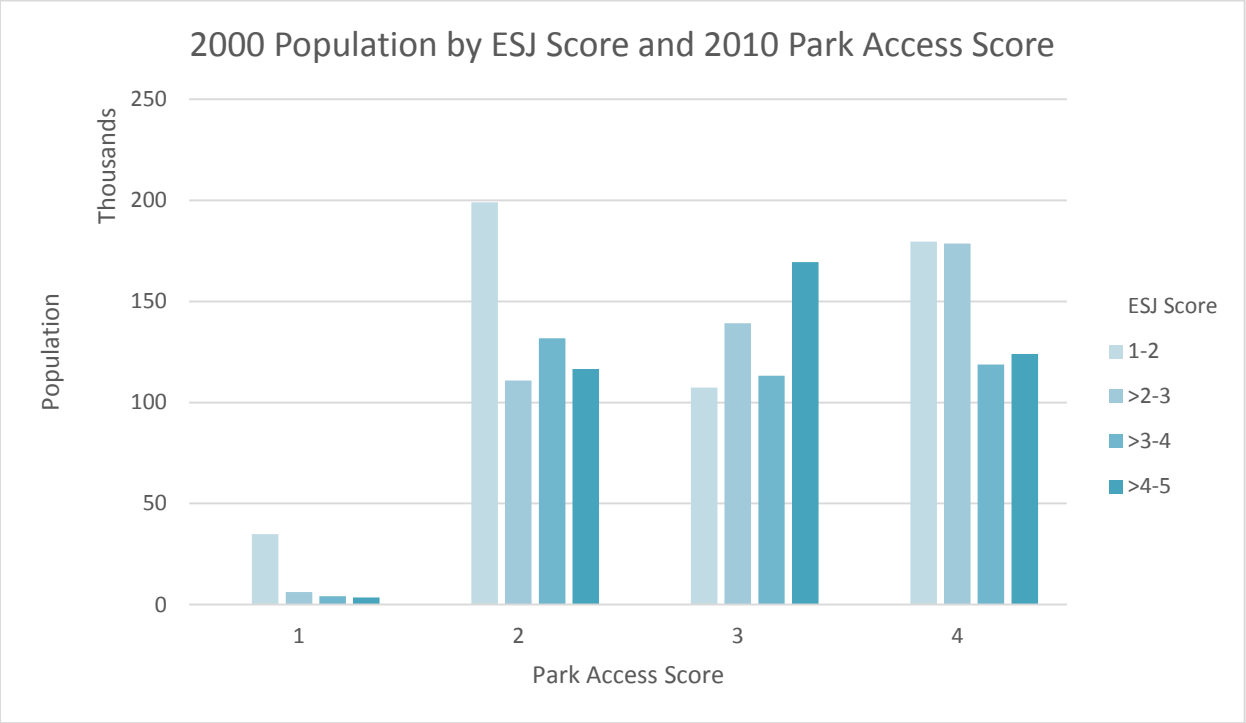

Figure 13: Population in 2000 by ESJ and 2010 Park Access Score

Another way to show the trend is by comparing the mean Park Access Score for each class of ESJ Score. Table 3 and Table 4 show these results for 2000 and 2010. The mean Park Access Score increased for all ESJ Score classes from 2000 to 2010. However, while the mean Park Access Score for those with the lowest ESJ Scores was the lowest of any ESJ Score class in 2000, the lowest mean Park Access Score in 2010 was for those with the highest ESJ Score. The largest gains in Park Access Score were made by those with the lowest ESJ Score. The single largest gain was made by those with an ESJ Score from 1 to 2, increasing by 0.58 from 2000 to 2010. Meanwhile, the smallest gain was made by both those with an ESJ Score from 3 to 4 and from 4 to 5, with a gain of 0.28.

Table 3: Tabulated Results for 2000

ESJ Score	Park Access Score				Total by ESJ Score	Mean Park Access Score of Population
	1	2	3	4		
1-2	95967	238987	95177	90678	520809	2.35
>2-3	8098	216100	117514	93161	434873	2.68
>3-4	10357	175615	96716	85213	367901	2.70
>4-5	8710	224349	108890	71502	413451	2.59

Total by Park Access Score	123132	855051	418297	340554	

Table 4: Tabulated results for 2010

ESJ Score	Park Access Score 1	2	3	4	Total by ESJ Score	Mean Park Access Score of Population
1-2	36531	182775	125196	213201	557703	2.92
>2-3	7526	147967	151954	177593	485040	3.03
>3-4	8834	138860	143582	147732	439008	2.98
>4-5	3268	160691	176140	109399	449498	2.87
Total by Park Access Score	56159	630293	596872	647925		

Discussion

This analysis demonstrates that access to parks improved overall for everyone in King County from 2000 to 2010, and while a rising tide lifts all boats, in this case some boats were lifted more than others. Holding population constant, the Park Access Score improved more for populations with a low ESJ score than it did for populations with a high ESJ Score. Taking into account demographic changes, the inequity grew even more. In 2010, of those with a Park Access Score of four, there are almost twice as many (95% more) people with an ESJ Score from one to two than there are with an ESJ Score from four to five. While the trends for other Park Access Score categories are less dramatic, this alone is evidence of inequitable access in King County.

This raises the obvious question of finding those pockets in King County that are both underserved by the park system and have high ESJ Scores. The spatial layers produced in this analysis can be used for this purpose, something that is typically called a site selection analysis. An example site selection analysis finding such pockets that are within the jurisdiction of King County Department of Natural Resources and Parks, unincorporated King County, is described later in this report.

The analysis presented heretofore has not incorporated car ownership. While car ownership data at the census block group level is available for the 2000 census, it is not yet available for the 2010 census. However, this analysis was designed in such a way as to easily incorporate car ownership data. Each of the types of park access opportunity presented in this analysis can be weighted. Two of the four types of opportunity represent one's ability to walk to a park, and could be weighted by a neighborhood's walkability index, for example. If a park is within

walking distance, but walking there means traversing a busy arterial with no sidewalks, it is reasonable to consider that type of access to be lesser access than walking to a park along a greenway, for example. Likewise, the two types of park access opportunity that represent driving can be weighted according to car ownership rate per household, for example. This would further differentiate between areas that are within driving distance to a park where access to cars is high and those where access to cars is low. A word of caution, however. Car ownership is likely highly correlated to income. Weighting the park access score with car ownership, and then expressing demand as being where income is low would, in effect, be "double counting" income. It is recommended that economic factors be considered in either Park Access Scores, or demand for parks, but not both. An example of the latter would be to compute the Park Access Score without using any economic weighting (such as car ownership) but then selecting potential sites for park development based on low Park Access Scores and low car ownership rates.

This analysis similarly looks at only the existence of parks, and by doing so uses park size as a proxy for quality of park. If data is available for specific park amenities, and the demand for said amenities, a similar analysis could be done for different demographics' demand for these amenities. For example, if one had data suggesting that a certain demographic had a particular demand for a certain type of park amenity, then one could map service areas for that particular amenity and compare it to the demographic demand for that amenity. However, such an analysis is out of the scope of this document.

The car transportation network file downloaded from the King County GIS Portal and used for the network analysis (services areas) includes only streets designed for car travel and does not include sidewalks and other paths that are not accessible to cars but are accessible to pedestrians. The network dataset created from this car transportation file was used for both pedestrian and car service areas. An alternative would be to use a simple buffer around each park for the different walking radii, but this would have its own problems, e.g. a buffer spanning a lake or a highway that is not traversable as a pedestrian. The walking service areas based on the road network dataset are thus not meant to be exact, but to meet the needs of the analysis at the scale of census block groups.

Site Selection

A sample site selection analysis follows. Given the previous results, it is recognized that park access shows inequity. Equity of access could be improved by siting a new park where both current park access is low and the ESJ score is low. Assume also that the park must be placed in unincorporated King County. First, only those census blocks groups that are within unincorporated King County are selected. Then, of those block groups, a site can be selected based on chosen factors and weighting. A quick way to find areas with low Park Access Scores and high ESJ Scores is to use a bubble plot as shown in **Error! Reference source not found.**14.

Consider the plot in quadrants. The bottom right quadrant reflects those block groups with a low ESJ Score and a high Park Access Score. Those need not be considered as they are wealthy and have great access to parks. The top right quadrant display those block groups with a high Park Access Score and a high ESJ Score. These block groups also already have a higher than average Park Access Score, and need not be considered. The bottom left quadrant are those with low Park Access Score, so are worth considering, but also have low ESJ Scores, and are thus predominantly white and higher income. The top left quadrant, however, are all those block groups that have low Park Access Scores and high ESJ Scores. In other words, this is the quadrant that DNRP would want to serve better. None of the block groups in this quadrant have large populations. Population as a weighting factor can confidently be thrown out as they would all be weighted roughly equally. Selecting all of the block groups in this top left quadrant yields 15 potential sites which are shown in **Error! Reference source not found.**15.

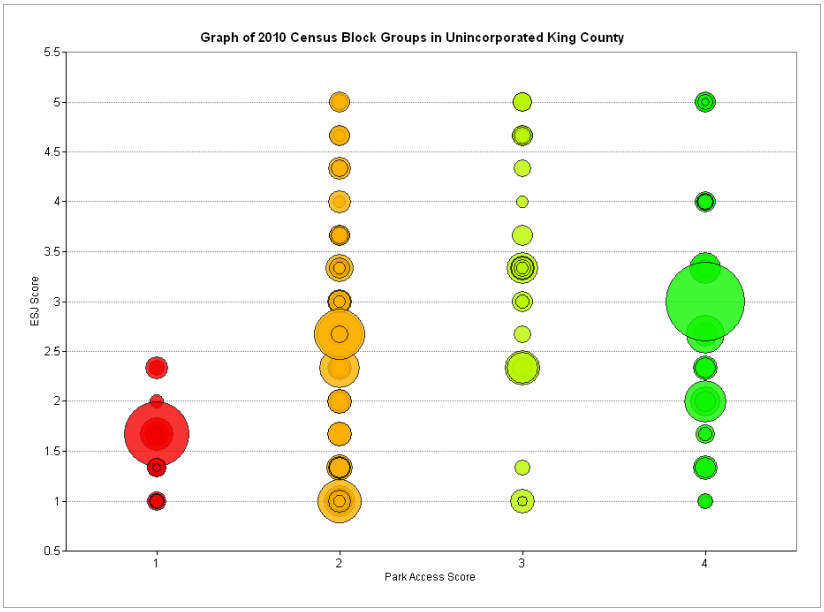

Figure 14: Bubble plot of census block groups showing ESJ Score vs. Park Access Score, with size scaling by Population

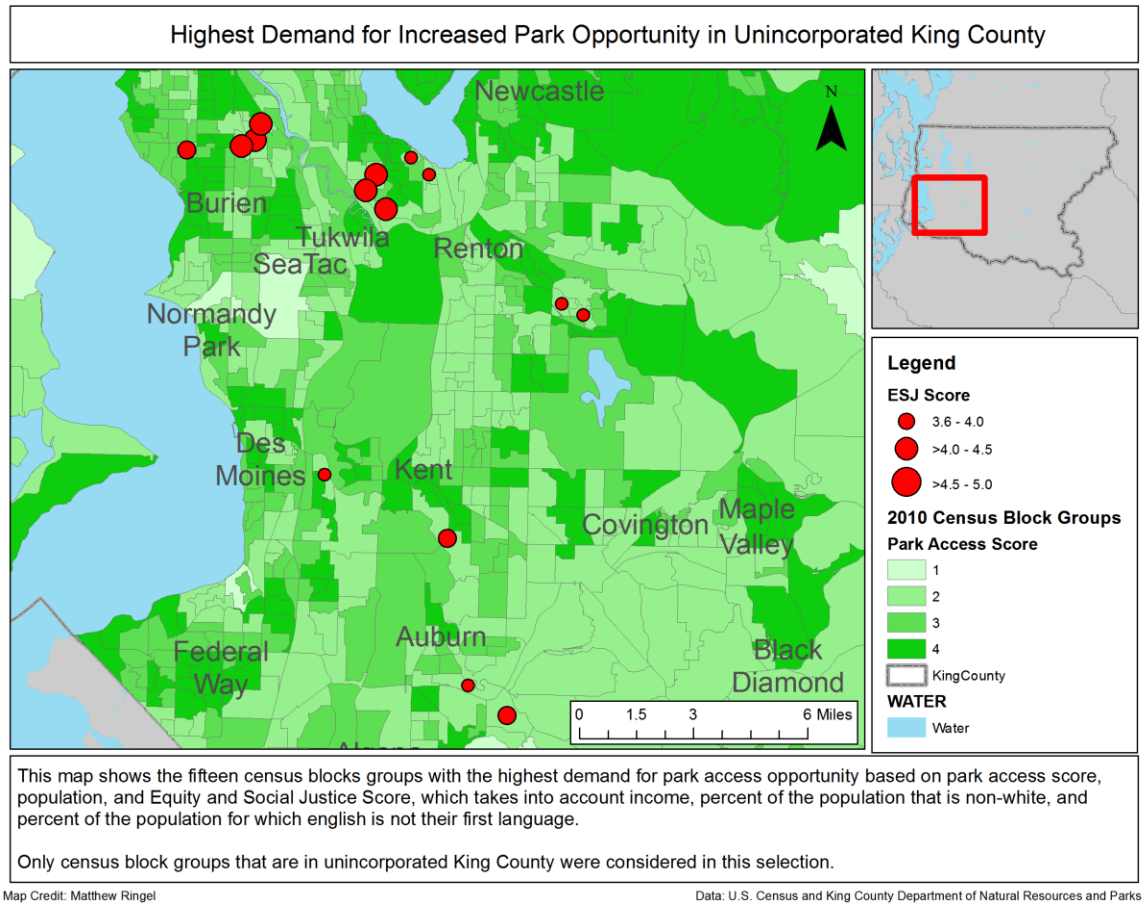

Figure 15: Site Selection results for unincorporated King County

Business Case & Implementation Plan

King County has performed equity assessments for several services in the County for people of color, low-income and limited English proficiency. These services include public transit facilities and service levels, transit trips, public libraries, public schools, public spaces, healthful food, health and human services, urban tree canopy, and school performance for graduation rates, reading, and math. The Department of Natural Resources (DNRP) is expanding on this to provide equity assessment on services they are responsible for. This capstone project has only concentrated on park service in King County and recommends the following course of action towards greater equitable access:

Currently King County applies the method of buffering an area around parks while adjusting for population density and calculating the percentage area of the census tract covered by the union of these buffers. The recommendation is to employ the methodology designed in this project which determines improvement in park access equity through a park access score which is derived from a service area analysis that determines service accessibility to parks and the existing ESJ scoring used by DNRP. However, regarding the ESJ scoring, the recommendation is

to use four classes rather than five in the ArcMap symbology when classifying the layer for display or analysis. As mentioned earlier, the use of quartiles allows for improved linear distribution as the variance in class size is lower.

Results from this project illustrate that the people with the best park access tend to be predominantly white, high-income and proficient in English. The analysis also demonstrates that from 2000 to 2010 access to parks improved overall for the population throughout King County. However, pockets of underserved populations do exist in King County and it is the recommendation of this project that the spatial layers produced through this analysis be used for a site selection analysis to address these deficiencies. Areas of low access to parks are discussed in the Results and Discussion portions of this report.

Additionally it is recommended that economic factors be considered in either park access scores or demand for parks, but not both. An example of the latter would be to compute the park access scores without using any economic weighting (such as car ownership), but then selecting potential sites for park development based low Park Access Scores and low car ownership rates.

Overall, it is encouraging to see improvement in the number of parks and access increase throughout the County from 2000 to 2010, but the results of this analysis do reflect inequities (as of 2010) in the southwestern part of the County in the areas around Burien, SeaTac and Tukwila.

Lastly, this project recommends that DNRP incorporate this methodology and employ it to evaluate other services regarding equity such as farmers markets, park facilities, playgrounds, picnic shelters, and water parks depending on available spatial data. A recent survey of appropriate data to date and available from the King County GIS data portal online are; bike facilities, bike lockers, farmer's markets in King County, park facilities, trails in King County, shoreline public access.

Literature Cited

Coalition for a Livable Future. *Parks and Natural Areas .* n.d. https://clfuture.org/atlas-map-series/parks-and-natural-areas (accessed August 17, 2014).

King County Department of Natural Resources. "Equity and Social Justice 2011 Work Plan for DNRP Draft November 18, 2011." *KingStat.* April 2014l. http://your.kingcounty.gov/dnrp/measures/documents/pdf/2011-DNRP-resultslessons.pdf. (accessed August 15, 2014).

King County. *DNRP Equity and Social Justice Program and Activities.* 2014. http://your.kingcounty.gov/dnrp/measures/equity.aspx (accessed August 17, 2014).

"Governing for Racial Equity Conference King County's Equity Impact Review Tool." *King County Equity and Social Justice.* December 23, 2012. http://www.seattle.gov/Documents/Departments/RSJI/GRE/AlbettaEIR-ToolGRE-December2012-KingCo.pdf (accessed August 14, 2014).

King County KingStat. *DNRP Equity and Social Justice Program and Activities.* 2014. http://your.kingcounty.gov/dnrp/measures/equity.aspx (accessed August 16, 2014).

King County. *Natural Resources and Parks.* 2014. http://www.kingcounty.gov/environment/dnrp/about.aspx (accessed August 17, 2014).

Office of Executive Constantine. January 28, 2014. http://www.kingcounty.gov/exec/equity/vision.aspx (accessed August 10, 2014).

"Office of the Executive ." *Performance, Strategy and Budget.* 2014. http://www.kingcounty.gov/exec/PSB/StrategicPlan/CountyStratPlan.aspx (accessed August 14, 2014).

Welcome to King County's Parks. 2014. http://www.kingcounty.gov/recreation/parks/inventory.aspx (accessed August 16, 2014).

McGlone, Daniel. "Healthy Communities in Delaware." *Azavea Journal*, June 2013.

Ming Wen, Xingyou Zhang, James Holt. "Presentation at the 2012 Active Living Research Annual Conference." *Spatial Disparities in the Distribution of Parks and Green Spaces in the United States.* March 2012.

MRSC. "Publications." *Levels of Service Standards.* September 1994. https://www.mrsc.org/publications/levelservstandard.pdf (accessed August 16, 2014).

Puget Sound Regional Council. *Opportunity Mapping.* 2014. http://www.psrc.org/growth/growing-transit-communities/regional-equity/opportunity-mapping/ (accessed August 10, 2014).

STAR Communities. *The Rating System.* 2014. http://www.starcommunities.org/rating-system (accessed August 8, 2014).

Walker, Chris. *The Public Value of Urban Parks.* Washington, DC: The Urban Institute, 2004.

Zhang et al. "Modeling Spatial Accessibility to Parks: a National Study." *International Journal of Health Gepgraphics*, 2011: 10:31.

APPENDICES

Appendix 1

From “Equitable Services & Access Response From Seattle”

Demographic Characteristics:
A consolidated demographic score (ESJ Score) that was calculated for all of King County, based on using US Census Tracts. The scores generated from the King County analysis were used for the Seattle analysis.
The source layers for the ESJ Score were: People of Color (people who don’t identify as white and/or are Hispanic or Latino); English Proficiency; and Median Household Income. The 2000 ESJ Score source layers came from the 2000 US Census data. For the 2010 ESJ Score, the People of Color demographic came from the 2010 US Census data while English Proficiency and Median Household Income came from the 2006 – 2010 5-Year American Community Survey. Each demographic source is classified into quintiles. A score is assigned to each Quintile class ranging 1 - 5. The ESJ score for each tract is the sum of 33.3% of quintile score for each of the three source layers. A lower score indicates less diversity, higher income, & higher English proficiency. A higher score indicates more diversity, lower income, & lower English proficiency.

2000 ESJ Score

People of Color	Score	Median Household Income	Score	Lack English Proficiency	Score
4.5% - 11.2%	1	$70,353.01 - $133,756.00	1	0.5% - 2.6%	1
11.3% - 15.9%	2	$60,410.01 - $70,353.00	2	2.7% - 4.9%	2
16.0% - 22.8%	3	$50,750.01 - $60,410.00	3	5.0% - 7.5%	3
22.9% - 33.4%	4	$40,839.01 - $50,750.00	4	7.6% - 12.8%	4
33.5% - 90.1%	5	$11,265.00 - $40,839.00	5	12.9% - 52.0%	5

2010 ESJ Score

People of Color	Score	Median Household Income	Score	Lack English Proficiency	Score
6.3% - 18.0%	1	$92,917.01 - $184,375.00	1	0.0% - 3.3%	1
18.1% - 27.1%	2	$77,708.01 - $92,917.00	2	3.4% - 6.7%	2
27.2% - 36.4%	3	$64,199.01 - $77,708.00	3	6.8% - 11.0%	3
36.5% - 51.1%	4	$49,764.01 - $64,199.00	4	11.1% - 17.1%	4
51.2% - 91.2%	5	$5,000.00 - $49,764.00	5	17.2% - 58.8%	5