Seeking Equity in Industrial Wastelands

Evaluating Environmental Justice in Residential Neighborhoods

By Nancy Pierce

Cover Image: Aerial view of auminum production effluvia, photo by J Henry Fair

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Abstract

SEEKING EQUITY IN INDUSTRIAL WASTELANDS:
EVALUATING ENVIRONMENTAL JUSTICE IN RESIDENTIAL NEIGHBORHOODS

Brownfields are most often located adjacent to disadvantaged communities. While toxicity is a primary concern surrounding brownfields there has been very little study on the social impact of these parks. This Master's Project adds to the specialized body of brownfield literature within the field of Landscape Architecture by aiding stakeholders in understanding the risks, benefits and effects of urban brownfield parks on surrounding neighborhoods, through the lens of environmental justice, using case study analysis and post-occupancy evaluations.

The goal for this project is to create a framework by which to evaluate the environmental justice of existing and future brownfield parks. Literature review of Brownfields, Environmental Justice and Urban Redevelopment propose three categories of evaluative criteria: Financial, Health and Quality of Life. Using the case study sites of Gas Works and Warren G Magnuson Parks, in Seattle, WA, five tractable metrics are defined as proxies for the many metrics identified for those criteria. Using this evaluative method, stakeholders can identify park impacts on the local community and whether environmental justice has been achieved through brownfield remediation.

The outcome of this project is an evaluative tool for gauging the environmental justice achieved by neighborhoods affected by brownfield parks. Due to data constraints stemming from the time frame chosen for this project (1970-2010), the inquiry was limited in its application for the selected case studies. Many of the study metrics were unavaiable for decades prior to 2000. Other brownfield park neighborhoods, with alternate viable metrics, could show different results using the evaluative method proposed here.

The two case study sites in Seattle reveal brownfield parks provide mixed benefits. Neighborhood financial and health metrics reveal positive (decreased unemployment), negative (increased vacancy rates, decreased age diversity) and ambiguous (consistent poverty) impacts while quality of life metric results are contradictory (vegetative cover).

This Master's Project reveals that while urban brownfield parks improve some metrics of environmental justice, they are not always beneficial for surrounding residents and at times represent an environmental injustice.

Keywords

Brownfield, Brownfield Neighborhood, Brownfield Park Neighborhood, Case Study, Environmental Justice, Gas Works Park, Landscape Architecture, Pacific Northwest, Post-occupancy Evaluation, Remediation, Residential Neighborhood, Seattle, Urban Park, Urban Renewal, Warren G Magnuson Park.

Dedication

To my Husband, Chris, for his unwavering support, endless hot meals and many late night pep talks – thank you for encouraging me to return to school and pursue my dreams.

To my son, Cyrus, for his patience, persistence and daily reminders to "take a break and play, Mommy!"

To my parents, Diane & Gary LeMaster, for teaching me there is no limit to what I may accomplish.

To Joyce Pierce, my incredible Mother-In-Law, without whom this endeavor simply would not have been possible.

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Roxi Thoren – An advisor who, no matter how stuck I was, always managed to get me back on the right track, and gave me the tools, support and insight to succeed with this project.

Chris Enright – Whose consistency, kindness, upbeat, can-do attitude and always thoughtful feedback made this project a joy to finish.

Dave Hulse – A wordsmith whose knowledge of etymology and ability to trim the fat off every sentence was a constant source of inspiration.

Jim Snyder, University of Idaho Library - The only person in the Pacific Northwest willing to loan out the "CensusCD neighborhood change database (NCDB) 1970-2000 tract data", thus enabling me to complete my research.

My Cohort - An incredibly gifted group of individuals who brought a smile to my face every day. We shared laughter and tears, joys and frustrations. We have become a family over these last several years. You are all dear to me. I cannot wait to see what grand adventures await us all!

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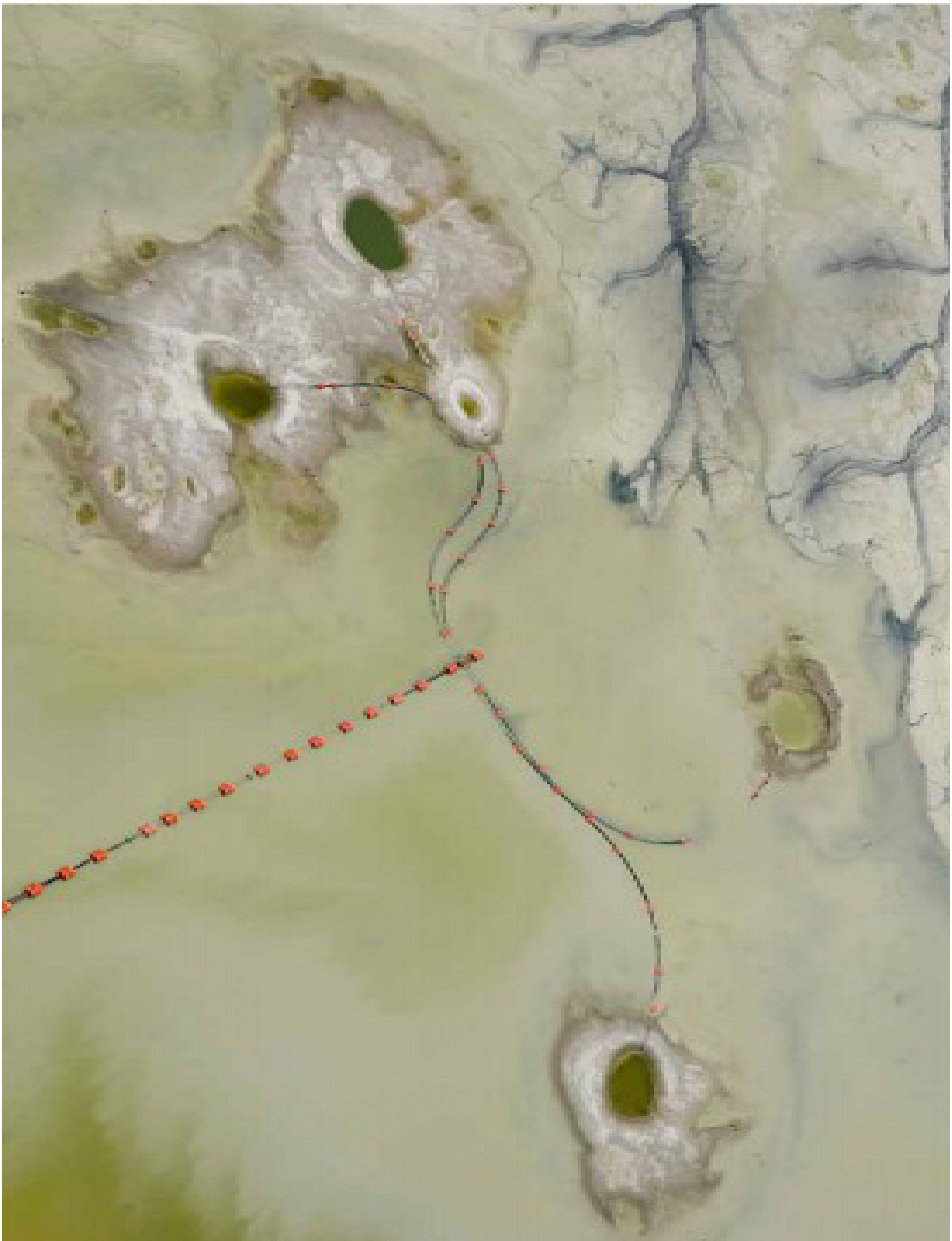

Aerial view of phosphate processing byproduct test discharge, photo by J Henry Fair

CHAPTER 1: The Importance of Environmental Justice Considerations with Brownfield Parks

1.1 MASTER'S PROJECT STATEMENT

This project asks the following question: Do urban brownfield parks provide environmental justice for nearby residents? I examined this question by investigating the following:

- What are the impacts of brownfield parks on local communities?

- How do brownfield parks affect the lives of nearby residents?

This project proposes a method for evaluating the environmental justice impact of brownfield parks on the surrounding neighborhoods. Combining the literatures of brownfields, environmental justice and urban redevelopment, the method proposed includes five tractable metrics within three categories of evaluative criteria to measure the impact of the parks on the neighborhoods around them.

1.2 PROJECT INTRODUCTION

This project investigates whether brownfield parks are indeed beneficial for nearby residents or if instead they represent an environmental injustice by presenting hidden threats to physical, social and economic health (Meyer 2007).

The net impact of a brownfield park, after remediation, on adjacent neighborhoods may outweigh the risk of removing the existing environmental risks if these parks

Fig 1.1 A 4.2 acre brownfield site in Leeds, England, formerly Yorkshire Chemicals, prior to construction of The Ruth Gorse Academy, which is planned to accommodate up to 1,580 pupils 11-18 years of age

contribute to resident displacement or unaffordable housing due to increased property value, loss of existing employment, increased poverty (due to any of the above), the disruption of established neighborhood networks or a reduction in existing social stability or neighborhood infrastructure.

Populations are skyrocketing, resources are limited, and urban sprawl is a problem worldwide (Fig 1.1). Relics of the industrial age, hundreds of thousands of brownfields exist across the world in areas ripe for development (Trust for Public Land, 2012; Siikamäki, J. & Wernstedt, 2008). Efforts to clean up and repurpose brownfield sites have soared over the past 30 years as brownfield sites are frequently recognized as located on land with high potential value near existing infrastructure (Siikamäki, J. & Wernstedt, 2008).

Brownfields are typically adjacent to disadvantaged communities both by design and as the result of low property values surrounding industrial sites (Freeland, 2004; Lee & Mohai, 2011). These communities are frequently not organized or empowered to make changes on their own behalf (Fig 1.2). These neighborhoods are the most vulnerable to gentrification (Logan & Molotch, 1987).

Many urban renewal projects, such as public parks and schools, have been constructed on reclaimed brownfields. Brownfield property tends to be inexpensive to purchase, making it attractive to city developers. Because cleanup costs can vary so widely, depending on the toxins present, remediation methods used and the standards to which developers are held, brownfields are often worth the investment gamble for growing cities. This is a popular

Fig 1.2 Abandoned brownfield next to a housing project, Connecticut

way for cities to obtain cheap land for building parks and schools at or below budget.

It is generally accepted that remediation efforts make brownfields usable and safe for public occupation (De Sousa 2014). Unfortunately, there are few post-occupancy evaluations (POE) studying the long-term environmental quality of these parks, and virtually no studies of their impacts on the surrounding neighborhoods and communities (De Sousa 2011, De Sousa 2012, Meyer 2007). Brownfield parks may impact economic, environmental and social aspects of a neighborhood, with the potential for a net negative impact, despite the removal of toxicity. Without study, we simply don't know the impact of these parks.

1.3 DEFINING BROWNFIELDS

A brownfield is a former industrial or commercial site (real property) where future use, expansion or development is affected by real or potential environmental contamination, such as hazardous substances and/or pollution (Fig 1.3). Brownfield parks are the product of superfluous infrastructure or manufacturing sites combined with the need for urban green space.

The term brownfield may encompass, but is not limited to, landfills, mines, gas stations, military bases, transportation corridors such as railroad lines, chemical manufacturing and storage depots, and areas affected by natural disaster or war. Pollutants range from fuel to refuse, toxic chemicals to nuclear waste. Pollutants are typically located in the soil, though water and air pollution may also exist or be a result of on-site conditions.

Currently there are many methods for brownfield remediation, depending on the types of contaminants present. Treatments include removing contaminated soils to offsite locations, capping, bioremediation through planting, methane management systems, leach fields and collection systems. It has been estimated the cost for site

Fig 1.3 Abandoned manufacturing plant next to new development, Paris

assessment and remediation can average $130,000 to $300,000 per acre (De Sousa 2014, Harnik, 2010).

Follow up testing, toxicity assessments and monitoring, such as groundwater monitoring wells, varies greatly by location. Unfortunately, many brownfields do not have a budget for ongoing monitoring and testing. Funding for long term maintenance and repairs is not always included in park budgets and may fall on the state, Department of Environmental Quality (DEQ), Environmental Protection Agency (EPA), Environmental Health Assessment Program (EHAP) or a combination of these (Meyer, 2010).

1.4 BROWNFIELD LANDSCAPE ARCHITECTS: WHO, WHERE, WHAT

The first significan public repurposing of an environmental hazard as a public park appeared in 1878 with Frederick

Fig 1.4 Emerald Necklace, Boston, MA, 1894 (bottom) with the Back Bay Fens enlarged (top)

Law Olmsted's Back Bay Fens in Boston, Massachusetts (Fig 1.4). This park is part of Boston's Emerald Necklace and was an open sewer for the growing city. Olmsted was hired to combat this malodorous health threat and provide flood control. Although it remained an open sewer, it worked much better after his redesign due to tial cleansing

Fig 1.5 Scioto Audubon Metro Park, before (left) & after (right)

Fig 1.6 Discovery Green, Houston Tx, before (left) & after (right)

twice a day. Olmsted restored the previously existing marsh and created a series of meandering pathways along the wooded tidal basin, adding acres of parkland for city residents (ENC, 2016).

Starting in the late 1960's with the de-industrialization of many Western countries, new sites for park construction became available in or near cities with excellent locations and/or proximity to infrastructure. These brownfield parks steadily gained favor, becoming widespread in the US and Europe in the 1990's, as the value of post-industrial spaces for public use became increasingly apparent (Siikamäki, J. & Wernstedt, 2008). The most famous industrial brownfield park may be Gas Works Park in Seattle, WA, by Richard Haag. It was the first brownfield park to maintain its industrial structures during park construction (TPL, 2006, Kirkwood, 2001). Since its construction in 1975, many other cities have followed suit and invested in industrial brownfield remediation and site conversion to public parkland. Gas Works Park will be discussed further in Chapter 5.

With so many cities looking to take advantage of waterfront real estate and abandoned land in urban centers, the industrial brownfield to park movement has been growing steadily over the past 30 years. Recent examples include the Scioto Audubon Metro Park in Columbus Ohio (Fig 1.5), formerly riverfront warehouses and parking lots turned wetland and public park, completed June 2014 and Discovery Green in Houston, TX, a 12 acre former railroad station and industrial site turned downtown destination park, completed in 2008 (Fig 1.6).

Landscape architect Peter Latz greatly shaped this sub-discipline of brownfield remediation with the creation of Landschaftspark Duisburg Nord (1991, Duisburg-Meiderich, Germany), a public park formed on the site of an abandoned steel and coal plant (Fig 1.7). Conversion of this site into a public park required extensive planning. Existing structures were preserved and native soils were retained on site to be treated with a combination of heavy metal absorbing plants and sequestration.

In recent years, other landscape architects have become noteworthy for their work with brownfield remediation. James Corner, the landscape architect behind The Highline (Phase I, 2009; Phase II, 2011; Phase III & IV, 2014; New York City), an elevated rails-to-trails park (Fig 1.8), and Freshkills Park (2012-present day, Staten Island), a former landfill (Fig 1.9), has won worldwide acclaim for his innovate work with urban brownfields. The High Line was a recipient of grant monies from the New York Brownfield Assessment and Cleanup Grant EPA Program for hazardous substance cleanup related to semivolatile organic compounds and metals (EPA, 2006). It added 1.45 miles of elevated park space to downtown New York City. Freshkills Park is currently undergoing transition from the world's largest landfill to a 2,200 acre public park and open space near New York City (scheduled to be completed by 2036) (NYC Parks, 2016).

Landscape architects Julie Bargmann and Kate Orff have both written and lectured profusely on the topic of brownfield remediation and are considered experts in this field. Julie Bargmann is "internationally recognized as a leader in the design and building of regenerative and environmentally appropriate landscapes" (LAF, 2016). She collaborated with historian T. Allen Comp, artist Stacy Levy, hydrogeologist Bob Deason, and others on the AMD&ART Project in Vintondale, PA; a revolutionary project which passively treats acid mine drainage (AMD&ART, 2016). She recently won the 2014 Honor Award from the American Society of Landscape Architecture (ASLA) and in 2001 earned her office, D.I.R.T. Studio, the National Design Award from the Smithsonian's Cooper-Hewitt Museum. Her writing has been featured in

Fig 1.7 Landschaftspark Duisburg Nord, Landscape Architect Peter Latz

Fig 1.8 The High Line, Landscape Architect James Corner

numerous publications. Julie Bargmann is currently the Landscape Architecture Chair and Associate Professor at the University of Virginia.

Kate Orff is described as an "activist and visionary (whose) work on design for climate dynamics has been shared and developed in collaboration with art institutions, governments and scholars worldwide" (LAF, 2016). Kate Orff, the founder of SCAPE Landscape Architect Studio, was named a United States Artist in 2012. She has written two books, Toward an Urban Ecology and Petrochemical America. Kate Orff is currently the Urban Design Program Director at Columbia University.

1.5 PROJECT SIGNIFICANCE

This Master's Project adds to the specialized body of brownfield literature within the field of Landscape Architecture by creating a tractable system for evaluating the environmental justice impact of brownfield parks on adjacent neighborhoods. Because they are so heavily used and have a direct influence on neighboring sites, understanding the effects of brownfield parks is pertinent to gauging whether these sites are worth the financial investment and risks to nearby residents.

This project proposes a new method of measuring the impact of brownfield parks on nearby neighborhoods by identifying qualitative categories of evaluation and using tractable methods to measure change over time.

1.6 BROWNFIELD EVALUATION METHOD DEVELOPMENT

The goal of this project is to aid stakeholders, such as city managers and community members, in understanding the risks, benefits and effects of brownfield parks through case study and post-occupancy evaluations. The outcome of this project is an evaluative tool for gauging the environmental justice achieved by neighborhoods affected by brownfield parks. This study will move brownfield parks from the area of heuristic and anecdotal assessment to a replicable, qualitatively accessible method of evaluation.

No established POE framework, metrics or thresholds currently exist for brownfield park neighborhoods. Without objective metrics, identifiable thresholds and replicable evaluative methods, it is impossible to know the impact of these projects. Community impact is the key to understanding brownfield park performance and effect.

While there is faith brownfields are beneficial to the surrounding community, there has not been adequate study performed to confirm this. A universal framework for evaluating park success and safety, based on a template of neighborhood environmental justice, is a fair and necessary way to evaluate the effects of these parks on nearby neighbors.

Case studies and post-occupancy evaluations are the most effective way to examine brownfield projects (De Sousa 2011, De Sousa 2012; Francis, 2001). The investigative model for this project utilizes two case studies and an evaluative template to perform a post-occupancy evaluation. The environmental justice of the neighborhood case study sites is then evaluated based on changes over time since brownfield park construction.
POE metrics focus on environmental justice in three categories: Financial, Health and Quality of Life. These categories are based

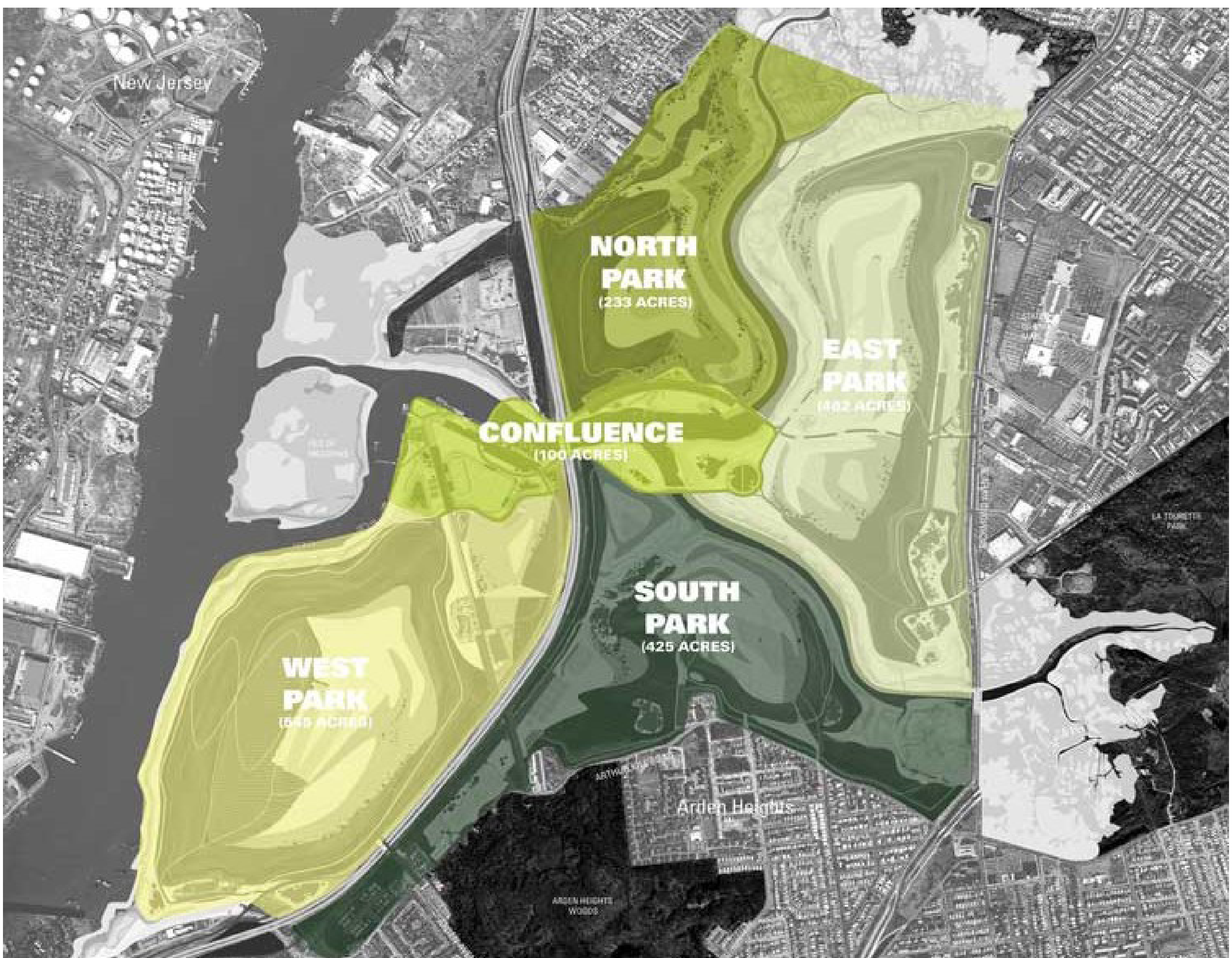


Fig 1.9 Freshkills Park, Landscape Architect James Corner

on the literature review of scientific journals, books and municipal websites. From fourty-one possible metrics, the metrics are refined to five by selecting tractable metrics for which data from 1970 (pre-park construction) to 2010 is available. Census data provided longitudinal demographics for the Sand Point, Laurelhurst, View Ridge, Windermere (Warren G Magnuson Park) and Wallingford (Gas Works Park) neighborhoods. Historic aerial photographs provide measurably visible changes over time for these same neighborhoods.

1.7 CHOOSING CASE STUDY PARKS

The longer the park had been both a working industrial site and completed park remediation and construction, the greater the likelihood of useful available information, resulting in a more substantial project.

The study area, Seattle, Washington, includes two brownfield parks, Warren G Magnuson and Gas Works Parks. The case study brownfield parks serve as way to test the evaluative model. Parks outside the US were rejected due to potential challenges gathering information and accessing the sites.

Warren G Magnuson Park has been in existence since May 29, 1977 while Gas Works Park opened in 1975, providing ample opportunity to track neighborhood changes since their inceptions (Fig 1.10). Warren G Magnuson and Gas Works Parks are both large community parks sited on Lake Washington and Lake Union, respectively - prime waterfront property (Fig 1.11). This allowed for comparative analysis of two similar parks within the same locality, compensating for local trends, economic downturns or other regional events which could otherwise skew results between parks located in disparate locations. Both parks are located near historic neighborhoods and were impacted by major industrial use.

Additional elements made Warren G Magnuson and Gas Works Parks ideal for this project. The neighborhoods have not

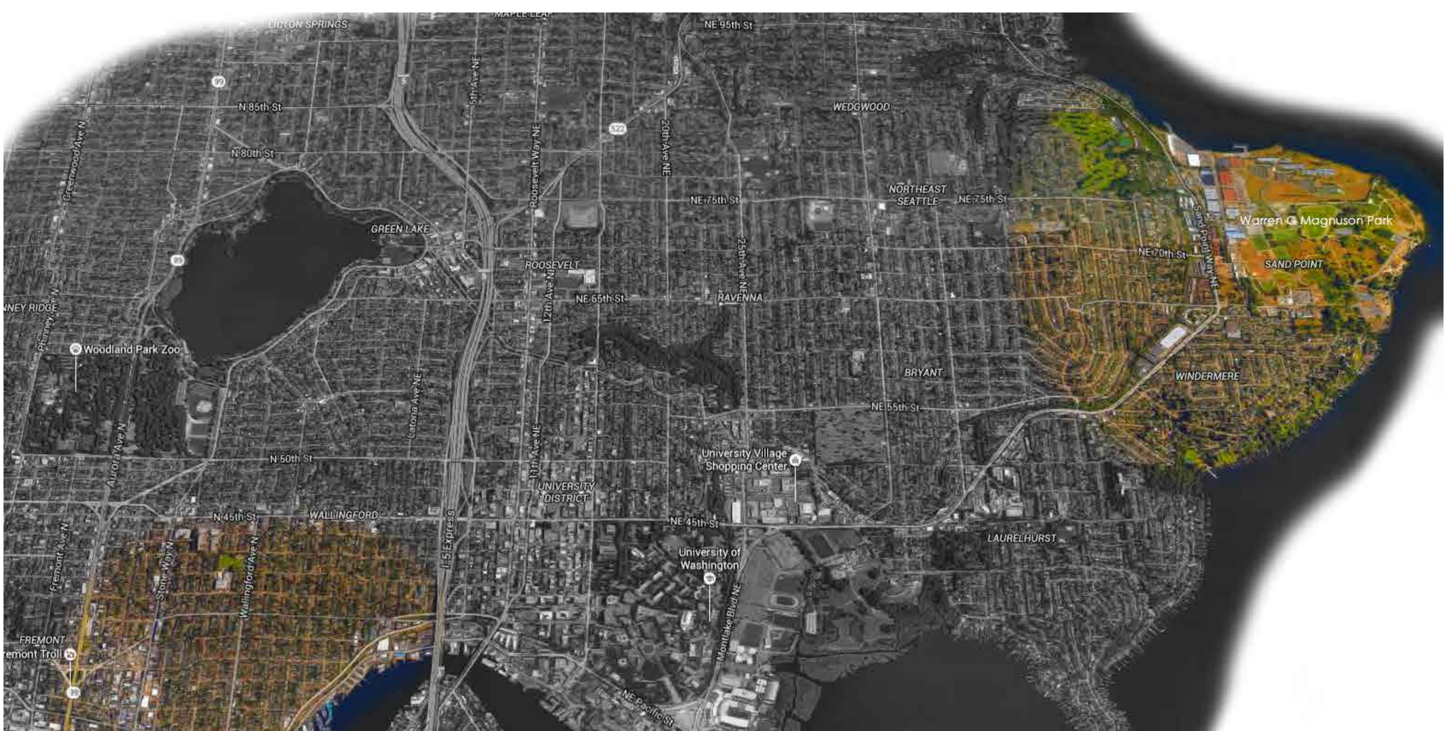


Fig 1.10 Warren G Magnuson (top) and Gas Works Parks (bottom), Seattle, Washington

been subjected to significant urban renewal; many neighborhood schools, homes and businesses have remained since before the parks were developed. Due to this stability of neighborhood structures, many evaluative metrics, such as vacancy, poverty and age diversity, can be directly tied to the greatest neighborhood transformation – the development of adjacent large brownfield sites into urban parks (Fig 1.12).

Beyond the reasons for this study, my interest in these parks is also personal. Seattle has for years been at the forefront of brownfield-to-park conversions, setting a national example of brownfield remediation, which I greatly admire. Gas Works Park has long been a favorite of mine due to its preservation of pre-existing industrial infrastructure.

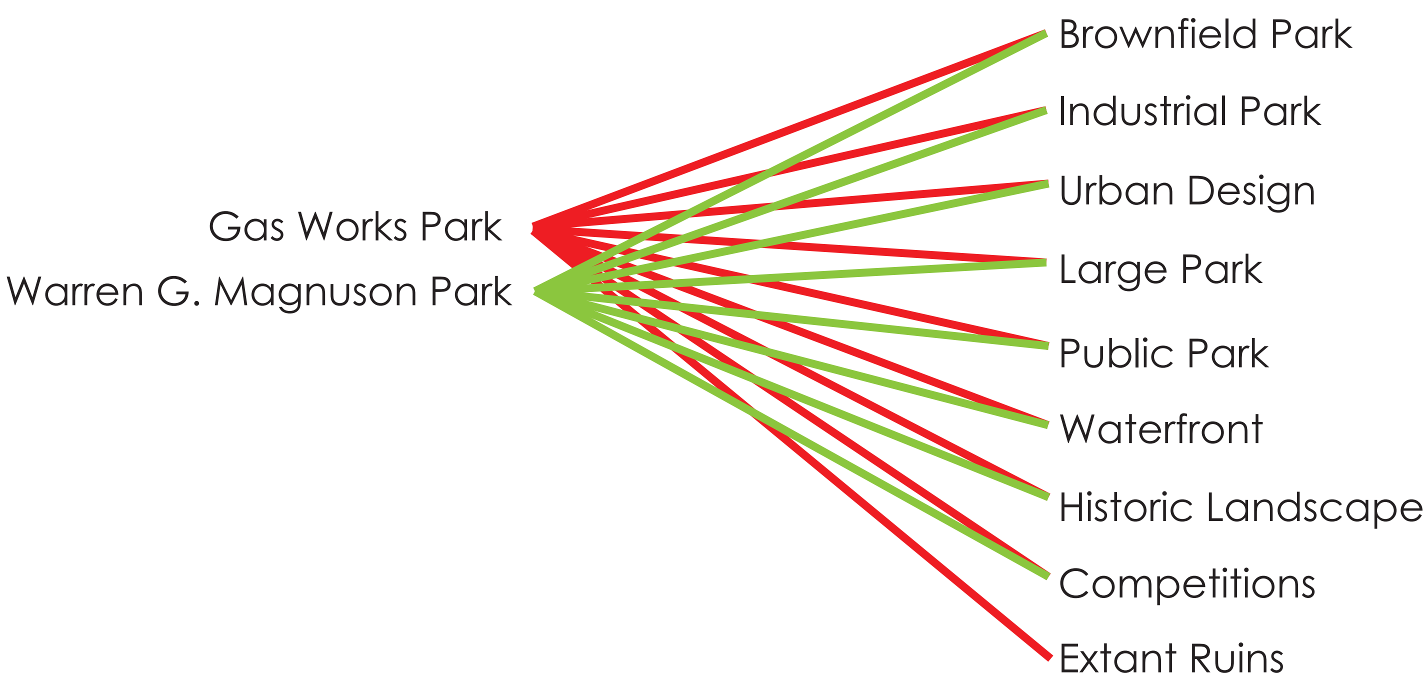


Fig 1.11 Park Comparison Diagram for Warren G. Magnuson and Gas Works Parks

Warren G Magnuson plays a role in my family history. For several years, my Grandfather flew planes out of the Naval Air Station after WWII. I spent time there in the early 80's with my parents during their service when parts of the site still actively housed military personnel.

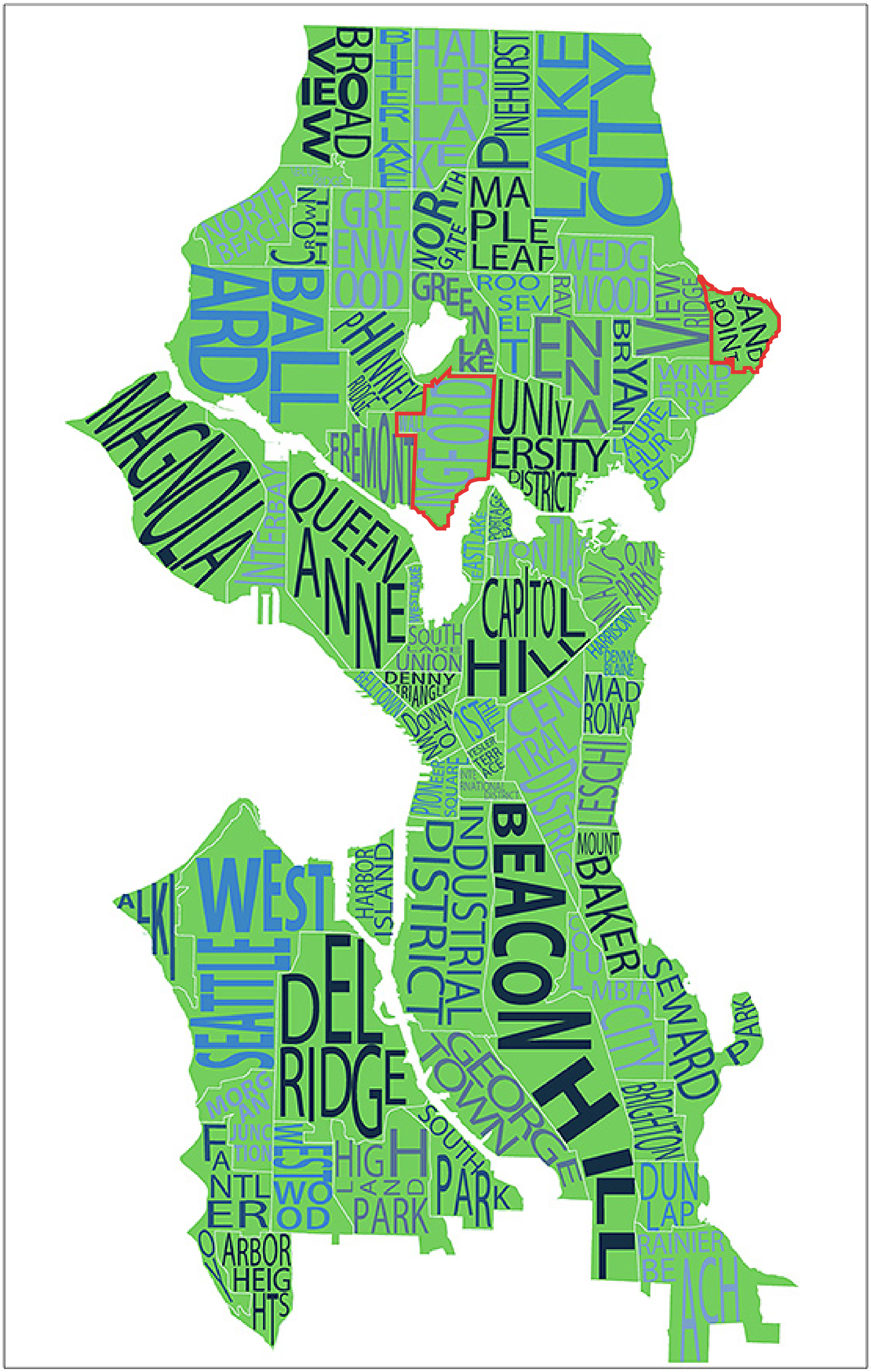


Fig 1.12 Seattle Neighborhood Map, with case study neighborhoods circled

Airborn mercury pollution from a power plant in Michigan, a major source or airborn mercury pollution, www.environmentamerica.org

CHAPTER 2: Brownfield Parks + Neighborhoods

2.1 HISTORY OF BROWNFIELD PARKS

Cities historically sited manufacturing and landfill sites at urban edges and along waterways, where land was inexpensive and the impact of the enterprise would not affect the daily operations of the city or the affluent. As cities grew, land previously considered unfit for public use (Fig 2.1) was eyed for development. Convenient access to infrastructure makes these sites ideal for urban services such as schools, residential developments and parks.

Over time, many of these derelict spaces have been given new life through transformation into a public park. Although little post-occupancy research has been performed on these parks, it is generally assumed brownfield-to-park conversions boost local economies, increase property values and improve the lives of local people by both removing toxins from the community and adding green space for public use (Fig 2.2).

2.2 INDUSTRIAL BROWNFIELD PARKS

Industrial brownfield parks are parks constructed on sites which previously held industrial use. This includes a wide range of site types such as industrial manufacturing

Fig 2.1 Garbage scows bringing waste to Freshkills Landfill

Fig 2.2 Conceptual image of Freshkills Park

locations, gas stations, railways, asphalt plants, chemical storage facilities and steel plants. Because so many brownfield sites exist in the US, and because regulations vary by state, there is no current record of the total number of brownfield sites in existence or the number of parks created on these brownfields. The Washington Department of Ecology lists 123 known brownfield sites in the Seattle area alone, the majority of which are awaiting cleanup (State of Washington, 2016). It can be safely assumed many more exist which have not yet been reported.

From Industrial Wasteland to Park

Before an industrial brownfield can be made safe for public occupation, all harmful chemicals must be removed or treated. A variety of remediation and development options exist, depending on the type of contamination present - all treatments must be site specific.

Often, contaminated soils are removed from the site and clean soils brought in (Fig 2.3). While removing contaminated soils may be effective, the question arises 'where do the toxic soils go?' Does it become someone else's problem? There are licensed facilities which handle the disposal of hazardous materials, such as toxic soils. These soils, depending on the type of contamination, may be reused at landfills or may be permanently buried. Capping or burying toxic soils may be an option as long as leaching and storm water concerns are sufficiently addressed.

Bioremediation is a soil treatment method that uses naturally occurring organisms to "degrade and detoxify organic substances to harmless compounds, such as carbon dioxide and water, in a confined and controlled environment" (EPA, 2005). This includes plants, bacteria and fungi. Soils treated in this manner may be reused once remediation is complete, meaning soil toxins


Fig 2.3 Brownfield soil removal

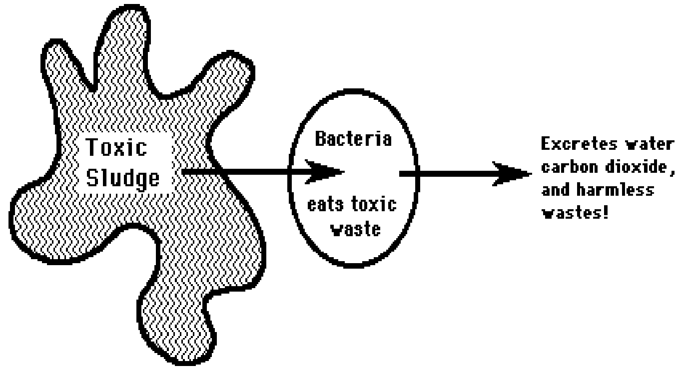


Fig 2.4 Microbial Bioremediation

are reduced to an acceptable level or eliminated completely.

There are several categories of bioremediation. Microbial bioremediation is the use of microbes to degrade toxins and render them inert (Fig 2.4). Mycoremediation uses fungi to break toxins down into less harmful substances (Fig 2.5).

Phytoremediation uses specific plants to remove toxins (Fig 2.6). Alpine Pennycress (Thlaspi caerulescens) is an example of plants which thrive in heavy metal contaminated soils. It can store up to 30,000 parts per million (ppm) zinc and 1,500 ppm cadmium, versus a typical plant, which can only store around 100 parts per million (ppm) zinc and 1 ppm cadmium (USDA, 2000). Willow (Salix viminalis) is another plant often used in cleanup efforts (SUNY-ESF, 2016). After a period of time, plants are harvested

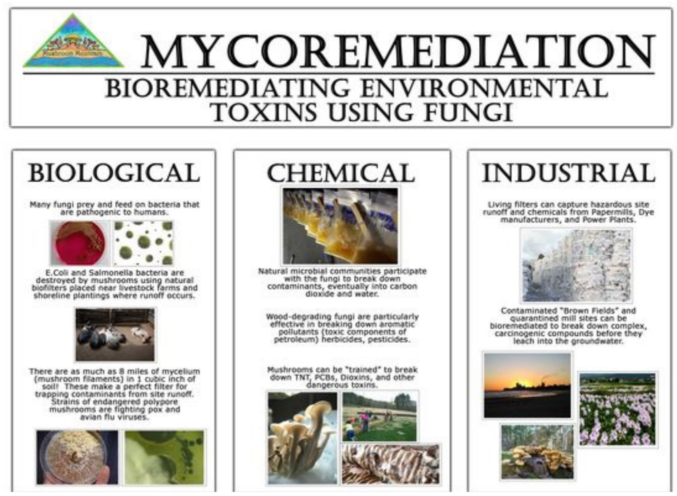


Fig 2.5 Micoremediation applications

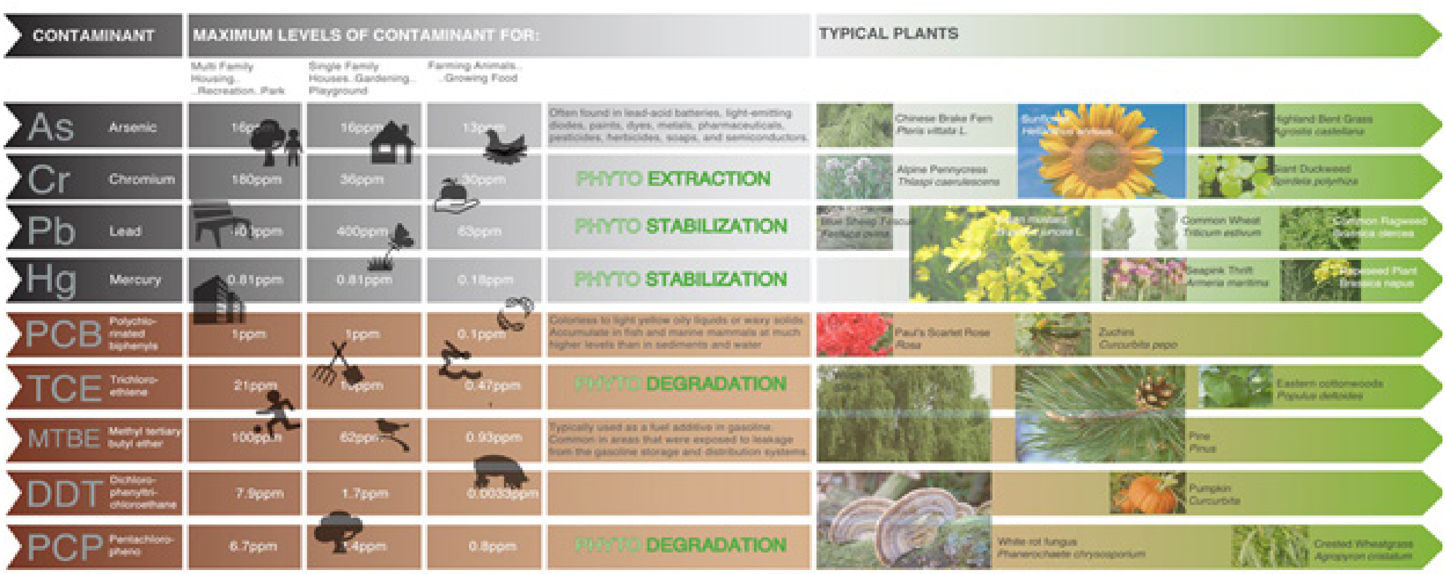


Fig 2.6 Phytoremediation plants

and disposed of, thereby removing heavy metals and other contaminants from the site.

Once site toxins are removed, capped or a remediation plan is put into place, park construction may proceed. In some cases, there are areas where cleanup has not yet been completed (Fig 2.7) and, while the park may be safe to visit, direct contact with the soil is strongly discouraged.

Fig 2.7 Gas Works Park signs stating "Do not enter the water. Do not land or launch boats. No swimming. No fishing. No wading. The lake sediment contains hazardous substances (SMC 18.12.070)."

2.3 HISTORY OF BROWNFIELD NEIGHBORHOODS

Brownfields have historically been located in poor neighborhoods of color. A 20 year study by United Church of Christ Justice & Witness Ministries found "race continues to be a significant and robust predictor of commercial hazardous waste facility locations when socioeconomic factors are taken into account. Significant racial and socioeconomic disparities persist in the distribution of the nation's commercial hazardous waste facilities. Although current assessment uses newer methods…the conclusions are very much the same as they were in 1987" (United Church of Christ, 2007).

Brownfields tend to be concentrated in areas which have, as a result of the activities of the associated polluting or hazardous industry, depressed property values (Fig 2.8). This places them, by default, in low income neighborhoods, since these properties are affordable for those with limited income. Therefore, low income neighborhoods and brownfields often go hand in hand.

The presence of these brownfield sites leads to increased health risks for the communities exposed to the environmental hazards they introduce. Brownfield neighborhoods often have higher rates of depression, asthma, diabetes, and heart disease (Cohen et al, 2003). In cases of direct exposure to brownfield toxins, incidences of low birth rates, infant mortality, lead poisoning in children and cancer have occurred (Berman & Forrester, 2013).

2.4 CURRENT DAY BROWNFIELD PARK NEIGHBORHOODS

Because of the many programs and funding opportunities available, brownfield parks are popping up everywhere. These include community gardens, restoration projects, and city and neighborhood parks. Brownfield parks take many forms, from Portland, Oregon's tiny 0.26-acre Rollin' Tire floodplain restoration to large city-scale parks such as Freshkills in New York.

Fig 2.8 A 250-acre brownfield, Carrollville Neighborhood, Oak Creek, WI

Fig 2.9 Tanner Springs Park, Portland, OR, is an example of a recently constructed brownfield park

Brownfield park neighborhoods, therefore, are quite varied as well.

Present day brownfield park neighborhoods range from poverty stricken to affluent, recently constructed to historic (Fig 2.9). The majority of urban brownfield parks fall into one of two categories: neighborhood parks or industrial sector parks, the latter of which are often located either near urban centers or in areas which have gained a renewed focus as cities expand and infill.

2.5 CONCERNS SURROUNDING BROWNFIELD PARKS AND ADJACENT NEIGHBORHOODS

It is generally accepted that brownfield sites, if left undeveloped, not only reduce property values, but also serve to attract the homeless, vandals and children, all of whom are subsequently exposed to site toxins, making remediation a high priority.

Health Risks and Community Endangerment

There may currently be as many as 4,500 acres of remediated landfill parks in major US cities (Harnik, 2010). Brownfield parks are typically funded by cities, government programs and/or private investors.
There exists contradictory evidence that brownfield remediation efforts are funded disproportionately. Some researchers claim neighborhoods with extreme poverty tend to be overly compensated and middle income locations tend to receive fewer funds, while others found brownfield grants to be distributed more evenly in regards to resident median income (Litt, et al, 2002). A number of programs for brownfield remediation exist, but only after President Clinton passed Executive Order 12898 in 1994 were the environmental and human health effects of brownfield cleanups on minority and low-income populations taken into consideration (Soltare & Greenberg, 2002). There are

exceptions to this rule. The Small Business Liability Relief and Brownfields Revitalization Act, passed by Congress in 2001, provides funding for brownfield programs, but is not required to address civil rights concerns or require environmental justice (Felten, 2005-2006).

Many concerns exist around clean up procedures, long term maintenance and natural disasters. Parks, schools and low-income housing are often constructed on brownfield sites (DeSousa, 2009; Meyer, 2010). The case of Morton Elementary School (Fig 2.10), built on the Agriculture Street Landfill site in New Orleans, is a great example of how inadequate cleanup, failure to involve local citizens and lack of full disclosure puts communities at risk.

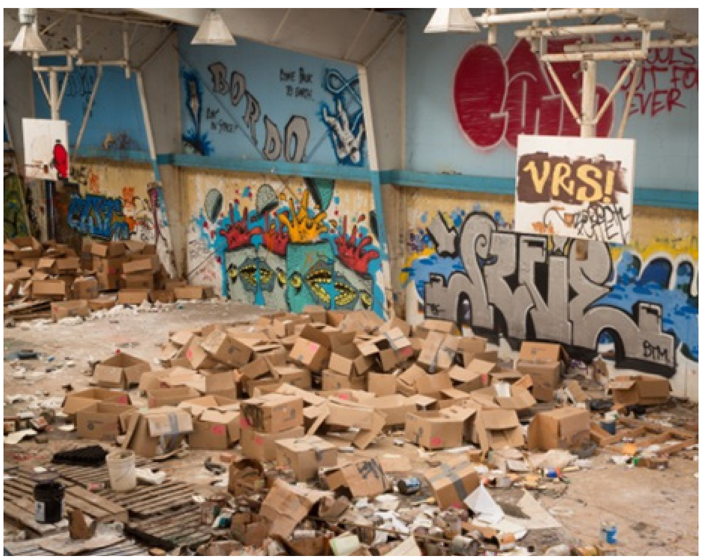


Fig 2.10 Gymnasium at Morton Elementary School, New Orleans, 2014

Responding to citizen concerns about excessive amounts of trash in the soil along with high levels of cancer and other health issues in the community, the EPA found, in 1993, higher-than-allowed levels of lead, arsenic and polychlorinated aromatic hydrocarbons at the school. After Morton School closed, legal documents showed the EPA had found evidence of contamination as far back as 1986 but, in association with the local government, chose to do nothing to remedy the situation. (Cohen, 2012). Shirley Jefferson Community Center (Fig 2.11) and the Press Park public housing development (Fig 2.12) were located on the same site and also closed due to excessive contaminants in the soil.

Fig 2.11 Shirley Jefferson Community Center, New Orleans, 2014

Fig 2.12 Press Park complex, New Orleans, 2014

There are many other examples of brownfield cleanup failure. The most famous may be the Love Canal fiasco in Niagara Falls, NY in the 1970's. Over 950 families suffered from hazardous chemical exposure as a result of Hooker Chemicals & Plastics Co. dumping over 21,000 tons of waste into the Love Canal. The site was then covered with soil and clay and deeded to the Niagara Falls Board of Education for $1. Homes and two elementary schools, the 99th Street School and the 93rd Street School, which served over 400 students, were developed on the site. Soon after, the residents experienced increased rates of cancer, miscarriages, birth defects and other health problems. There was a foul smell to the air and children suffered chemical burns on their hands and faces after playing outdoors. Families were evacuated between 1978 and 1980 when President Carter twice declared the site a federal environmental emergency. The contamination was considered so severe, it lead to the creation of CERLA, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Superfund Law) of 1980. Remediation was completed on the site between 1983 and 1999. It was removed from the Superfund National Priority List in 2004 (EPA, 2016).

Benefits of Brownfield Redevelopment

On the other side of the coin are brownfield projects which are performed with high cleanup standards and provide direct benefits to the community. These beneficial examples continue to grow as cleanup methods become more sophisticated and follow up monitoring becomes mandatory.

Florida has promoted the construction of health centers on brownfields with tax credits of up to $500,000. One success story involving this funding is the Willa Carson Health and Wellness Center in Clearwater, FL (Fig 2.13). The clinic, previously an abandoned gas station, provides free health care to over 7,000 underserved and uninsured residents. The city was able to obtain $150,000 to remove 450 tons of contaminated soils, underground storage tanks and hydraulic lifts, and an additional

Fig 2.13 Willa Carson Health and Wellness Center, Clearwater, FL

$300,000 in Florida State Tobacco Settle funds for the construction of the health clinic, which opened in 2001. Building on the success of this project, in 2008 then Florida Governor Charlie Crist passed House Bill 527, which provides state tax credits for health care facilites built to serve local communities constructed on brownfield sites. This law was the first of its kind in the nation (ATSDR, 2016).

Another example of brownfield success and community enrichment is Crestview Station in Austin, Texas (Fig 2.14). From 1949 until 2005, the 71 acre property was a chemical research facility. Waste produced from the research was buried on site until 1969 (TECQ, 2015). In 2005, developers applied to the Voluntary Cleanup Program, run by the Texas Commission on Environmental Quality, for assistance with cleanup and the construction of a high-density, mixed use, transit-oriented development. Over 20,000 cubic yards of buried waste products and polluted soils were removed and groundwater monitoring systems were put into place. Today the site includes 500 single-family homes, 600 apartments, 150,000 square feet of retail & office space built around a Capitol Metro rail stop and sports fields. Property values have increased significantly and new jobs were created (TECQ, 2015).

Fig 2.14 Crestview Station, TX

A third example is from McMinnville, OR. Sue Buel Elementary School was built adjacent to a 2-acre former asphalt plant abandoned by the Martin & Wright Paving Company in the 1990's. After 40 years of operation, the site was littered with abandoned buildings, underground storage tanks, remnant equipment and vehicles, and contaminated with petroleum (Figs 2.15 & 2.16) (Oregon DEQ, 2004).

Fig 2.15 Site debris in boneyard area

Fig 2.16 Asphalt Surfact Treatment (AST) pad and former storage building

Because of environmental concerns, no habitable structures were built on the brownfield site. Instead, with assistance from a $62 million levy, the asphalt plant site was incorporated into the school project to serve as parking lot and storm water retention pond. These sustainable features, on a remediated brownfield, helped earn Sue Buel Elementary the first U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Gold certification for Schools in Oregon (Siegel, 2010). Opening in 2008, the school serves more than 600 students (Fig 2.17).

Fig 2.17 Sue Buel Elementary, McMinnville, OR

Take Away of Brownfield Redevelopment

There are a wide range of successes and failures surrounding brownfield redevelopments. While brownfield remediation presumably removes dangerous toxins from the local environment, there have been some major historical mistakes made which have put some communities at risk. Successful brownfield remediations provide newly developable land within cities. Although contamination testing exists on various levels, there are very few studies evaluating the impact on surrounding neighborhoods. There are no standards for follow up evaluations regarding the environmental justice impact of brownfields communities. This project seeks to address that gap.

BROWNFIELD LAWS

*In 1980, the **Comprehensive Environmental Response Compensation and Liability Act** (**CERCLA**), also known as the **Superfund Act**, was passed which holds "Potentially Responsible Parties" liable for environmental clean-up and natural resource damage on sites. These parties include current and past site owners/operators, and both transporters and generators of hazardous substances (Kirkwood, 2001). In 2002, CERLA was amended to apply only to those parties who directly took part in the contamination (Hollander, et al, 2010).*

*A Brownfields Grant Program, **Public Law 107-118**, was established in 1993 to aid in brownfield cleanup efforts from within the EPA, separate from Superfund.*

*The **Small Business Liability and Brownfield Revitalization Act** was passed in 2002 and limited developer liability under Superfund. This limited liability applies to Bona Fide Prospective Purchasers, Contiguous Landowners, Innocent Landowners as long as these parties take reasonable steps to prevent environmental contamination on the properties in question (Wiegard, 2003).*

TIMELINE OF ENVIRONMENTAL MILESTONES

Pre-1960

1916: The National Parks Service established

1886: The Audubon Society founded

1854: Henry David Thoreau publishes *Walden*

1961-1970

1970: President Richard Nixon establishes the U.S. Environmental Protection Agency

1970: 20 million people celebrate the first Earth Day

1968 Experts from around the world meet for the first time at the UN Biosphere Conference in Paris, France

1962: Rachel Carson publishes Silent Spring

1966: Valley of the Drums fire, Bullitt County, KY.

1967: The Torrey Canyon oil tanker runs aground and spills 117,000 tons of oil into the North Sea near Cornwall in the United Kingdom.

1971 - 1980

1980: Congress creates Superfund to clean up hazardous waste sites

1979: Convention on Long-Range Transboundary Air Pollution

1977: President Jimmy Carter signs Clean Air Act

1977: Warren G Magnuson Park, Seattle, WA

1976: President Gerald Ford signs the Toxic Substances Control Act

1976: Congress passes the Resource Conservation Act, regulating hazardous

1975: Gasworks Park, Seattle, WA

1974: Chemists Rowland and Molina publish their landmark findings that chlorofluorocarbons (CFCs) threaten to erode the Earth's ozone layer

1974: Environmentalist Lester Brown founds the Worldwatch Institute

1974: Congress passes the Safe Drinking Water Act

1973: The Convention for the Prevention of Pollution from Ships (MARPOL) is adopted

1973: OPEC oil embargo triggers energy cricis

1972: The Club of Rome publishes *The Limits to Growth,*

1972: Congress passes the Clean Water Act,

1972: EPA bans DDT

1978: Love Canal disaster, Love Canal, NY

1979: Three Mile Island nuclear power plant accident near Harrisburg, PA

1981 - 1990

1990: Congress passes Clean Air Act

1990: President George Bush signs the National Environmental Education Act

1990: President George Bush signs the Pollution Prevention Act

1983: The U.S. Environmental Protection Agency and the U.S. National Academy of Sciences release reports warning of global warming

1982: The UN Environment Programme organizes the Stockholm +10 conference in Nairobi.

1981: National Research Council report finds acid raid intensifying in the northeastern U.S. and Canada

1982: Times Beach, St. Louis County, Missouri, evacuated due to dioxin contamination

1985: Scientists report a giant hole in the earth's ozone layer opens each spring over Antarctica

1986: one of the four reactors at the Soviet Union's Chernobyl nuclear power plant explodes

1987: Medical and other waste washes up on shores and closes beaching in New York and New Jersey

1989: Exxon Valdez spills 11 million gallons of crude oil into Alaska's Prince William Sound

1991-2000

1998: President Bill Clinton announces the Clean Water Action Plan

1997: Kyoto Protocol signed

1997: An Executive Order is issued to protect children from environmental health risks, including childhood asthma and lead poisoning

1996: President Bill Clinton signs the Food Quality Protection Act

1995: The Intergovernmental Panel on Climate Change (IPCC), releases a report concluding that there is a discernible human influence on global climate

1994: The World Conservation Union (IUCN) publishes a revised Red List of endangered and threatened species, reports one in four mammal species and one in eight bird species faces a high risk of extinction in the near future.

1994: EPA launches the Brownfields Program

1992: most countries and 117 heads of state participate in UN Conference on Environment and Development (Earth Summit), in Rio de Janeiro, Brazil

1992: The Convention on Climate Change

1991: Duisburg Nord Landscape Park, Duisburg-Meiderich, Germany

1993: A cryptosporidium outbreak in drinking in Milwaukee, WI sickens 400,000 people and kills more than 100

1993: The ozone hole over Antarctica is measured at 3 million km^2

1997: Forest fires around the world burn more than 5 million hectares of forests and other land. More tropical forests are burned in 1997 than in any other year in recorded history.

1998: The ozone hole over Antarctica grows to 25 million km^2

2001 - 2010

2010: Gulf Coast Ecosystem Restoration Task Force established

2009: Highline (Phase I), New York, NY

2006: EPA's WaterSense program is created to protect future water supplies

2006: EPA issues the Ground Water Rule

2005: EPA issues the Clean Air Act Interstate Rule

2005: Kyoto Protocal goes into effect

2002: President George W. Bush signs the Small Business Liability Relief and Brownfields Revitalization Act

2000: UN Treaty on Persistent Organic Pollutants (POPs)

2005: Hurricane Katrina, costliest natural disaster in US history

2010: The BP-operated Deepwater Horizon oil rig explodes, 11 killed, 4.9 billion barels of crude oil spilled - the largest spill in US history

2011 - Present

2014: Highline (Phase III & IV), New York, NY

2012: Freshkills Park, Staten Island, NY

2011: Highline (Phase II), New York, NY

Old factory, www.relatably.com

CHAPTER 3: Defining + Evaluating Environmental Justice

3.1 ENVIRONMENTAL JUSTICE: THE BEGINNING OF A MOVEMENT

Although there has been much progress made in the last several decades towards achieving environmental justice, especially within low-income communities and communities of color, much work remains. Urban redevelopment does not always benefit existing communities and often contributes to resident displacement and community gentrification (Logan & Molotch, 1987). The risk of urban development to disadvantaged communities includes equity loss, disinvestment, redlining, loss of affordable housing, loss of employment through changing neighborhood structure, a reduction in neighborhood diversity, remaining environmental burdens and the loss of important community culture (DeSousa, 2006). A lack of information regarding brownfield redevelopment impact on local communities exists to this day.

Gentrification has placed populations in urban areas in direct competition for inner city space with relatively powerful and privileged groups. Environmental cleanup of these formerly industrialized, now residential, communities can be a powerfully displacing force.
- National Environmental Justice Advisory Council

Brownfields are disproportionately located within and around communities of color (Felten, 2005-06; United Church of Christ, 2007; Essoka, 2010). As a result, it was from within these communities major efforts for change originated. Starting with the Civil Rights Movement in the 1960's, the environmental justice movement evolved through a grassroots blend of the social justice movement and the environmental movement, primarily within communities of color. It grew and evolved, culminating in 1991 at the First National People of Color Environmental Leadership Summit in Washington DC. Over 300 representatives from across the nation participated (Fig 3.1) (Alston, 2010). A significant outcome from the summit was the establishment of the 17 Principals of Environmental Justice (EWG, 2016).

Fig 3.1 First National People of Color Environmental Leadership Summit delegates rallying at US Capitol Building in Washington D.C., October 24-27, 1991

During the 1990s, in response to pressure from the Congressional Black Caucus, the Environmental Protection Agency (EPA) created the Environmental Equity Workgroup as a means to study the disparate environmental risk burden placed on populations of color and low income in the United States. Their findings led to the establishment of the Office of Environmental Justice, from which the National Environmental Justice Advisory Council (NEJAC) was developed in 1993.

In 1994, President Clinton signed Executive Order 12898, aimed at achieving environmental protection for all communities, especially low-income and those of color, through public participation and information dissemination. As a result, the Environmental Justice Federal Interagency Working Group (IWG) was developed in 1994, comprised of 11 heads from the departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Homeland Security, Housing and Urban Development, the Interior, Labor, Transportation and Veteran's Affairs, along with the General Services Administration, the Small Business Administration and the White House Office. The IWG sets standards and regulations, issues grants and reviews proposed federal actions regarding environmental justice concerns.

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Fair treatment means that no group of people, including racial, ethnic or socio-economic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal and commercial operations or the execution of federal, state, local and tribal programs and policies.
- US Environmental Protection Agency

To date, these government agencies, along with private and non-profit organizations, are on the forefront of working to achieve environmental justice for communities across the United States through a combination of public meetings, policy review, policy implementation and test cases. The four strategies (EPA, 2012) of the IWG include:

1) *Assist other federal agencies to integrate environmental justice into their programs, policies, and activities.* This includes the publication of environmental justice strategies and implementation progress reports.

2) *Work with other federal agencies to strengthen use of interagency legal tools.* This includes the utilization of the National Environmental Protection Act (NEPA) and Title VI of the Civil Rights Act of 1964 as tools to advance environmental justice goals.

3) *Foster healthy and sustainable communities.* This includes the Sustainable Communities Partnership between the Department of Housing and Urban Development, Department of Transportation, and EPA, which provides commmunity access to affordable housing and transportation while maintaining environmental protection.

4) *Strengthen community access to federal agencies.* This provides community access to federal programs and advisors, and includes nationwide Stakeholder Dialogue Sessions which provide a platform for community members to discuss concerns and best practices for development within their neighborhoods.

Despite these efforts, demographic neighborhood assessments are rarely performed prior to, or after, brownfield remediation. To achieve environmental justice for brownfield park neighborhoods, solutions must be socially and ecologically sensitive to local communities. Although pollutant loads are significantly reduced with brownfield redevelopment (EPA, 2011), the direct community impacts are rarely measured. Potential risks associated with redeveloped sites, such as unaffordable housing and resident displacement, are not fully considered during the redevelopment and revitalization process (NEJAC, 2006).

3.2 PROJECT OVERVIEW

The solution this project proposes is to define environmental justice as a character of urban redevelopment. This is achieved by creating a way to measure the impact of brownfield parks through the lens of environmental justice using case studies and post-occupancy evaluations. A model was developed and tested using two case studies.

This project assumes, based on the widespread presence of industrial sites in urban areas and the prevalence of brownfields, brownfield parks will continue to be built. Due to their attributes, it is assumed brownfield parks will continue to have a significant impact on surrounding neighborhoods (Fig 3.2). The nature of the impact depends greatly on the purpose for which the brownfield park is constructed and long term maintenance planning.

3.3 BROWNFIELD CASE STUDIES + POST OCCUPANCY EVALUATIONS

An evaluative model encompassing both case study analysis and post-occupancy evaluations was developed to measure brownfield park impacts on neighborhoods using literature reviews of Brownfields, Environmental Justice and Urban Redevelopment. These three categories were chosen to evaluate past and current theories and practices applicable to this project. The model was then refined and tested using two case studies.

Brownfield literature encompasses a wide range of topics specific to the condition of the parks. These include future site use potential, the evolution of public opinion on brownfields, current policies, regulations, liability and laws surrounding brownfields, past and current brownfield projects, ethics surrounding brownfields and methods, incentives, barriers and sustainability of

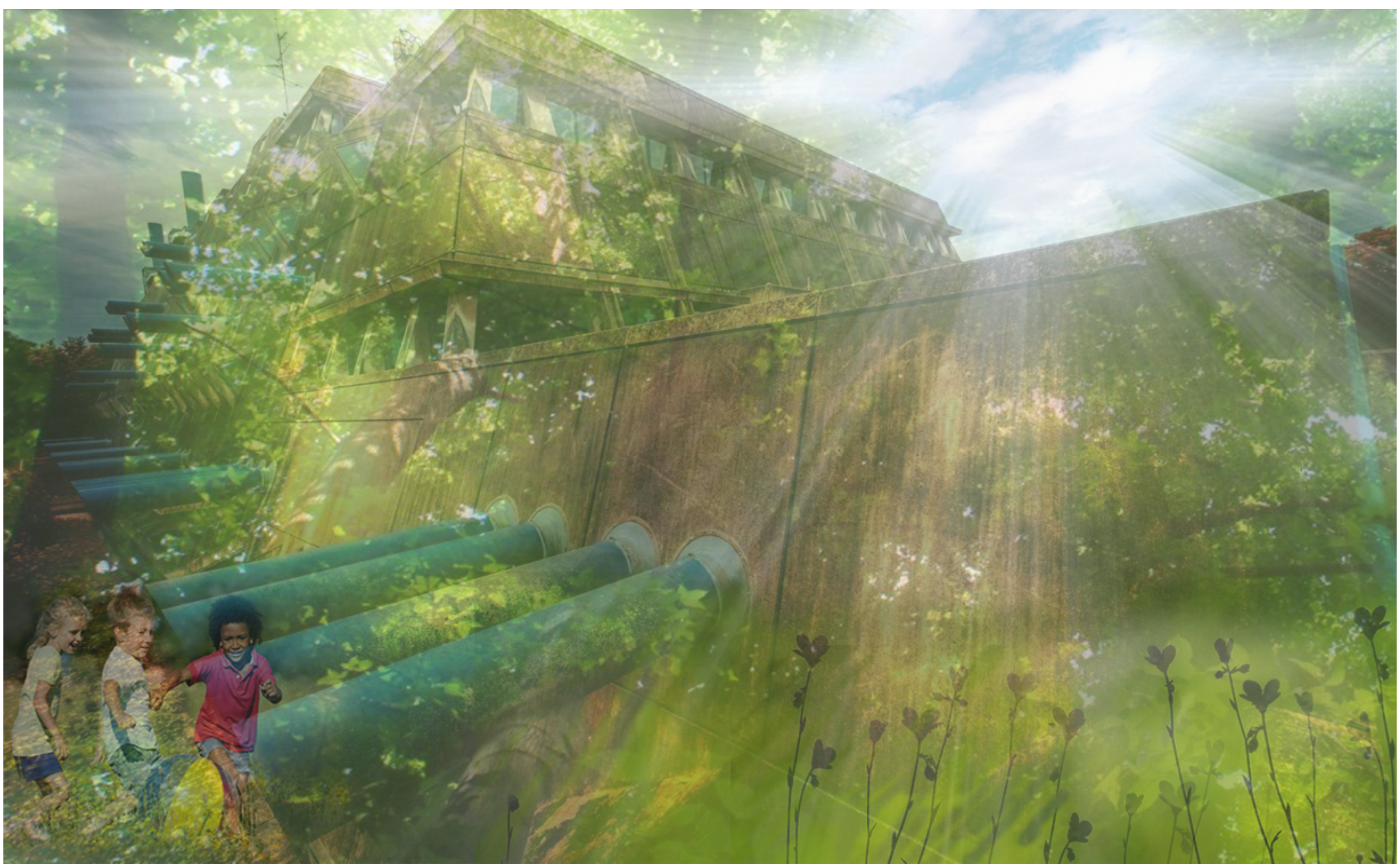


Fig 3.2 Children playing on former toxic site

brownfield remediation projects. All of this directly affects users and surrounding neighbors.

Environmental justice literature investigates racial, social and socioeconomic disparities; methods for achieving equity; public health; community participation; community safety, threats and challenges; safe siting of schools and other public amenities; community mobility; effect of changes in property values; gentrification; quality of life; the definition and current state of environmental justice achieved by low-income and communities of color; and the means to provide equity in environmental decision making among community members. These topics, in relation to urban brownfield parks, are at the core of this project because they all relate to the equity and impact of industry on communities.

Urban redevelopment literature studies best practices for communities and informs the impact of redevelopment; environmental impacts; examples of potential and unintended effects of urban redevelopment; and implications of brownfield redevelopment. All of these topics were essential to understanding the function and impact of brownfield redevelopment on adjacent neighborhoods.

17 PRINCIPALS OF ENVIRONMENTAL JUSTICE

1. Environmental justice affirms the sacredness of Mother Earth, ecological unity and the interdependence of all species, and the right to be free from ecological destruction.

2. Environmental justice demands that public policy be based on mutual respect and justice for all peoples, free from any form of discrimination or bias.

3. Environmental justice mandates the right to ethical, balanced and responsible uses of land and renewable resources in the interest of a sustainable planet for humans and other living things.

4. Environmental justice calls for universal protection from nuclear testing, extraction, production and disposal of toxic/hazardous wastes and poisons and nuclear testing that threaten the fundamental right to clean air, land, water, and food.

5. Environmental justice affirms the fundamental right to political, economic, cultural and environmental self-determination of all peoples.

6. Environmental justice demands the cessation of the production of all toxins, hazardous wastes, and radioactive materials, and that all past and current producers be held strictly accountable to the people for detoxification and the containment at the point of production.

7. Environmental justice demands the right to participate as equal partners at every level of decision-making including needs assessment, planning, implementation, enforcement and evaluation.

8. Environmental justice affirms the right of all workers to a safe and healthy work environment, without being forced to choose between an unsafe livelihood and unemployment. It also affirms the right of those who work at home to be free from environmental hazards.

9. Environmental justice protects the right of victims of environmental injustice to receive full compensation and reparations for damages as well as quality health care.

10. Environmental justice considers governmental acts of environmental injustice a violation of international law, the Universal Declaration On Human Rights, and the United Nations Convention on Genocide.

11. Environmental justice must recognize a special legal and natural relationship of Native Peoples to the U.S. government through treaties, agreements, compacts, and covenants affirming sovereignty and self-determination.

12. Environmental justice affirms the need for urban and rural ecological policies to clean up and rebuild our cities and rural areas in balance with nature, honoring the cultural integrity of all our communities, and providing fair access for all to the full range of resources.

13. Environmental justice calls for the strict enforcement of principles of informed consent, and a halt to the testing of experimental reproductive and medical procedures and vaccinations on people of color.

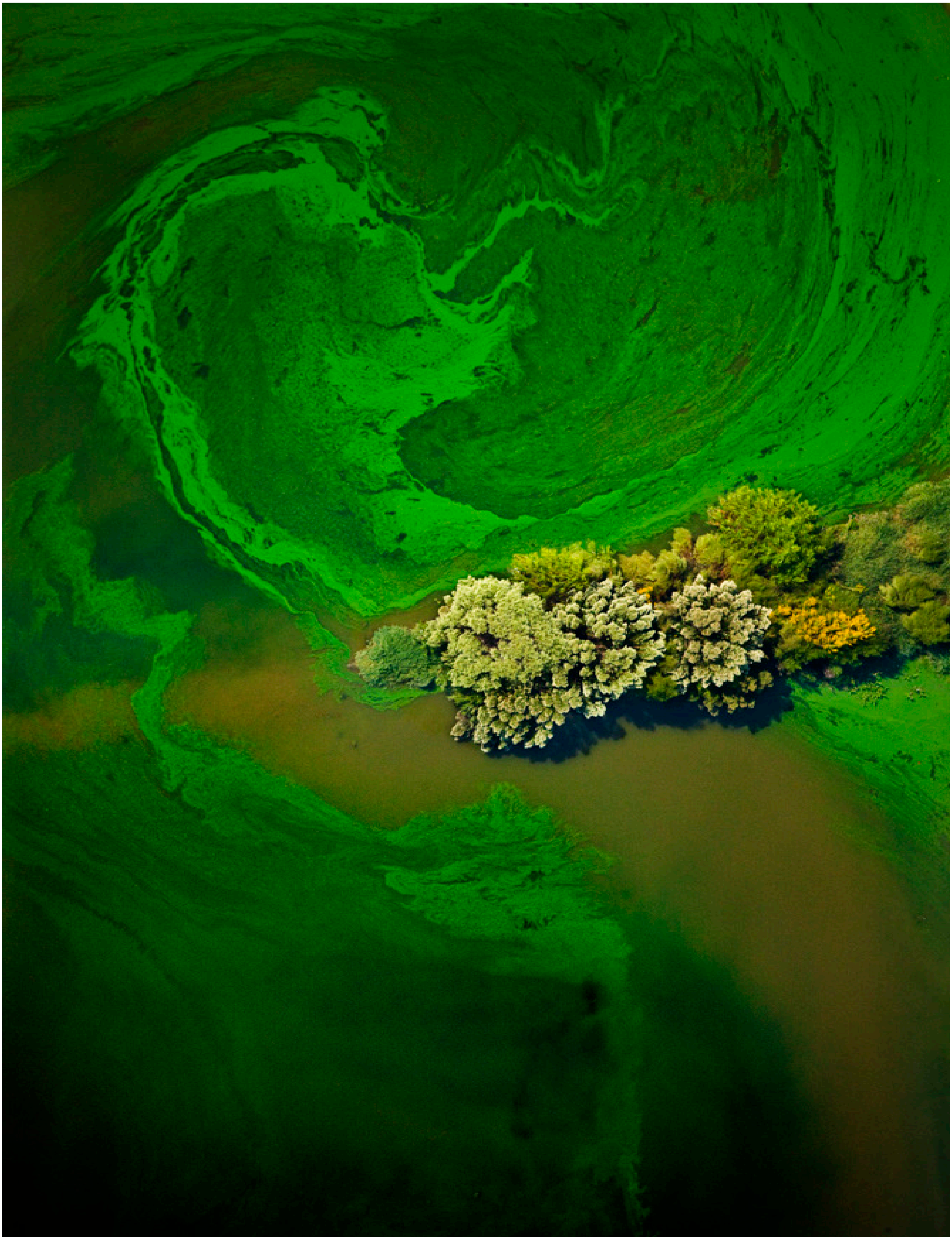
14. Environmental justice opposes the destructive operations of multi-national corporations.

15. Environmental justice opposes military occupation, repression and exploitation of lands, peoples and cultures, and other life forms.

16. Environmental justice calls for the education of present and future generations which emphasizes social and environmental issues, based on our experience and an appreciation of our diverse cultural perspectives.

17. Environmental justice requires that we, as individuals, make personal and consumer choices to consume as little of Mother Earth's resources and to produce as little waste as possible; and make the conscious decision to challenge and reprioritize our lifestyles to insure the health of the natural world for present and future generations.

First National People of Color Environmental Leadership Summit, 1991


Aerial view of herbicide manufacturing waste, photo by J Henry Fair

CHAPTER 4: Environmental Justice Models + Evaluations

4.1 DEFINING ENVIRONMENTAL JUSTICE

Environmental justice is difficult to define. There is much discussion regarding environmental justice, but rarely action taken to elucidate and/or measure it. No common interpretation exists across disciplines; no universal method of study precisely evaluates it.

This project attempts to define and measure environmental justice characteristics, specifically within brownfield neighborhoods, by developing a matrix of measurable indicators, identified through literature review.

Environmental justice addresses issues of: (1) unequal distribution of resources such as clean air and water, healthy food, homes, parks, places to walk and sit in public, etc.; (2) inaccessibility of public goods and resources because of transportation, cost or discrimination; and (3) exclusion from facilities and full participation in decisions about one's community largely because of poverty, prejudice, race, income, recent immigration, or other marginal status. Landscape architects increase or diminish environmental justices by nearly every act of planning and design, either knowingly or unwittingly.
– American Society of Landscape Architects

4.2 DEVELOPING THE EVALUATIVE MODEL: BROWNFIELDS + ENVIRONMENTAL JUSTICE + URBAN REDEVELOPMENT

Following my process diagram (Fig 4.1), I performed the following steps to create a framework by which to evaluate the environmental justice of existing and planned brownfield parks:

1. Perform a thorough literature review of Brownfields, Environmental Justice and Urban Renewal.

2. Develop a preliminary list of literature defined metrics for evaluation. Compare the literature defined metrics to the National Neighborhood Indicators Partnership and Community Health Status Indicator Categories metrics for community and neighborhood health.

3. Investigate these initial metrics to determine which metrics were most frequently cited.

4. Revise metrics based on step 3, to include only those found to be viable, tractable and feasible to gather from available data within the time allowed to complete the Master's project.

5. Run the case study parks through the revised tractable metrics.

6. Perform a post-occupancy evaluation on the case study neighborhoods.

7. Evaluate the results.

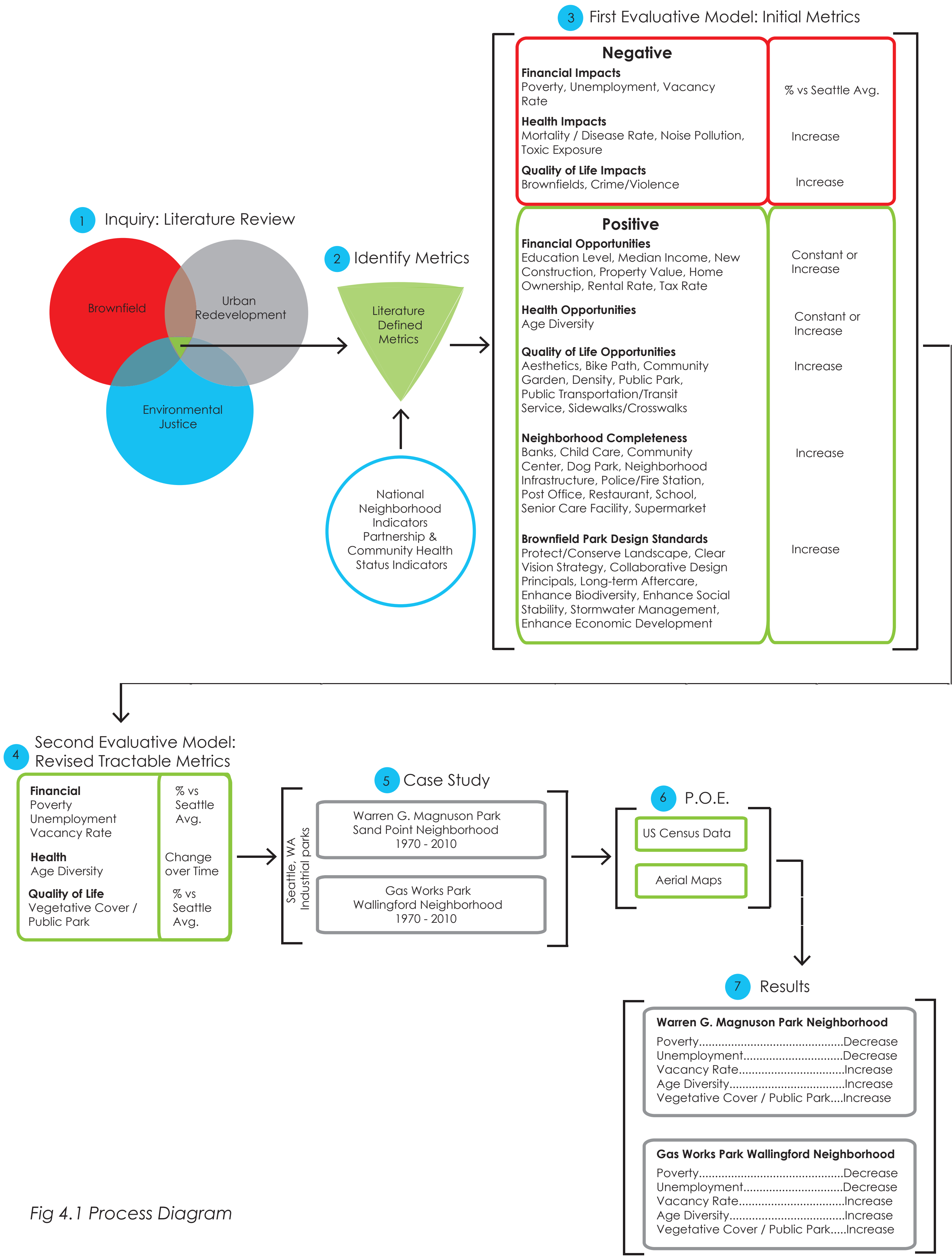


Fig 4.1 Process Diagram

4.3 DEVELOPING THE EVALUATIVE MODEL

The literature review included peer review journals, books written by Landscape Architects and other experts and municipal / government websites. In addition, community park development and brownfield remediation literature were researched to gain a thorough understanding of this subject. This led to a large list of potential metrics (Fig 4.2), which were organized into five categories:

- Financial
- Health
- Quality of Life
- Neighborhood Completeness
- Brownfield Park Design Standards

These five categories evolved out of a blending of national neighborhood health indicators, adapted from the National Neighborhood Indicators Partnership (NNIP), Community Health Indicators, adapted from the Community Health Status Indicators Project (CHSI), and the EPA, which were then used to guide the grouping of related metrics from the literature review (Fig 4.3).

The EPA looks at 6 demographic indicators when evaluating environmental justice. These demographic indicators were developed to *"help achieve EPA's goal for Environmental Justice (i.e., the fair treatment and meaningful involvement of all people). The EPA places particular emphasis on the public health of and environmental conditions affecting minority, low-income, and indigenous populations. In recognizing that these populations frequently bear a disproportionate burden of environmental harms and risks … EPA works to protect them from adverse public health and environmental effects of its programs. EPA should pay particular attention to the vulnerabilities of these populations because they have historically been exposed to a combination of physical, chemical, biological, social, and cultural factors that have imposed greater environmental burdens on them than those imposed on the general population"* (EPA, 2010).

For these same reasons, this project incorporates 3 of the 6 EPA indicators, as based on the literature review of Brownfields, Environmental Justice and Urban Renewal(author's additions italicized, in brackets):

- Percent Low-Income *(Poverty, Unemployment – Financial Category)*
- Percent Minority
- Less Than High School Education
- Linguistic Isolation
- Individuals Under Age 5 *(Age Diversity – Health Category)*
- Individuals Over Age 64 *(Age Diversity-Health Category)*

The social factors and the physical environment are especially important because they represent the conditions in which people are born, work, and play. Neighborhoods with affordable healthy food, safe and accessible housing, and quality employment opportunities can positively influence behaviors and help to create healthy lifestyles.
-Community Health Status Indicators, Centers for Disease Control and Prevention

Financial

The Financial category metrics measure the economic health of a neighborhood. Metrics such as Median Income and Tax Rate track percent change in real and potential income over time by measuring the direct financial status of individuals. Metrics such as Education Level, Poverty and Unemployment are financial analogues to track change in potential income.

LIT. DEFINED METRICS (ADAPTED)	HOW EJ IS MEASURED	AUTHORS: DeSousa (2014)	GAO (1987)	Harnik, Taylor and Welle (2006)	Harnik (2010)	Hollander et at (2010)	Kirkwood (2011)	Loures& Panagopoulos (2007)	Mah (2012)	Siikamäki & Wernstedt (2008)	Wedding & Crawford-Brown (2007)	Way (2013)	Byrnea et al (2009)	Chilton et al (2008)
							Brownfields							
Financial														
Education Level	(Increase/Decrease over Time)												O	O
Median Income	(vs % state average)										O		O	
New Construction	(vs Seattle avg)													
Poverty	(vs % national average)								O					
Property Value	(vs Seattle avg)						O			O	O			O
Home Ownership	(vs Seattle avg)													O
Rental Rate	(vs Seattle avg)										O		O	
Tax Rate	(vs Seattle avg)										O			
Unemployment	(vs % national avg)										O			O
Vacancy Rate	(vs Seattle avg)										O			
Health														
Age Diversity	(vs Seattle avg)													
Mortality / Disease Rate	(vs Seattle avg)								O		O			O
Noise Pollution	(vs Seattle avg)								O					
Toxic Exposure (Air/Soil/Water Pollution)	(vs Seattle avg)					O	O		O	O	O			O
Quality of Life														
Aesthetics	(vs Seattle avg)						O		O					
Bike Path	(Increase/Decrease over Time)													
Brownfields (Existing)	(vs Seattle avg)					O	O		O					O
Community Garden	(vs Seattle avg)				O									
Crime / Violence	(Increase/Decrease over Time)										O			O
Density	(vs Seattle avg)													
Public Park	(within 1 mile)				O	O	O		O	O	O			O
Public Transportation / Transit Service	(vs Seattle avg)													
Sidewalks / Crosswalks (Safe Routes / Walkability)	(Increase/Decrease over Time)													
Neighborhood Completeness														
Banks	(within 1 mile)													
Child Care Facility	(within 1 mile)													
Community Center	(within 1 mile)													
Dog Park	(within 1 mile)													
Neighborhood Infrastructure	(Increase/Decrease over Time)								O		O			O
Police/Fire Station														
Post Office														
Restaurant	(within 1 mile)										O			
School	(within 1 mile)													
Senior Care Facility														
Supermarket	(within 1 mile)										O			
Brownfield Park Design Standards														
Protect/Conserve Landscape	(Increase/Decrease over Time)					O	O	O						O
Clear Vision /Strategy	(Increase/Decrease over Time)				O	O	O	O						O
Collaborative Design Principals	(Increase/Decrease over Time)					O	O	O						
Long-term aftercare	(Increase/Decrease over Time)				O	O	O	O	O	O				
Enhance Biodiversity	(Increase/Decrease over Time)					O	O	O						
Enhance Social Stability	(Increase/Decrease over Time)						O	O		O				
Stormwater Management	(Increase/Decrease over Time)					O	O				O			
Enhance Economic Development	(Increase/Decrease over Time)						O	O	O					
Other														
No Metrics Listed		O	O	O								O		

Fig 4.2 Literature Defined Metrics for Environmental Justice.

Creighton (2005)	Dai (2011)	Dale & Newman (2009)	DeSousa (2006)	DeSousa, et al (2009)	EJSCREEN (2015)	EPA (2005)	EPA (2006)	EPA (2009)	EPA (2010)	EPA (2011)	Essoka (2010)	Felten (2006)	Freeman (2005)	Karaoglu (2004)	Lee & Mohai (2012)Litt	Litt et al (2002)	Loures & Crawford (2008)	Meyer, P (2010)	NEJA (1996)	Rowan & Fridgen (2003)	Soltare & Greenberg (2002)	United Church of Christ (2007)	Wolch, et al (2014)	Checker (2011)	EPA (2011)	Farr (2008)	Frickel & Elliott (2011)	Harnik & Donahue (2011)	NEJAC (2006)	**Totals**
Environmental Justice																								**Urban Redevelopment**						
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							O	O	O											O	O	O	O				O			9
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NATIONAL NEIGHBORHOOD INDICATORS PARTNERSHIP (NNIP)

American Community Survey
After the 2000 Census, ACS estimates measure averages over a one-year, three-year, or five-year period. and are available for all geographies down to the census tract level

Births/Natality
Birth indicators - teen pregnancy, infants with multiple risk factors, demographic change, and projected school enrollments

Deaths/Mortality
mortality and causes of death, health, economic, and safety conditions of our communities

Decennial Census
Census Bureau national household survey for apportioning congressional seats, for identifying distressed areas, age, sex, and race

Home Mortgage Disclosure Act
(HMDA) requires most lending institutions to report mortgage loan applications, including the outcome of the application, information about the loan and applicant, and location of the property,structure type, lien status, and if the loan had high interest rates

Integrated Data Systems (IDS)
links individual level data from multiple agencies such as schools, juvenile justice, and human services, for case management or program monitoring and evaluation

IRS Individual Tax Statistics
The DataPlace Internal Revenue Service (I.R.S.) data files are compiled from zip code data - filer’s age, income level and sources, tax credits and deductions, and tax preparation method

Local Employment Dynamics
(LED) Partnership provide details about America's jobs, workers, employers and local economies and communities. available down to the block group

National Center for Education Statistics
(NCES) conducts an annual survey of every public elementary and secondary school in the United States - school level, grades taught, student-teacher ratio, and federal Title I funding eligibility, race/ethnicity, free/reduced price lunch eligibility, migrant status, and gender

Police practices

Property sales/assessment
Tracking property sales volume and prices

Property surveys
Land use, building condition, or occupancy status

USPS Vacancy Data
Quarterly aggregate data on addresses identified by the USPS as having been "vacant" or "No-Stat" in the previous quarter. for tracking neighborhood change on a quarterly basis. represent the universe of all addresses in the United States and are updated every three months. Census Tract level

ZIP Business Patterns
Produced annually, useful for studying the economic activity of small areas; analyzing economic changes over time; and benchmarking statistical series, surveys, and databases between economic censuses. The Business Patterns series provides information on number of establishments and employment

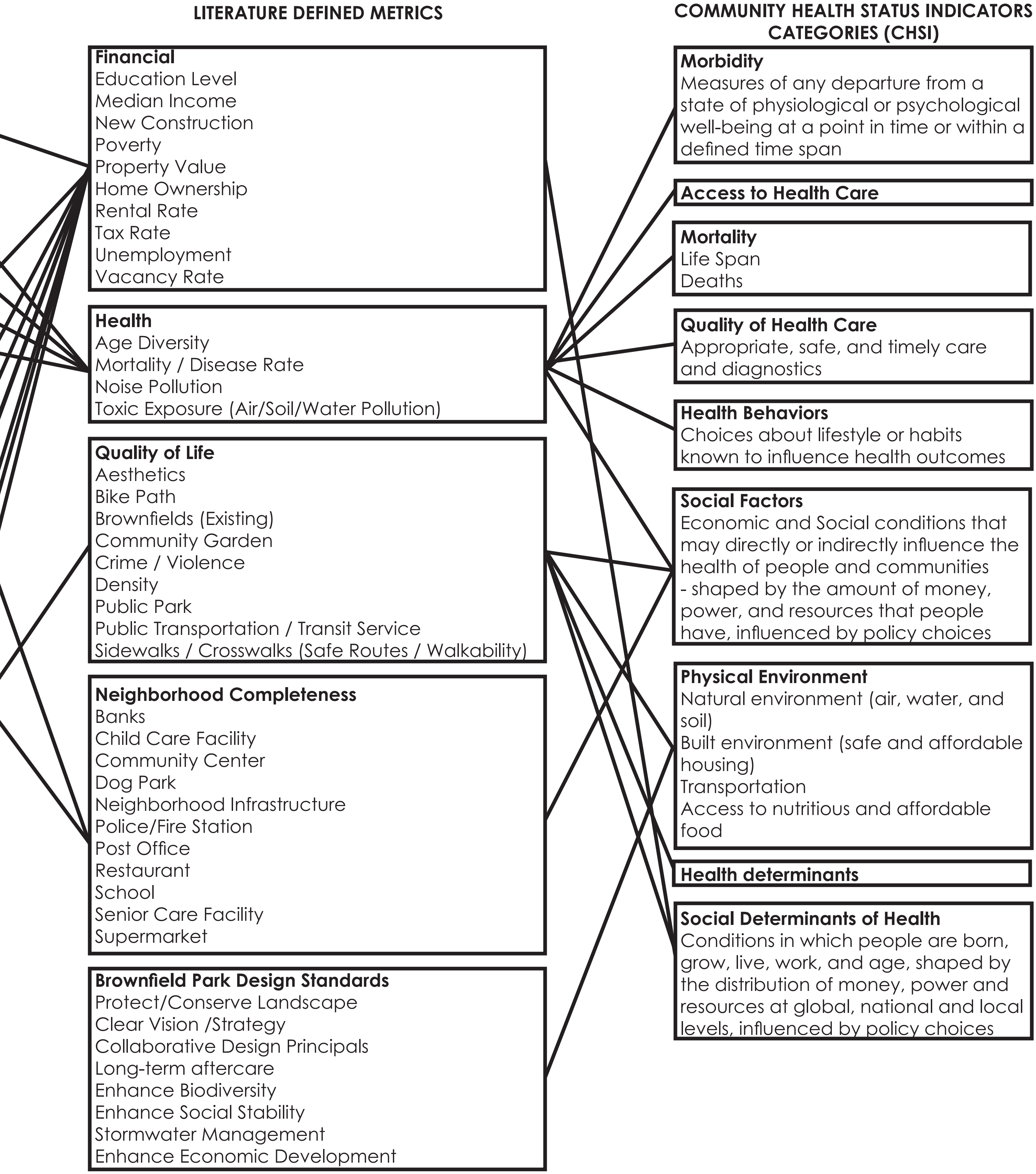

Fig 4.3 NNIP, Literature Reveiw and CHSI metrics comparison charts

The criteria for identifying a census tract as low-income are from the Department of Treasury's New Markets Tax Credit (NMTC) program. This program defines a low-income census tract as any tract where the tract's poverty rate is greater than 20 percent. The US Department of Agriculture (USDA) defines a food desert as any census district where at least 20 percent of the inhabitants are below the poverty line and 33 percent live over a mile from the nearest supermarket.

Metrics such as Property Value and Home Ownership are direct financial indicators which track the value of real property. Metrics such as New Construction, Rental Rate and Vacancy Rate metrics were identified as indirect financial indicators to track changes in monetary expenditure and use over time for real property within the study area.

The metrics most cited for neighborhood robustness in this category were Property Value (17 times), and Poverty (13 times). Unemployment and Education Level were each cited 10 times.

Health

The Health category metrics track changes in individual health and health risks over time for community members. This provides insight on the effects of brownfield development on community health and gauges whether remediation and park construction present a higher or lower health risk to community members.

The metric Age Diversity was identified as an indirect indicator of neighborhood resiliency and self-sufficiency. Metrics such as Mortality/Disease Rate, Noise Pollution and Toxic Exposure (Air/Soil/Water Pollution) were identified as direct indicators of the health of individuals within the neighborhood.

The metrics most cited for neighborhood health in this category were Toxic Exposure (Air/Soil/Water Pollution) (24 times) and Mortality/Disease Rate (13 times). Age Diversity and Noise Pollution were each cited 3 times.

Quality of Life

The Quality of Life category included metrics which were identified as correlating a high and low quality of life for neighborhood residents. This evaluates neighborhood risks and opportunities presented to residents which directly affect their everyday lives.

Metrics such as Aesthetics, Bike Paths, Community Gardens, Density, Public Parks, Public Transportation/Transit Services, Sidewalks/Crosswalks (Safe Routes/ Walkability) are direct indicators of public investment, inferring a high quality of life and access to amenities beneficial to the community.

Metrics which were identified as inferring a low quality of life, such as Brownfields (Existing) and Crime/Violence are a direct measure of increased risk to residents and infer the needs of the population are not being met.

The metrics most cited for quality of life in this category were Public Parks (14 times) and Existing Brownfields (9 times.)

Neighborhood Completeness

The Neighborhood Completeness category included metrics which were identified as providing both desirable and necessary services within the study area, regardless of access to public or private transportation. Because these metrics are typically scarce in depressed neighborhoods, this category identified whether an area has high livability standards. Food Security is defined as "People having at all times, physical, socialand economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" by the United Nations (Perez-Escamilla, 2008.)

These metrics are a direct indicator of community health and included Banks, Child Care Facilities, Community Centers, Dog Parks, Neighborhood Infrastructure, Police/Fire Stations, Post Offices, Restaurants, Schools, Senior Care Facilities and Supermarkets. These metrics were further refined to three sub-categories:

- Food Security
    - o Restaurant, Grocery
- Services
    - o Bank, Fire Station, Police, Post Office
- Social Services
    - o Child Care Facility, Community Center, School, Senior Care Facility

The metrics most cited for neighborhood completeness in this category were Neighborhood Infrastructure (4 times) and Supermarkets (3 times).

Brownfield Park Design Standards

The Brownfield Park Design Standards category included metrics central to the goals and benefits of brownfield remediation: Protect/Conserve Landscape, Clear Vision/Strategy, Collaborative Design Principals, Long-term Aftercare, Enhanced Biodiversity, Enhanced Social Stability, Stormwater Management and Enhanced Economic Development. These metrics are direct indicators for identifying park sustainability, and social and financial investment in the site, which imply the site will provide long term benefits to users and the immediate environment alike.

The metrics most cited for brownfield park design standards in this category Enhanced Social Stability (9 times), Protect/Conserve Landscape and Long-term Aftercare (8 times each).

List of Most Cited Literature Review Metrics

The most cited elements in each category (Fig 4.4) proved a starting point for locating significant metrics. I then worked to see which among them were tractable. They included, within the Financial category, the metrics Property Value, Poverty, Unemployment and Education; within the Health category, the metrics Age Diversity, Mortality/Disease Rate, Noise Pollution and Toxic Exposure (Air/Soil/Water Pollution); within the Quality of Life category, the metrics Existing Brownfields and Vegetative Cover/Public Park; within the Neighborhood Completeness category, the metrics Neighborhood Infrastructure and Supermarkets; and within the Brownfield Park Design Standards category, the metrics Enhanced Social Stability, Protect/Conserve Landcape and Long-tern Aftercare.

METRIC	NUMBER OF TIMES CITED
Financial	
Property Value	17
Poverty	13
Unemployment	10
Education	10
Health	
Age Diversity	3
Mortality/Disease Rate	13
Noise Pollution	3
Toxic Exposure (Air/Soil/Water Pollution)	24
Quality of Life	
Existing Brownfields	9
Vegetative Cover / Public Park	14
Neighborhood Completeness	
Neighborhood Infrastructure	4
Supermarkets	3
Brownfield Park Design Standards	
Enhanced Social Stability	9
Protect/Conserve Landscape	8
Long-term Aftercare	8

Fig 4.4 Literature Review most cited metrics

4.4 MODELS AND EVALUATIVE CATEGORIES

After the matrix was developed the two case study parks were run through the model to test it. The list of metrics was refined from those most commonly cited in the literature into a tractable set of metrics by reviewing the available data, and eliminating metrics that had no data to allow an accurate evaluation of the case studies through those lenses. Most of the metrics were removed from the case study because they were unable to be located (time series data for the 40 year period, 1970 to 2010, were unavailable in many cases) or too time consuming to obtain within the scope of this Master's Project.

Data to evaluate at least one analogue for each of the above listed categories was the revised project objective, but again not possible due to difficulties with data sourcing, in large part because information from 1970 was necessary in order to achieve the study goals of including pre- and post-park information. For census data, spatial limits were defined by the tracts surrounding the case study sites. Spatial limits for the aerial maps included areas within 1 mile of the case study parks. Using available, tractable data for the time frame required, the metrics were narrowed down to five, within three categories (Fig 4.5).

The Quality of Life category metric was modified to Vegetative Cover / Public Park, and was used to indicate cues of care, affluence and access to green space. The evaluative model was then modified based on the revised metrics.

During the literature review, thresholds for each metric were found to be both varied and undefined, based on the current state of research. To overcome this, thresholds were adapted from established state levels (for Poverty, Unemployment and Vacancy Rate); Age Diversity was evaluated as a comparison to the city average; and the USDA definition of food desert was adapted to evaluate vegetative cover: a residence is defined as being located within a park desert if greater than 1 mile from a public park (USDA, 2010).

4.5 DATA PROXIES

Due to the time frame required for this project, it was not possible to include many of the desirable metrics due to difficulty finding or gaining access to the information. Because of this, data proxies were used as stand-ins for other data when primary data sources were unavailable. Available data was extrapolated and applied to the project criteria to achieve a gradient or change over time for each of the final categories.

Instead of defining thresholds quantitatively, I chose to define them qualitatively. Changes over time were tracked to evaluate environmental justice for each case study. This allowed me to track changes, for example, in Poverty levels, and evaluate the environmental justice as a gradient based on these changes.

LIT. DEFINED METRICS (ADAPTED)	HOW EJ IS MEASURED
Financial	
Poverty	(vs Seattle avg)
Unemployment	(vs Seattle avg)
Vacancy Rate	(vs Seattle avg)
Health	
Age Diversity	(vs Seattle avg)
Quality of Life	
Vegetative Cover / Public Park	(within 1 mile)

Fig 4.5 Revised Evaluative Model

Financial

Metrics for the Financial category (Fig. 4.6) were reduced to the three most tractable: Poverty, Unemployment and

Financial	
Education Level	(Increase/Decrease over Time)
Median Income	(vs % state average)
New Construction	(vs Seattle average)
Poverty	**(vs Seattle average)**
Property Value	(vs Seattle average)
Home Ownership	(vs Seattle average)
Rental Rate	(vs Seattle average)
Tax Rate	(vs Seattle average)
Unemployment	**(vs Seattle average)**
Vacancy Rate	**(vs Seattle average)**

Fig. 4.6 Financial category metrics most cited to best track environmental justice of brownfield redevelopment on adjacent neighborhoods. Final, tractable selections in bold.

Vacancy Rate. These were determined to be excellent proxies for the other metrics which were either unavailable or too time consuming to collect during the scope of the Master's project, because they speak directly to the financial health of the neighborhoods.

Percent poverty is a significant indicator of neighborhood health and viability. By comparing the percent poverty in census tracts surrounding the case study parks with the Seattle average, differences may be identified and potentially correlated with park development.

Percent Unemployment is a good metric for evaluating the effect of the parks on the neighborhoods because unemployment `increases signify a change in real and potential income, which negatively affects neighborhood dynamics and stability. If jobs are leaving the neighborhood after a brownfield site closes and transitions into a park, this has a negative impact on the financial health of the local community due to the inability for residents to provide for themselves and their families.

Vacancy Rate is a proxy for Financial Health and examines indirect financial indicators and evaluates changes in use, over time, for real property within the study area. This aids in measuring the economic health of the neighborhoods. Higher vacancy results signify a lack of available tenants able or willing to pay for housing, and a net loss of profit for the property owners resulting from the vacant residences. Lower vacancy signifies the area is a desirable location within which to live and affordable for at least some segment of the population.

Health

Age diversity was determined to be the best proxy for the Health Category (Fig 4.7), because this metric measures the number of youth, adults and seniors in the community. In a gentrified neighborhood, age diversity is typically very low due to families being displaced and wealthy individuals within a narrower age range moving in. Neighborhoods with high diversity are assumed to be more equitable due to the ability to provide housing for a wide range of individuals.

Health	
Age Diversity	**(vs Seattle average)**
Mortality / Disease Rate	(vs Seattle average)
Noise Pollution	(vs Seattle average)

Fig. 4.7 Health category metrics most cited to best track environmental justice of brownfield redevelopment on adjacent neighborhoods. Final, tratable selection in bold.

Age Diversity is significant for this project because a population with greater age diversity signifies a range of housing options, incomes and lifestyles while a population with little Age Diversity signifies a more consistent range of housing options and income, which potentially indicated a gentrified neighborhood.

Social resiliency and the economic self-sufficiency of community members, and therefore the neighborhood, may be evaluated via age diversity. The Dependency Ratio of children (0-14 years old) and seniors (55 years or over) compared to the working-age population (15-54 years old) indicates the potential level of dependency between these demographics within the community (EPA, 2010). This ratio points to widespread impacts if workers are unable to provide for their dependents. For example, in a single income household, an entire family could face financial hardship if the only source of income is unable to find or maintain employment.

Quality of Life

Vegetative Cover / Public Parks was chosen as a proxy for the Quality of Life category (Fig 4.8) because green spaces denote care, requiring time and money to maintain. This infers a high enough quality of life to be able to dedicate resources for recreation and pleasure. In addition, numerous studies confirm the positive effects of vegetation on human health along with the impact of ecosystem services in vegetated areas and increase in property values.

Quality of Life metrics unable to be located in the time allowed included Aesthetics, Bike Paths, Sidewalks/Crosswalks (Safe Routes)/ Walkability, Crime, Density and Public Transportation/Transit Service.
Aesthetics are difficult to apply quantitative measurements to because they are so subjective. Bike Path data, along with Sidewalks / Crosswalks (Safe Routes) / Walkability has only recently begun to be tracked and was too time consuming to accurately account for. Crime data was a metric holding much promise in tracking environmental justice within the case study neighborhoods. After contacting the Seattle Police Department, crime data was found to be complicated to access. Density was another metric proving too difficult to track for the time period of this study. Public Transportation / Transit Service required more time than was available to track accurately.

Neighborhood Completeness	
Food Security (Restaurant, Grocery)	(within 1 mile)
Services (Bank, Fire Station, Police, Post Office)	(Increase/Decrease over Time)
Social Services (Child Care Facility, Community Center, School, Senior	

Fig. 4.9 Neighborhood Completeness category metrics most cited to best track environmental justice of brownfield redevelopment on adjacent neighborhoods. Final, tratable selection in bold.

Quality of Life	
Aesthetics	(vs Seattle average)
Bike Path	(Increase/Decrease over Time)
Brownfields (Existing)	(vs Seattle average)
Community Garden	(vs Seattle average)
Crime / Violence	(Increase/Decrease over Time)
Density	(vs Seattle average)
Vegetative Cover / Public Parks	**(within 1 mile)**
Public Transportation / Transit Service	(vs Seattle average)
Sidewalks / Crosswalks (Safe Routes / Walkability)	(Increase/Decrease over Time)

Fig. 4.8 Quality of Life category metrics initially chosen to best track environmental justice of brownfield redevelopment on adjacent neighborhoods. Final selection in bold.

Neighborhood Completeness

Metrics for the Neighborhood Completeness category (Fig 4.9) required extensive research through public documents to obtain, and in some cases was not recorded. Due to the difficult nature of gathering these

Brownfield Park Design Standards	
Protect/Conserve Landscape	(Increase/Decrease over Time)
Clear Vision /Strategy	(Increase/Decrease over Time)
Collaborative Design Principals	(Increase/Decrease over Time)
Long-term aftercare	(Increase/Decrease over Time)
Enhance Biodiversity	(Increase/Decrease over Time)
Enhance Social Stability	(Increase/Decrease over Time)
Stormwater Management	(Increase/Decrease over Time)
Enhance Economic Development	(Increase/Decrease over Time)

Fig. 4.10 Brownfield Park Design Standards category metrics most cited to best track environmental justice of brownfield redevelopment on adjacent neighborhoods. Final, tratable selection in bold.

metrics within the time frame, this category was removed from the study.

Brownfield Park Design Standards

Metrics for Brownfield Park Design Standards category (Fig 4.10) are only measurable if made clear at the beginning of a project. I was unable to locate information pertaining to the two case study parks which spoke to these standards, beyond meeting public safety standards for toxic exposure at the time the parks were remediated. As a result, this category was removed from the case study.

Final Metrics

Based on the literature review of Brownfields, Environmental Justice and Urban Renewal, five categories were developed with fourty-five potential metrics. Verifying through available data and using data proxies, the metrics were narrowed to five within three categories. These five metrics serve to measure the impact of a brownfield park on its neighborhood.

4.6 METRIC SOURCES: CENSUS DATA AND AERIAL MAPS

Census Tracts for Seattle and the Case Study Neighborhoods

Although the neighborhood census tracts do not all fit neatly within the neighborhood boundaries, they are closely enough associated to be included for this project.

Census Tract*	Seattle Neighborhood	Case Study Park
22	View Ridge	Warren G Magnuson Park
23 (Also 2398)	Sand Point	Warren G Magnuson Park
24	View Ridge	Warren G Magnuson Park
38	View Ridge	Warren G Magnuson Park
39	View Ridge	Warren G Magnuson Park
40 (Also 4098)	View Ridge	Warren G Magnuson Park
41	Laurelhurst / Windermere	Warren G Magnuson Park
42	Hawthorne Hills / Bryant	Warren G Magnuson Park
49	Fremont	Gas Works Park
50	Wallingford	Gas Works Park
51	Wallingford	Gas Works Park
54	Wallingford	Gas Works Park

*Census Tract numbers have been abbreviated for clarity. Full Census Tract numbers are 530 3300 XX00. (XX being the numbers listed above, unless otherwise noted).

Fig 4.11 Census Tract neighborhoods and associated case study parks

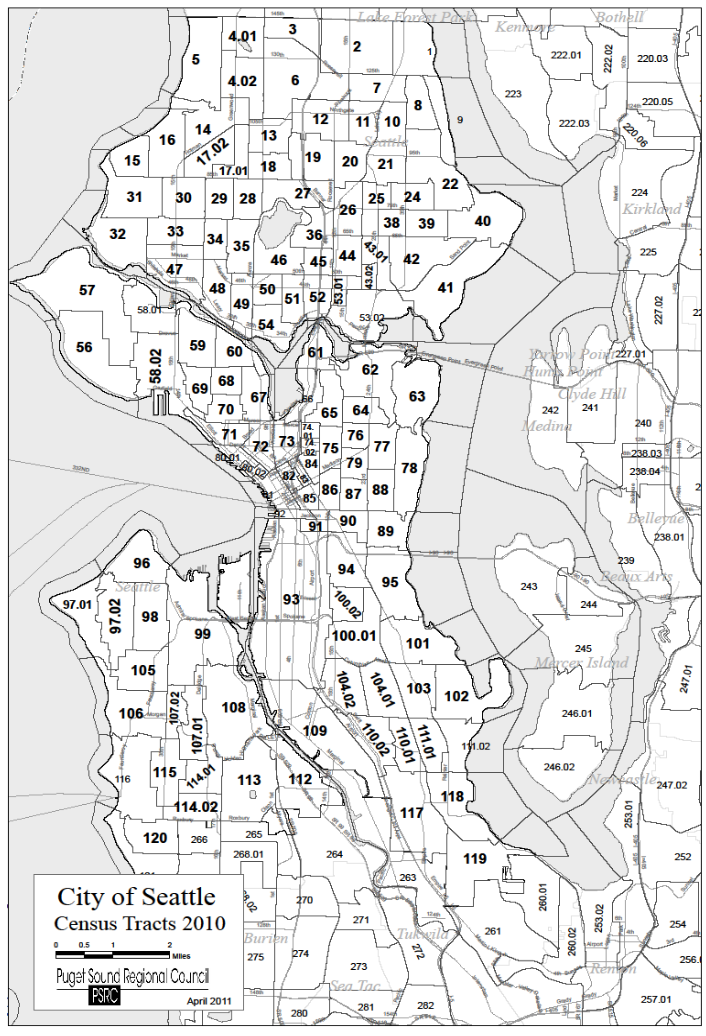

Fig 4.12 City of Seattle Census Tracts, 2010

The table (Fig 4.11) clarifies which census tract most closely fits within each Seattle neighborhood. All 133 census tracts within Seattle, WA, are included for this project (Fig 4.12).

Census Data

Census data was utilized to track change over time, every ten years, beginning in 1970 and continuing through 2010. The Financial category metrics Poverty, Vacancy and Unemployment were compared to the Seattle average to account for regional trends. The Health category metric Age Diversity was evaluated for change over time.
The finest grain of census data available prior to 1980 is the census tract. This means all census tracts touching the 1 mile radii for the case study neighborhoods were chosen to be included in this project.

Both area covered by census tracts and the identifying number of the tracts themselves changed over time (Figs. 4.13 – 4.16). Additionally, information collected was inconsistent from decade to decade as were identifying codes for each census metric. The metrics of Age Diversity (available 1970-2010), Poverty (available 1970-1990), Vacancy (1970-2000) and Unemployment (available 1970-1990), were sourced from census data.

Aerial Maps

Aerial maps were gathered for approximate ten year timeframes (Fig 4.17 – 4.26). Maps from 1969, 1980, 1990, 2002 and 2010 were used to track visible changes in vegetative cover and public parks within the neighborhood case studies during the study period for the Quality of Life category. Changes over time were then measured and evaluated. A margin of error exists due to using historic aerial maps, where some vegetation may be difficult to distinguish, but by using maps from the same year and the same method for calculating vegetative area, any error present should be similar across the study sites and decades. All calculations were rounded to the nearest whole number.

The areas chosen for the case study neighborhoods constitute a radius of approximately 1 mile from the center of each of the chosen brownfield parks. This was determined to be the area of greatest impact on case study neighborhoods by their respective brownfield parks.

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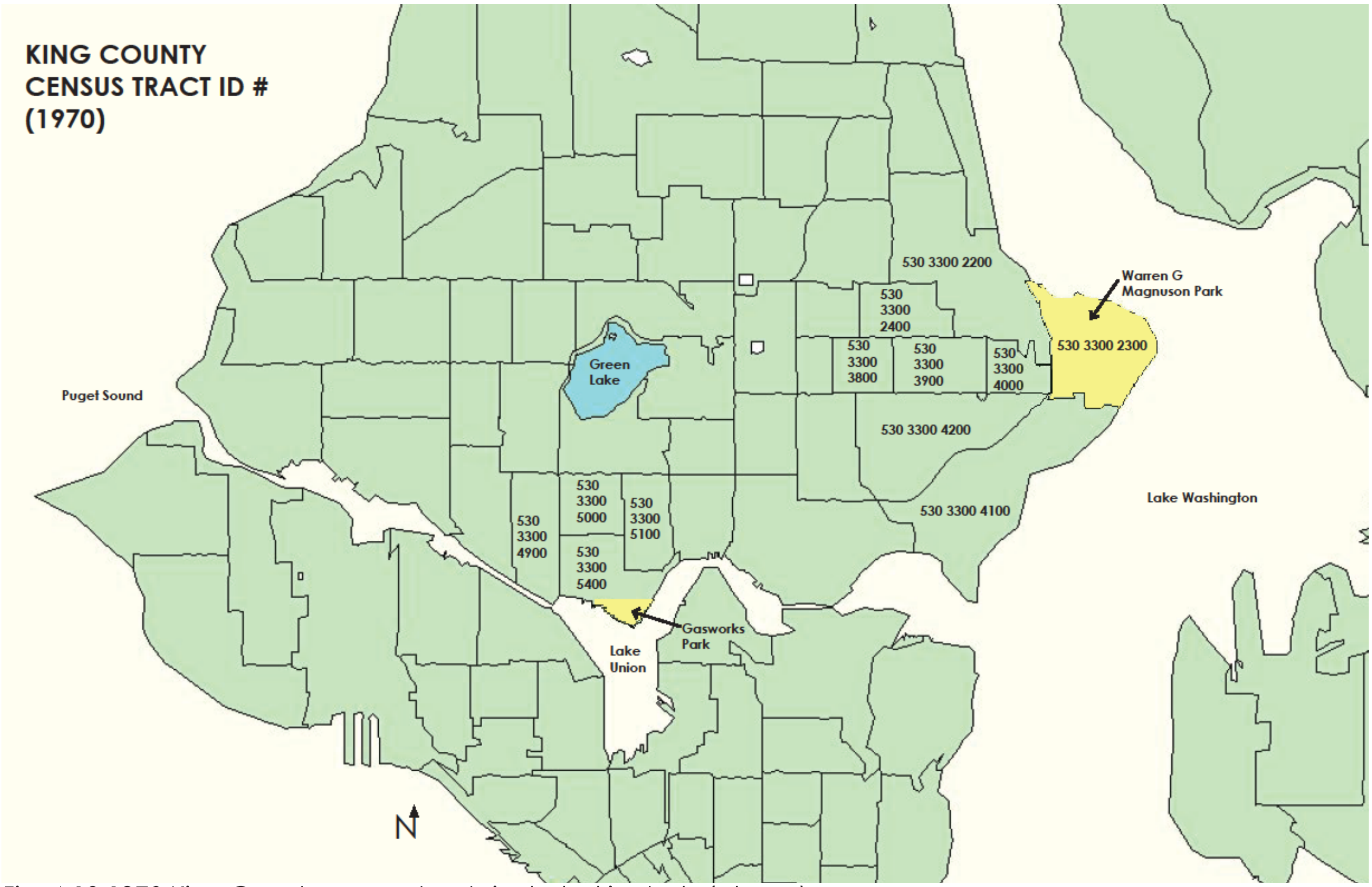
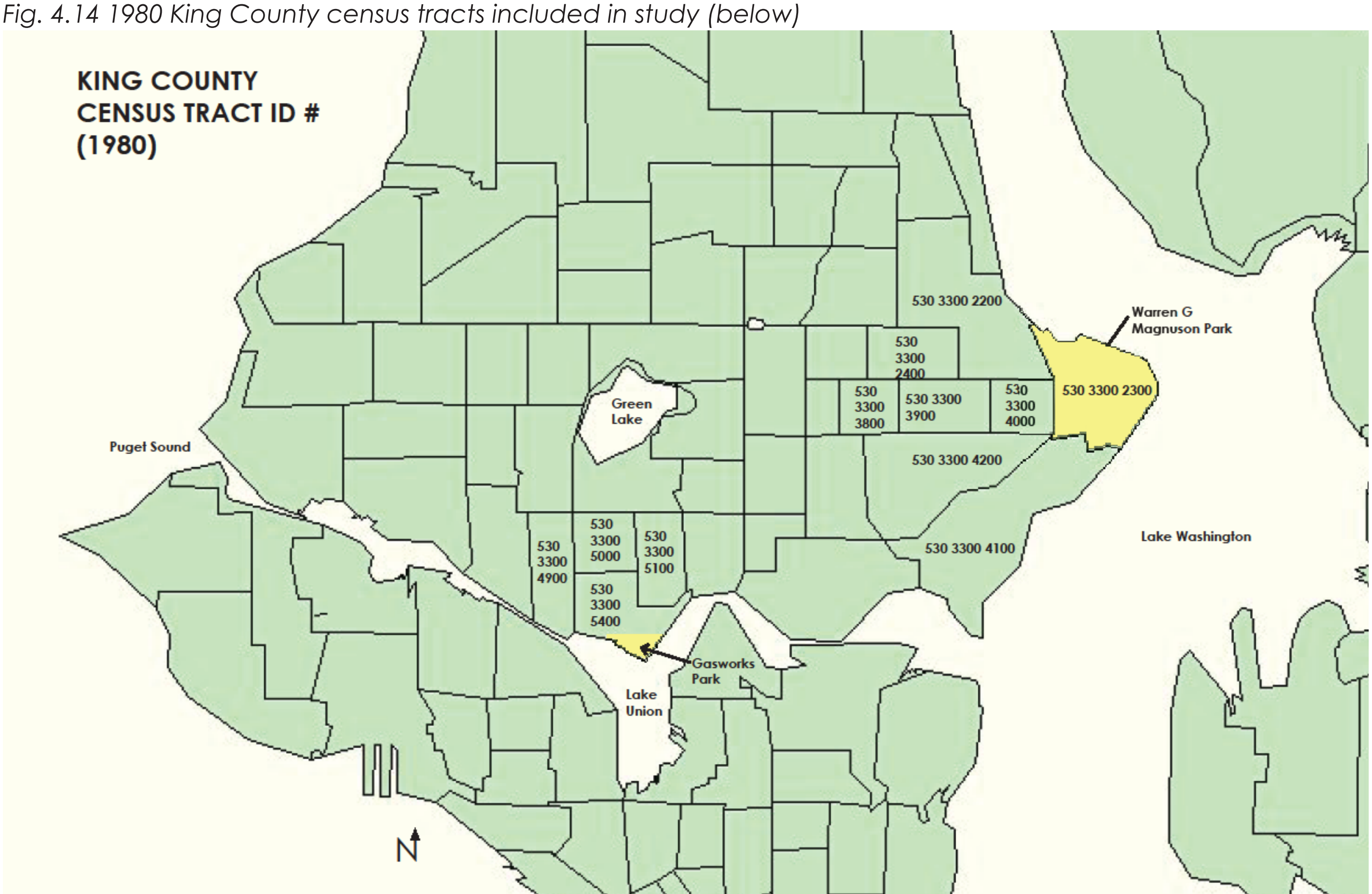


Fig. 4.13 1970 King County census tracts included in study (above)

Fig. 4.14 1980 King County census tracts included in study (below)



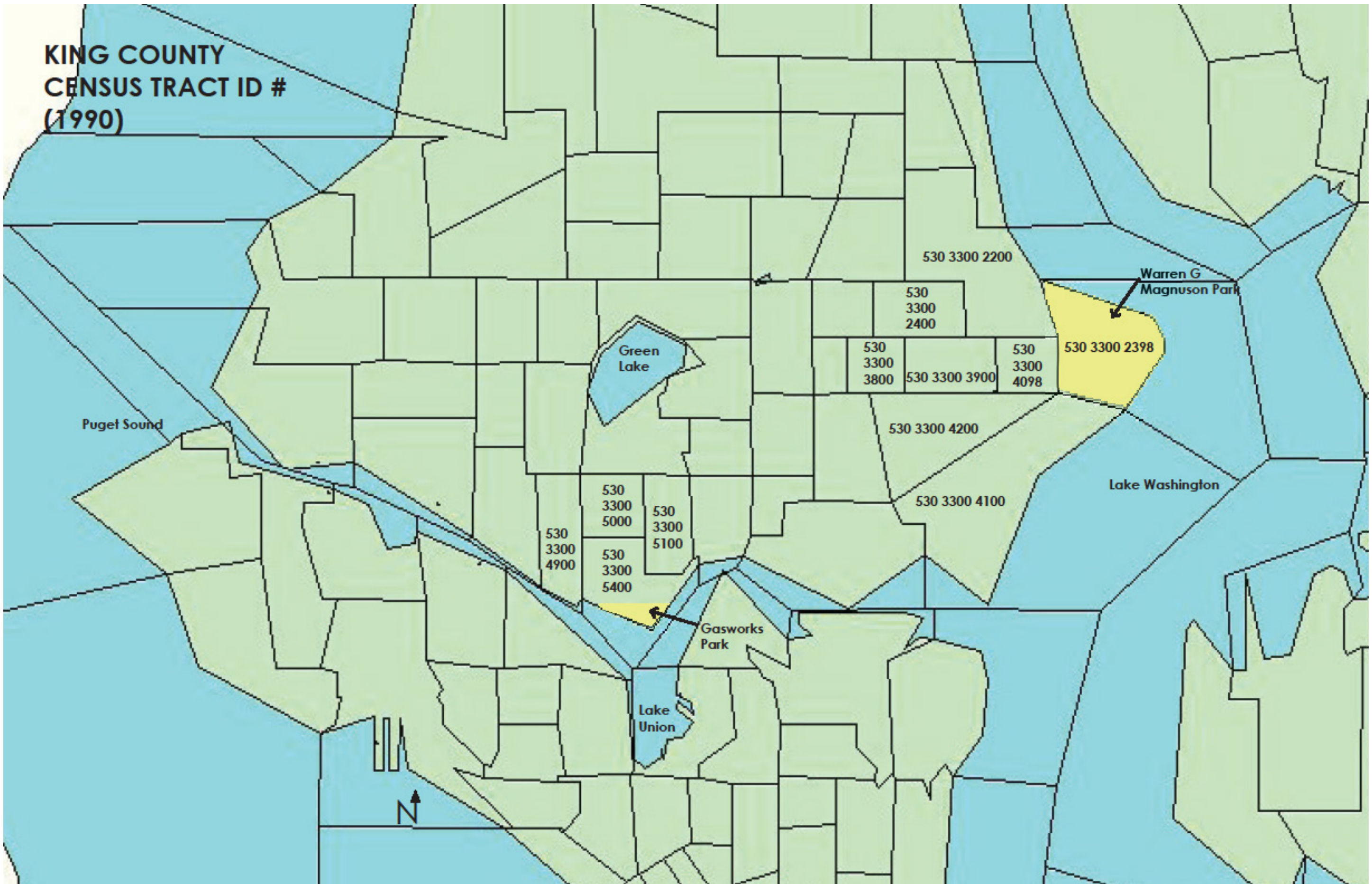
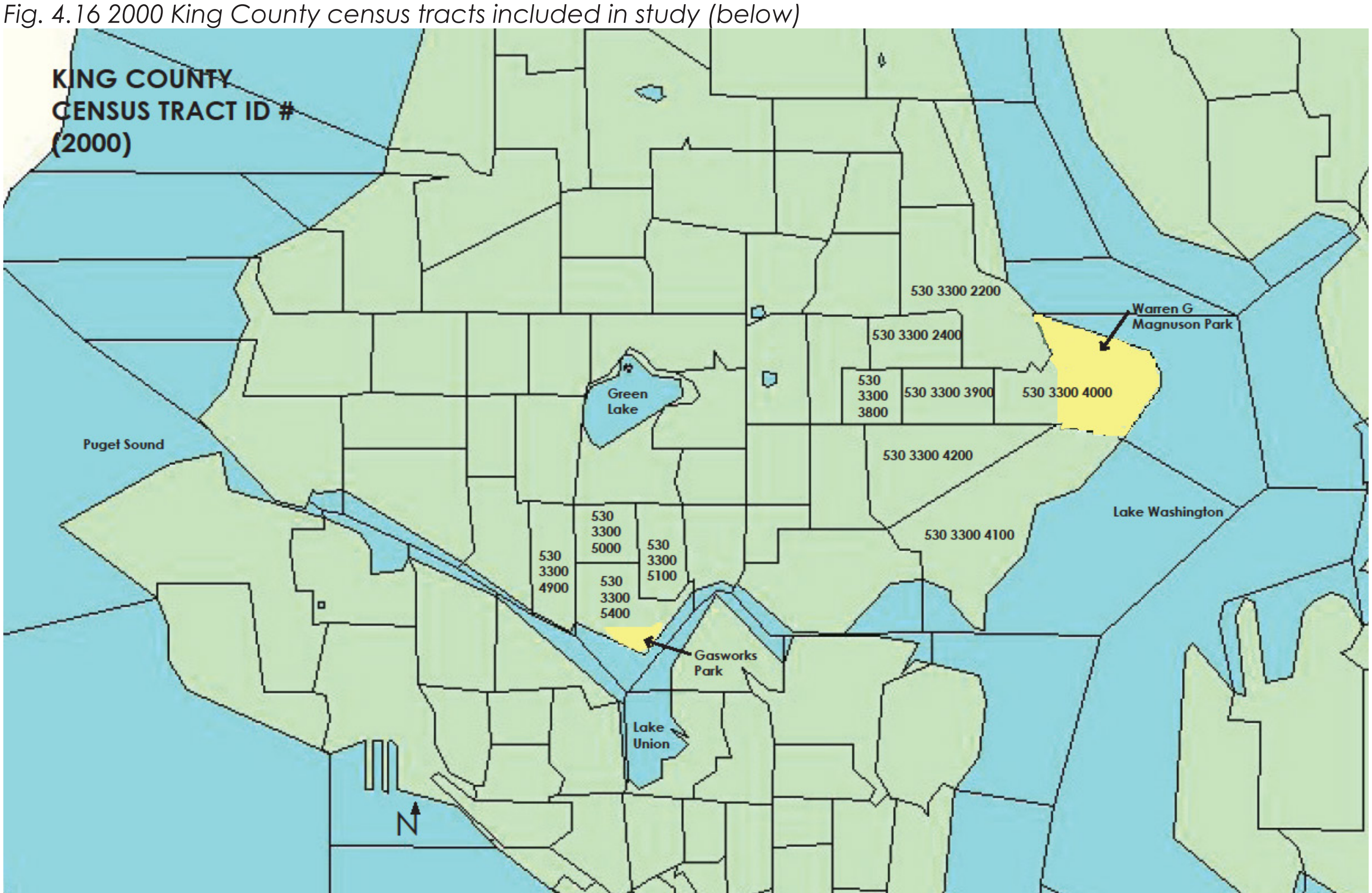


Fig. 4.15 1990 King County census tracts included in study (above)

Fig. 4.16 2000 King County census tracts included in study (below)



Gas Works Park

The case study boundaries for Gas Works Park were N 45th Street, to the North, Ship Canal Bridge / 1-5 to the East, Aurora Ave N to the West and Lake Union, to the South. This approximate 1 mile study area, shown on the maps below (Fig 4.17 – 4.21) constituted the first case study neighborhood.

Fig. 4.17 Map of Gas Works Park and neighborhood (1969)

Fig. 4.18 Map of Gas Works Park and neighborhood (1980)

Fig. 4.19 Map of Gas Works Park and neighborhood (1990)

Fig. 4.20 Map of Gas Works Park and neighborhood (2002)

Fig. 4.21 Map of Gas Works Park and neighborhood (2010)

Warren G Magnuson Park

The case study boundaries for Warren G Magnuson Park were NE 95th Street to the North, NE 47th Street to the South, 40th Ave NE to the West and Lake Washington to the East. This approximate 1 mile study area, shown on the maps below (Fig 4.22 – 4.26) constituted the second case study neighborhood.

Fig. 4.22 Map of Warren G Magnuson Park and neighborhood (1969)

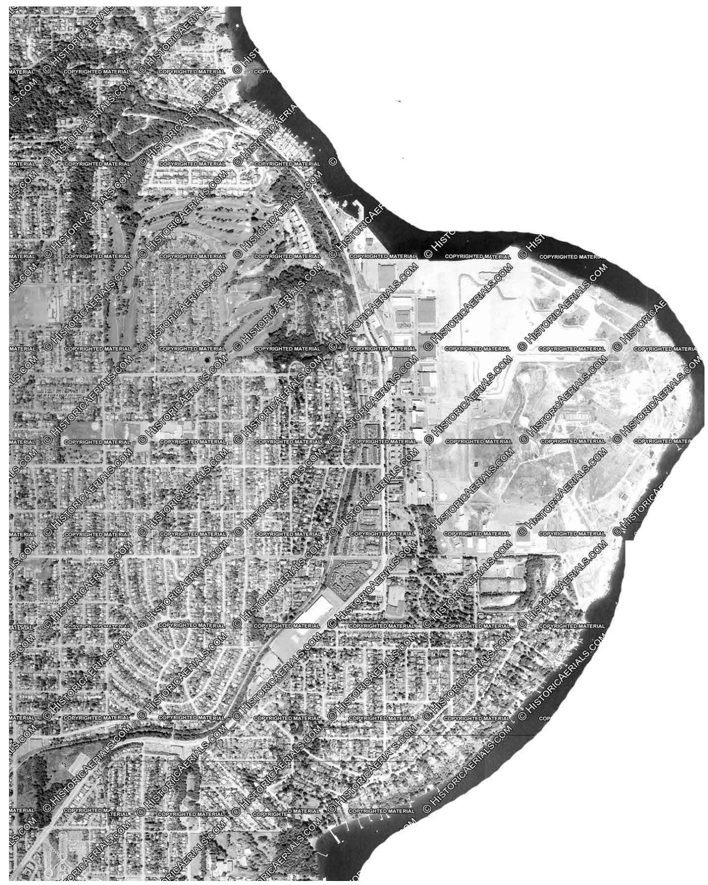


Fig. 4.23 Map of Warren G Magnuson Park and neighborhood (1980)

Fig. 4.24 Map of Warren G Magnuson Park and neighborhood (1990)

Fig. 4.25 Map of Warren G Magnuson Park and neighborhood (2002)

Fig. 4.26 Map of Warren G Magnuson Park and neighborhood (2010)

Aerial view of oil sands tailing pond, photo by J Henry Fair

CHAPTER 5: Case Study Sites

5.1 CASE STUDY INTRODUCTION

The two case study sites are located in Seattle, Washington (Fig. 5.1). They were chosen for their location in the Pacific Northwest (which offered easy access during the research phase of this project), their long history (both brownfields were converted to parks in the 1970s, over 40 years ago, which allows for tracking changes in the adjacent communities over a substantial time frame), and their similarities to each other (large public parks located on the Seattle waterfront).

5.2 WARREN G MAGNUSON PARK, SEATTLE, WA (INDUSTRIAL BROWNFIELD, 1977)

Before Warren G Magnuson Park – The History of Sand Point Airfield

Warren G Magnuson Park has a rich military history. Originally the Sand Point Airfield, this site was established by the US Government in 1920, one of only three Naval Air Stations on the West Coast (Fig 5.2), the others being located near San Francisco and in San Diego, California (Ferguson, 2015). This location was the site of Seattle's first airport, the site of the first world circumnavigation flight (Figs 5.3 & 5.4) and the headquarters of the 13th Naval District, which was the center for naval aviation coordination during WWII. In addition, this location played a large role in the early development of the Boeing Company.

Fig 5.1 Warren G Magnuson Park & Gas Works Park Case Study Neighborhoods

Fig. 5.2 Sand Point Naval Air Station, circa 1957

Fig 5.3 Douglas World Cruisers, flown by U.S. Army Air Service Pilots prepare for first round world flight

Fig 5.4 DWC Chicago Crew prior to first world circumnavigation by air

In September 2015, the City Council proclaimed Sand Point Naval Air Station as Seattle's eighth historic district, placing it under the guidelines of Seattle's historic preservation laws. Listed nationally as the Naval Air Station Seattle, it is also a federal historic district and has the highest level of significance, meaning building renovations qualify for extensive federal tax credits. Building exteriors and grounds fall under guidelines from the City of Seattle and the Department of the Interior (Ferguson, 2015).

Warren G Magnuson Park – From Naval Base to Public Park

In 1970, the US Navy declared 313 acres of the Naval Air Station Seattle (also known as Sand Point Airfield) would be marked as surplus, while the remaining 90 acres of property would be retained as the Naval Station Puget Sound. Despite resistance from local aeronautical enthusiasts, all flight operations were ended and the station was renamed Naval Support Activity - Seattle. In 1975, 117 acres were transferred to National Oceanic and Atmospheric Administration (NOAA) and 196 acres were transferred to the City of Seattle for Sand Point Park.

In support of the Sand Point Park Master Plan, which proposed the development of a 75-acre Sports Meadow, tennis courts, neighborhood park and restaurant, approximately 120 acres of tarmac and runways were removed. The Park was renamed in honor of Senator Warren Grant Magnuson and officially opened in 1977. During the 1980s, Kite Hill was constructed, near the site of historic Sand Point Head, using 40,000 tons of demolished runway and earth. Soon after the NOAA campus and Art Walk was completed (Fig 5.5).

In September of 1995, the Naval Station Puget Sound officially closed and the remaining 90 acres of property was transferred to the City of Seattle and University of Washington. Guidelines and proposals for Warren G Magnuson Park were developed throughout the 1990s, culminating in 2004 with the approval of the sports fields and wetlands master plan (McRoberts, 2000).

It has been under various forms of development since its opening as a public park in 1977. Major changes to the park include the installation of a wetland and a sports field plan (Ordinance 121502) adopted in 2004 which included nine synthetic turf fields designed by The Berger Partnership (Fig 5.7).

Amenities include boating, tennis, swimming, walks, kite flying and sports fields; natural areas including a recently completed wetland restoration, a historic campus, an off leash dog park, nature programs,

Fig 5.5 Warren G Magnuson Park, circa 2011

Warren G Magnuson Park – Present Day

Warren G Magnuson Park (Fig 5.6) is located in NE Seattle in the Sand Point Neighborhood at 7400 Sand Point Way NE, Seattle, Washington 98115. It covers a total of 350 Acres and includes a mile long stretch of Lake Washington's shoreline. It is open 4am – 11:30pm daily.

picnic areas, walking trails, a wading pool, windsurfing opportunities, bike trails, a community garden (opened 2004), and public art. Many people enjoy swimming, fishing and berry picking here as well. Toxins in the redeveloped park areas and along the lake shore are no longer a concern according to the EPA and the State of Washington (Hirsch, 2016). In addition, this

Fig. 5. 6 Concept Plan for Warren G Magnuson Park

is the site of the Solid Ground low-income housing project, consisting of five buildings dedicated to providing housing for homeless individuals, five buildings owned by the University of Washington for educational programs, the Junior League of Seattle Children's Playground and an amphitheater. Magnuson Community Center offers specialty camps, racquetball courts, and a variety of programs including nature and wetland discovery. Park events include Magnuson Park Cyclocross (Fig 5.8) and the Great Kilted Run (Fig 5.9). The Fin Project: From Swords to Plowshares (Fig 5.10), is a popular art installation consisting of submarine fins turned sculpture, which was a gift to the city from a group of donors, including the US Navy.

The park has won several awards from design, engineering and parks associations. These include Washington Rec & Park Association Best Park Design Award 2010;

many of the buildings, to Radium-226 Cesium-137 and Strontium-90 found inside buildings 2 and 27 (Fig 5.11) as well as the soil surrounding these buildings. In addition, the building floors are known to contain petrochemical and solvent contamination (City of Seattle, 2013).

Fig 5.7 Warren G Magnuson Sports Field Plan

ASLA, Washington Chapter, Merit Award in General Design, 2014; Washington Recreation and Park Association, Spotlight Award, 2010; and ACEC, Washington Chapter, Engineering Excellence National Gold Award for Water Resources, 2010.

Warren G Magnuson Park - Brownfield Concerns

The park has had confirmed toxins on site. These ranged from soil contaminated by airplane fuel and runway tarmac, 40,000 tons of which were recycled to build Kite Hill, to lead, asbestos and mercury inside

Fig 5.8 Magnuson Park Cylocross Route

Fig 5.9 The Great Kilted Run Course Map

Fig 5.10 The Fin Project: From Swords to Plowshares by John T. Young, dedicated in 1998.

The radioactive residue was from radioluminescent (glow-in-the-dark) paint used on aircraft dials during World War II. In addition to buildings 2 and 27, extremely low levels of Radium-226 were found in the off-leash dog area by a consultant, Thomas L. Gray and Associates (TGA), hired to investigate radiation concerns. TGA reported "an individual would have to spend 6 hours a day/365 days a year for 30 consecutive years to receive about 2 millirems (mrem) a year of the radium. For comparison, the National Council on Radiation Protection and Measurements reports that the average U.S. resident receives about 620 mrem a year from average daily life" (Hirsch, 2016).

Fig 5.11 Planned cleanups for buildings 2 and 27

The US Navy, in accordance with their Environmental Restoration Program, was required to follow federal cleanup guidelines to remove contamination at Warren G Magnuson Park. These guidelines included the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) aka "Superfund", Time Critical Removal Action (TCRA), under CERCLA, and the National Oil and Hazardous Pollution Contingency Plan (NCP). Contamination included all of the radioactive materials, asbestos, mercury, and lead paint, from inside the buildings, as well as any contaminated soils. Approximately 100 bins of contaminated soils and building materials were transported for disposal as Low-level Radioactive Waste (LLRW) at a permitted facility in Grandview, Idaho (Washington Dept of Ecology, 2014).

Present day risks are minor and include 0.15 mrems of radioactive material left behind after cleanup, which could potentially cause cancer in eight of 10,000 exposed people (Hirsch, 2016). This is considered an acceptable level of exposure by the EPA and the State of Washington. Because the cleanup is considered complete, there are currently no park use restrictions.

5.3 SAND POINT, VIEW RIDGE, WINDERMERE + LAURELHURST NEIGHBORHOODS, NE SEATTLE, WA

Sand Point

Sand Point (Fig 5.12) is in a fairly affluent and well-educated area of Seattle, comprised mostly of upscale single-family houses with a car-dependent suburban feel (Martinez, 2010). The park itself is in Sand Point neighborhood, surrounded by View Ridge to the west, Windermere to the south, and Laurelhurst to the southwest. Sand Point has a low population density compared to the Seattle average (Fig 5.13), with most residents completing college (Fig 5.14).

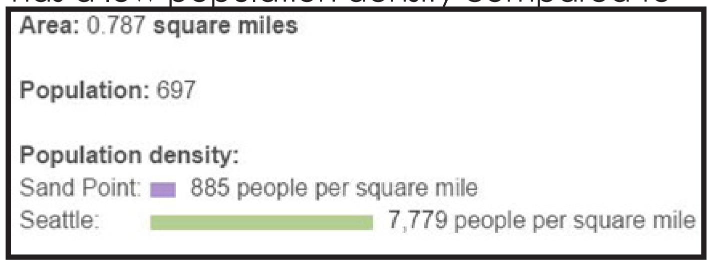


Fig 5.13 Sand Point Neighborhood Density

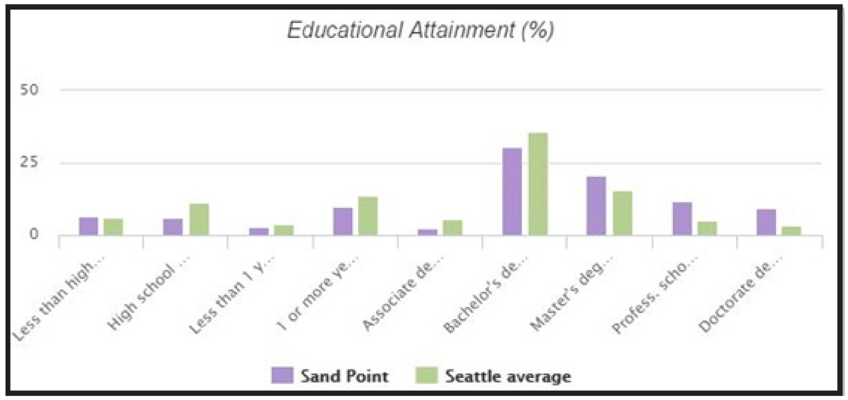


Fig 5.14 Sand Point Neighborhood Education

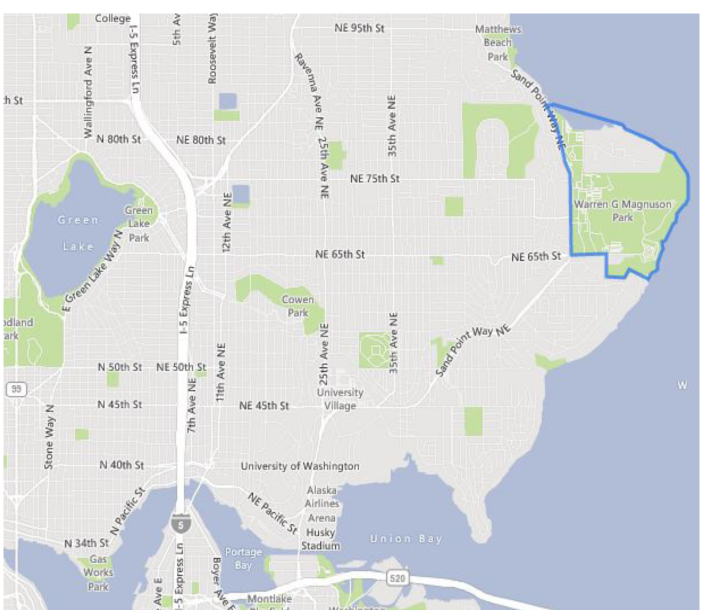


Fig 5.12 Sand Point Neighborhood

Considered the safest neighborhood in Seattle in 2010, Sand Point is situated five miles northeast of downtown. The majority of the neighborhood consists of Warren G Magnuson Park. The history of the Sand Point Neighborhood lies in the history of the Navy air base. The majority of houses here were built in the 1970's (Fig 5.15). This building boom occurred at the same time as the creation of Warren G Magnuson Park, supporting the idea that brownfield park creation spurs economic growth.

Because amenities such as grocery stores are some distance away, Sand Point received a low Walk Score of 32. Walk Scores are calculated by the Walk Score Company and based on ease of accessing amenities via walking routes.

Walk Score is a private company that assigns a numerical walkability score to addresses

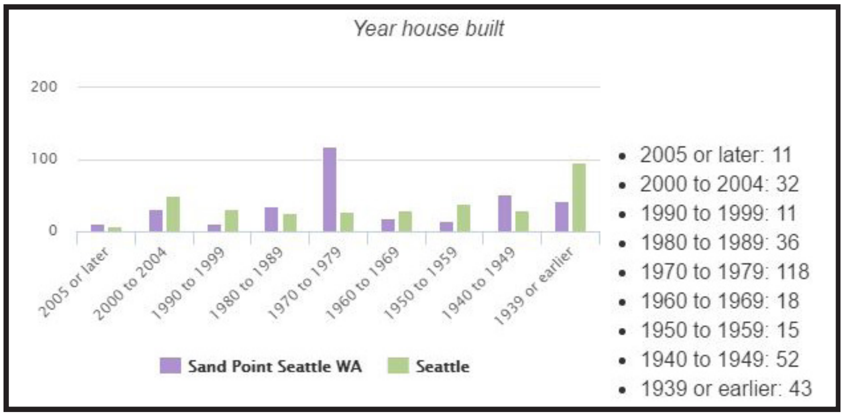


Fig 5.15 Sand Point Neighborhood Home Age

in the United States, Canada, and Australia. Routes within a 5 minute walk (1/4 mile) are given maximum points, with no points given after a 30 minute walk. A score of between 70 and 100 indicates a highly walkable neighborhood, while a score of between 0 and 49 indicates a car dependent lifestyle due to the distance necessary to travel to access food, shopping or recreational opportunities.

View Ridge

View Ridge is located on a hill overlooking Warren G Magnuson Park (Fig 516). View Ridge was first settled in 1936 by Ralph Jones and Al Balch. Prior to this, the area was first visited by loggers, then farmers taking advantage of the cleared land. Because it was a two day trip to View Ridge from Seattle in the 1890s, few people thought to settle there. In the 1920's, the Navy moved onto Sand Point, bringing with it infrastructure such as roads and the Northern Pacific Railroad.

In 1935, Jones and Blach purchased 10 acres of second-growth forest, located between NE 65th Street and 50th Ave NE, for $25. They platted the land, built homes for themselves on 50th Avenue NE and began selling the surrounding lots for $450 to $950 apiece, which was well within reach of war veterans with GI loans. In 1938, Life magazine had a spread on affordable homes, three of which were located in View Ridge. As a result of the publicity, View Ridge grew until it reached from NE 65th Street to NE 75th Street and from 40th Avenue NE to Sand Point Way NE.

The neighborhood was annexed in 1942. In the 1960's power lines were placed underground. After the naval base closed in 1970, the neighborhood lobbied to prevent the Naval property below them from becoming another airport. Instead it became Warren G Magnuson Park. The last unsold lot in View Ridge sold for $100,000 in 1988. Balch and Jones lived in the homes they built until their deaths (Wilma, 2001). The neighborhood is currently home to a thriving Hasidic community.

View Ridge has a population density close to that of the Seattle average (Fig 5.17), with most residents completing college (Fig 5.18). Many houses here were built in the 1930's, with another growth spurt happening in the 1950's (Fig 5.19). Compared to the Seattle average, the median income is higher, with more homeowners and fewer renters and more children in the neighborhood (Fig 5.20). Because most amenities such as grocery stores are some distance away, View Ridge received a Walk Score of 38.

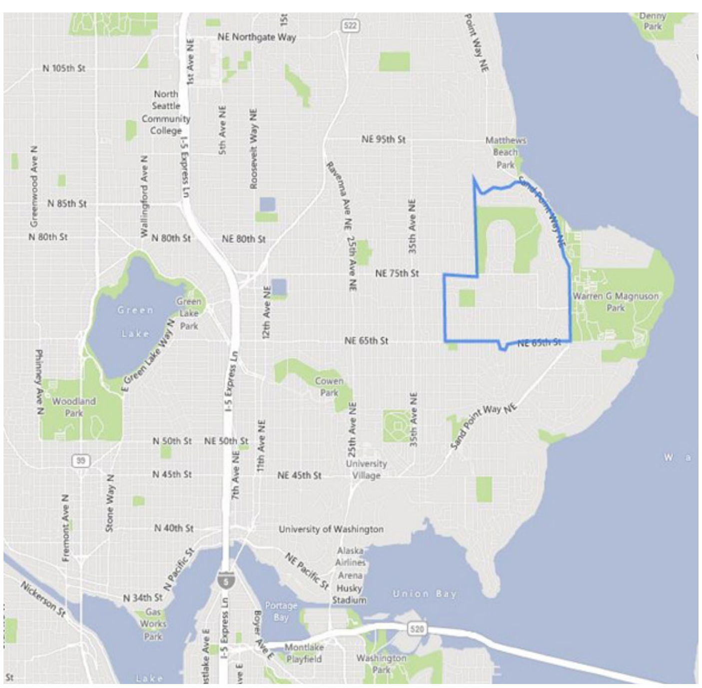


Fig 5.16 View Ridge Neighborhood

Fig 5.17 View Ridge Neighborhood Density

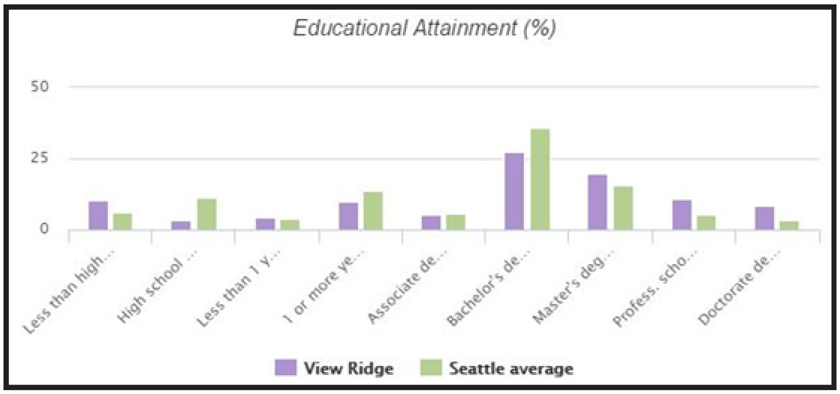


Fig 5.18 View Ridge Neighborhood Education

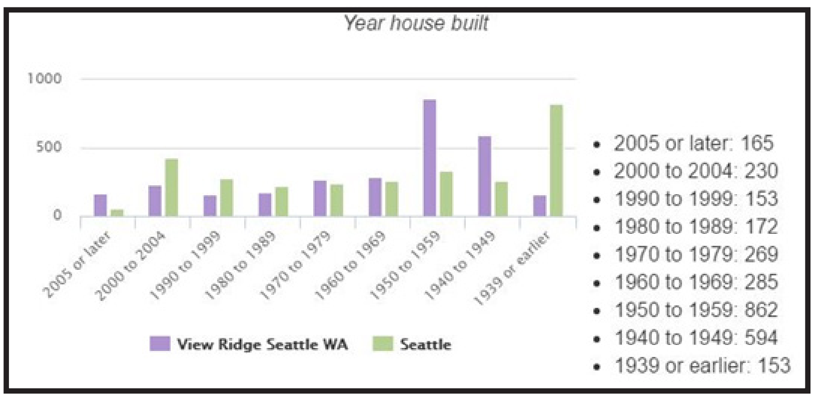


Fig 5.19 View Ridge Neighborhood Home Age

	View Ridge	Seattle
Median Household Income	$60,819	$45,736
Owners/Renters	79%/21%	48%/52%
Median Age	42	37
Single Males	12%	23%
Single Females	12%	19%
Homes With Kids	27%	18%
Household Size	2.2	2.1
Commute Time	27 min	27 min

Fig 5.20 View Ridge Neighborhood vs Seattle

Windermere

Windermere (Fig 5.21) consists mainly of upscale, single-family homes and many married couples with children. There is a private park with a playground, a ball field, tennis courts, and a lakefront beach, along with easy access to the Sandpoint Way business district along. The Burke-Gilman trail runs through the neighborhood.

Windermere has a population density close to that of the Seattle average (Fig 5.22), with most residents completing college (Fig 5.23). Houses here have been built continuously since the 1920's, with a number of growth spurts (Fig 5.24). Compared to the Seattle average, the median income is higher, with more homeowners and fewer renters and more children in the neighborhood (Fig 5.25). Because most amenities such as grocery stores are some distance away, View Ridge received a Walk Score of 39.

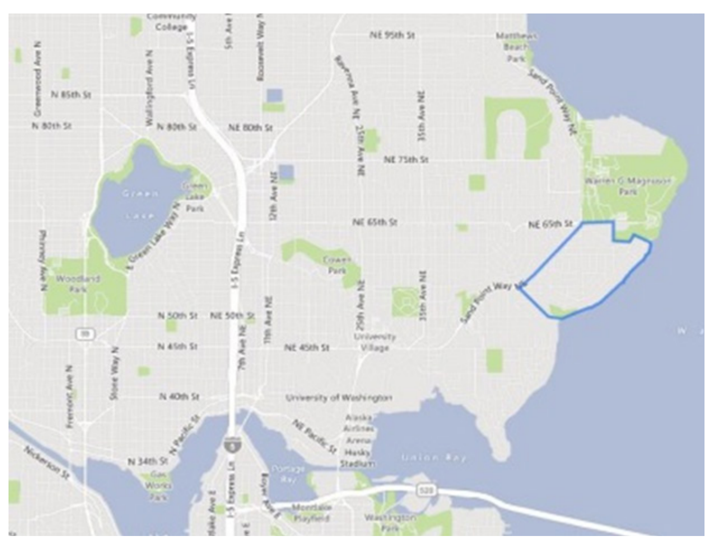


Fig 5.21 Windermere Neighborhood

Fig 5.22 Windermere Neighborhood Density

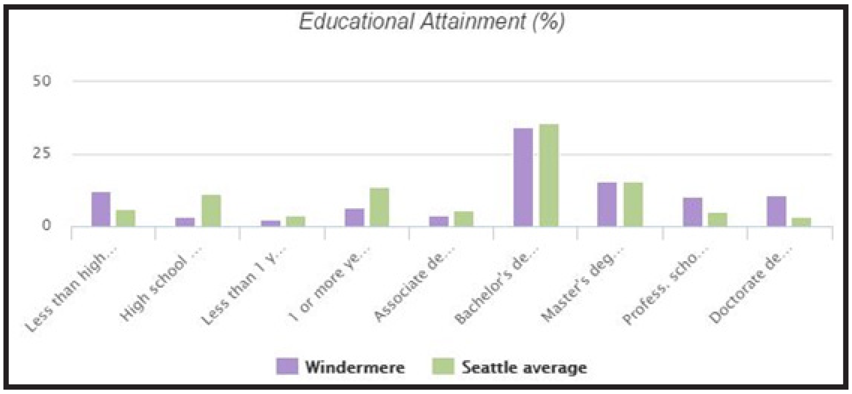


Fig 5.23 Windermere Neighborhood Education

Fig 5.24 Windermere Neighborhood Home Age

	Windermere	Seattle
Median Household Income	$81,866	$45,736
Owners/Renters	73%/27%	48%/52%
Median Age	37	37
Single Males	12%	23%
Single Females	9%	19%
Homes With Kids	35%	18%
Household Size	2.5	2.1
Commute Time	25 min	27 min

Fig 5.25 Windermere Neighborhood vs Seattle

Laurelhurst

Seattle annexed Laurelhurst, one the original Seattle suburbs, in 1910 and today it is a high-end community close to the University of Washington with easy access to downtown (Fig 5.26). It is also the home of the Children's Hospital and Regional Medical Center, which moved to the neighborhood in 1953. Laurelhurst is a family neighborhood with many cul-de-sacs and married couples with children.

On September 1, 1911, the U.S. Army Corps of Engineers began construction of a 75 foot ship canal that would extend from Lake Washington through Union Bay, to Lake Union and on to Puget Sound. After four and a half years of construction, the ship canal was completed. This caused Lake Washington to drop nine feet (Rochester, 2001). This resulted in additional lakefront property for current landowners and provided additional development opportunities for the Laurelhurst neighborhood.

Laurelhurst has a population density close to that of the Seattle average (Fig 5.27), with most residents completing

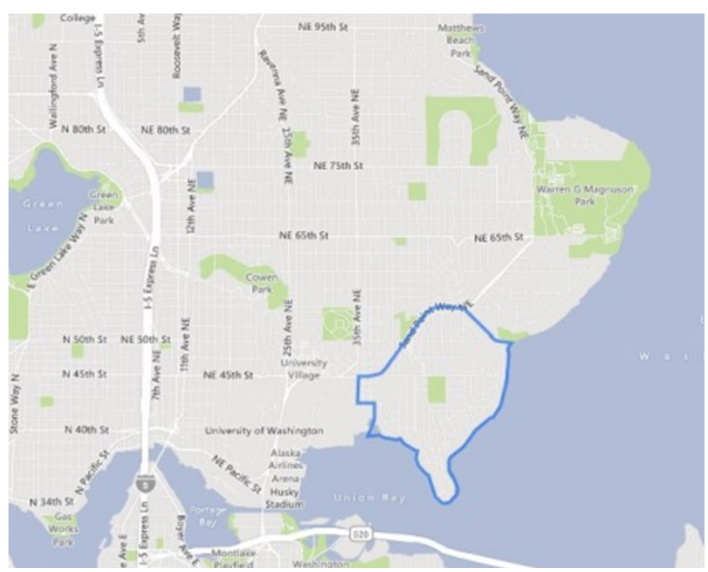


Fig 5.26 Laurelhurst Neighborhood

college (Fig 5.28). The majority of houses here were built in the 1920's and 1930's (Fig 5.29).Compared to the Seattle average, the median income is significantly higher, with more homeowners and fewer renters and more children in the neighborhood (Fig 5.30). Because some amenities such as grocery stores are some distance away while others, such as restaurants, are nearby Laurelhurst received a middle range Walk Score of 51.

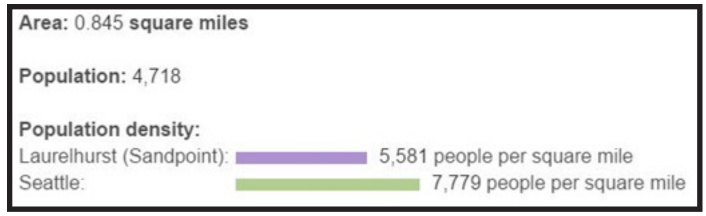


Fig 5.27 Laurelhurst Neighborhood Density

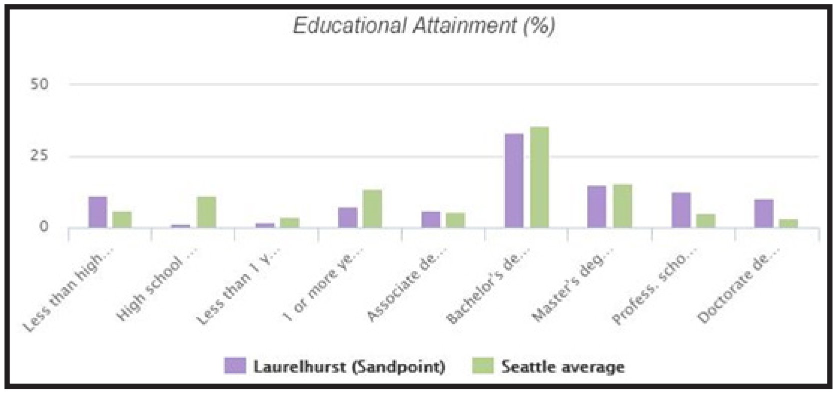


Fig 5.28 Laurelhurst Neighborhood Education

Fig 5.29 Laurelhurst Neighborhood Home Age

	Laurelhurst	Seattle
Median Household Income	$81,866	$45,736
Owners/Renters	73%/27%	48%/52%
Median Age	37	37
Single Males	12%	23%
Single Females	9%	19%
Homes With Kids	35%	18%
Household Size	2.5	2.1
Commute Time	25 min	27 min

5.4

Fig 5.30 Laurelhurst Neighborhood vs Seattle

Fig 5.31 Seattle Gas Company, circa 1956

GASWORKS PARK, SEATTLE, WA (INDUSTRIAL BROWNFIELD, 1975)

Gas Works Park – History

The area previously known as Brown's Point was cleared in 1906 by the Seattle Light Company to construct a plant which manufactured gas from coal. This plant was later converted to process crude oil. In 1930, the Seattle Light Company renamed itself the Seattle Gas Company (Fig 5.31). It was the hub of a 30 mile underground gas distribution network.

As part of its manufacturing process, the company produced a near constant shower of soot and sparks which fell over Wallingford. In the 1930's Wallingford residents began to consider the plant a nuisance and petitioned to have it closed. In 1937, the plant transitioned to oil-to-gas generators and the old coal-gas facilities were retired. By the early 1940s over 43,000 customers were served by the Seattle Gas Company, which operated 24 hours a day and processed 150,000 gallons of oil.

By the late 1940's demand developed for gas byproducts, such as toluene, solvent naphtha, sulfur, xylene, resin tar, and "Gasco" charcoal briquettes, resulting in the installation of new equipment at the plant. But, by the mid-1950s, demand for oil gas diminished, replaced by natural gas. Soon, import of natural gas in the 1950's made the plant obsolete (Veith, 2005).

After the plant closed, there remained "a 20 acre 'layer cake of hydrocarbon contaminates . . . a slough of lampblack and oily wastes' . . . covered with the 'totemic industrial artifacts of a pre-electronic age,' which is to say, those black towers." (Veith, 2005). Public debate ensued whether to keep the site industrial or develop it into a park, as it had been prior to development by The Seattle Light Company. Seattle Councilmember Myrtle Edwards led park advocates to a victory and the city acquired the site for a park.

Gas Works Park – From Coal Gasification Plant to Public Park

This former industrial brownfield is now a 19.1 acre neighborhood park. It contains 1,900 feet of shoreline and reaches nearly 400 feet into Lake Union. It is open 6am – 10pm daily.

The site was purchased by the city in 1962 for a price of $1,340,000. It was designed by Landscape Architect Richard Haag and opened to the public in 1975 (Fig 5.32). Gas Works Park won the ASLA President's Award of Excellence in 1981 and was put on the National Register of Historic Places in 2013. Originally named Myrtle Edwards Park, the Edwards family requested her name be removed due to retention of industrial structures on site (Fig 5.33). Myrtle Edwards Park is now located next to Olympic Sculpture Park.

Gas Works Park – Present Day

Park amenities include restrooms (ADA Compliant), paths (ADA Compliant), picnic sites, a play area, waterfront views, Burke-Gilman Trail access (the Burke-Gilman Trail runs past the Gas Works parking lot and follows the Burlington-Northern Railroad 12.5

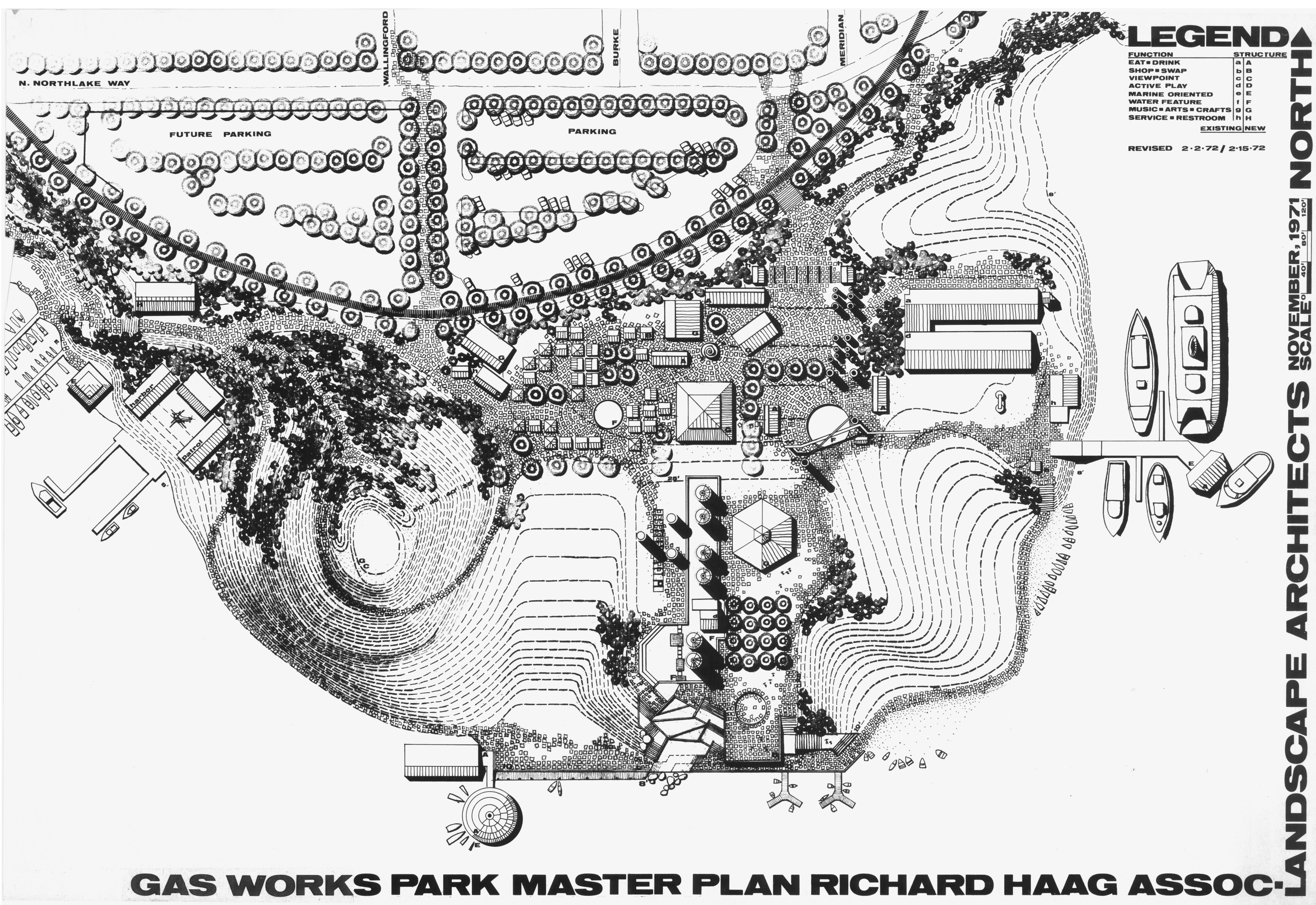


Fig 5.32 Gas Works Park Master Plan, by Richard Haag

Fig 5.33 Gas Works towers which were retained on site (above)

Fig 5.34 Aerial view of Gas Works Park (below)

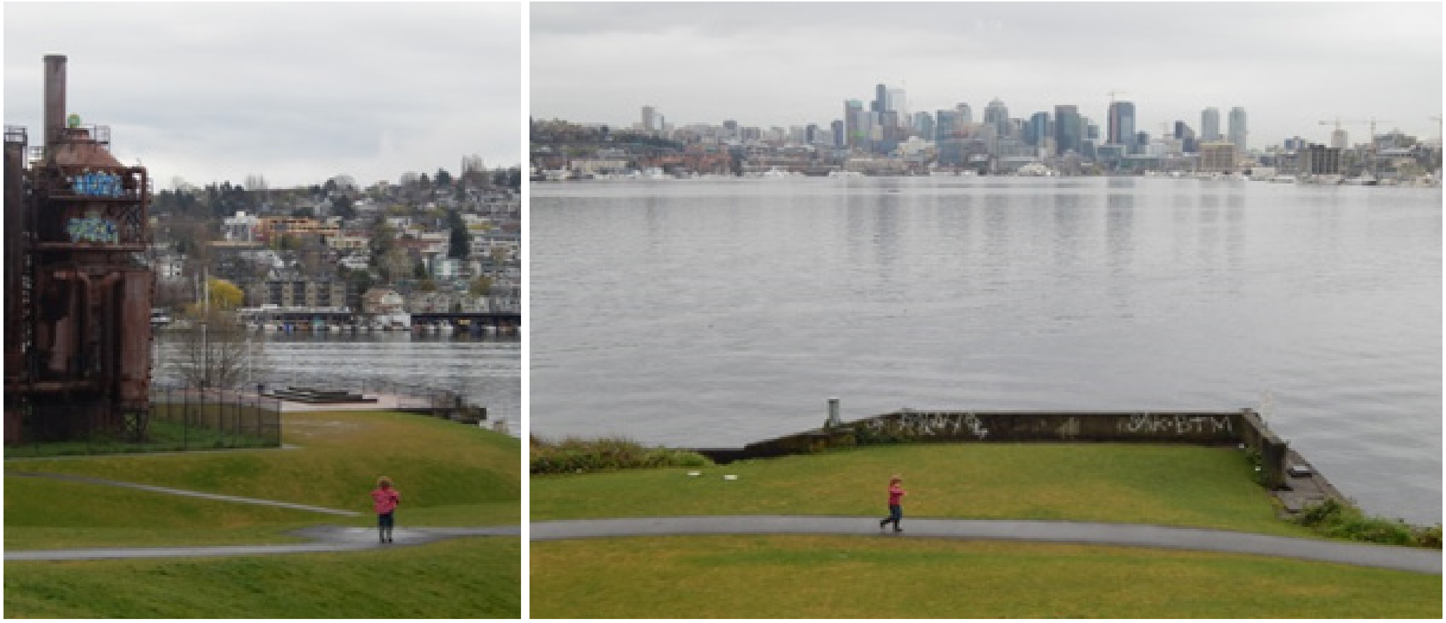


Fig 5.35 View of Gas Works and Seattle beyond

Fig 5.36, 5.37 & 5.38 The Children's Play Barn

miles north to Log Boom Park in Kenmore), and kite flying. Gas Works Park has a play area with a large play barn, and big hill popular for flying kites. It also has an excellent view of downtown Seattle (Figs 5.34 & 5.35)

The boiler house has been converted to a picnic shelter with tables, fire grills and an open area. The former exhauster-compressor building, now a children's play barn, features a maze of brightly painted machinery (Figs 5.36 – 5.38). In 2008 renovations were proposed for the children's play area and a levy passed for $1.4 million to fund the construction. Public hearings are being held with construction expected to begin in 2016-2017 (Smith, 2014).

Sundial, by Charles Greening, lies at the top of Kite Hill. It is a 28-foot mixed material sundial which uses viewers as the gnomon (vertical element) to tell time. It also contains a bronze calendar, references to the natural world and astrological signs. It was donated to the city in 1978 by an anonymous donor (Fig 5.39). Another interesting feature is a set of concrete arches, a popular venue for wedding photographs (Fig 5.40).

Community events are popular at Gas Works Park. It is a participating park in the Peace Concert series and hosts an Annual Fourth of July fireworks display. Gas Works Park is the starting point for Seattle's World Naked Bike Ride and the end point for the Solstice Cyclists. The park is managed by Seattle Parks & Recreation.

Fig 5.39 Sundial (above) *Fig 5.40 Arches, concrete supports remaining from old train rails (below)*

Gas Works Park - Brownfield Concerns

According to Geological Engineer Allen Hatheway, Gasworks Park is the world's last remaining example of 'perhaps the single most important industrial enterprise of the nineteenth century' (Raymond, 2008).

I haunted the buildings and let the
spirit of the place enjoin me.
I began seeing what I liked, then I
liked what I saw—new eyes for old.
Permanent oil slicks became plain
without croppings of concrete,
industrial middens were drumlins,
the towers were ferro-forests
and the brooding presence
became the most sacred of
symbols.
I accepted these gifts, and
decided to absolve the
community's vindictive feel
towards the gas plant.
- Richard Haag

As part of its industrial legacy, the Seattle Gas Light Company had a devastating effect on this site, leaving it heavily contaminated (Fig. 5.41). Leaks from the gas works facilities contaminated groundwater and soil with a number of hazardous chemicals including benzene, a toxic carcinogen, and polycyclic aromatic hydrocarbons including naphthalene, a toxic but not carcinogenic compound (Washington Dept. of Ecology, 2005).

An Environmental Impact Statement was required prior to park construction to analyze existing conditions as well as the possible impact of the park on surrounding areas. However, existing conditions were not all examined with equal weight according to Elizabeth Meyers (Raymond, 2008). A thorough neighborhood inventory and analysis of existing conditions was lacking.

To complete on-site remediation, Gas Works Park had a fascinating array of strategies including sequestration, bioremediation and fencing some areas to prevent public access. When constructing the park, some contaminated soils were removed off site while the majority, an estimated 30,000 cubic yards, were retained on-site and either incorporated into Kite Hill or capped (Wright, 2000). Infrastructure remaining after the decision to preserve the towers and boiler house was demolished and used as additional fill for Kite Hill. Gas Works Park was the first park of its kind to retain contaminated soils onsite instead of removing them to a landfill.

Soils generated from site grading were mixed with biodegradable debris, including leaves and sawdust, and then covered with treated sewage sludge containing oil-degrading microbes and tilled back into the soil (Wright, 2000). This allowed air circulation and increased bacterial activity to digest and break down harmful chemicals. This onsite sequestration of contaminated soils was the most cost effective method of treatment and preferable to removing all of the contaminated soils to an offsite location. After treating the soils, the area was hydro-seeded with turf grass.

In 1984, the park was temporarily closed when hydrocarbons were found to have leached into the children's sandbox (Veith, 2005). The EPA closed the park to re-evaluate site risks (Washington Dept. of Ecology, 2005; Wright, 2000). After testing, 12" of clean soil was placed over areas of concern. In 1997, testing at Gas Works Park revealed hazardous levels of arsenic, benzene, toluene and carcinogenic polynuclear atomic hydrocarbons in the groundwater along with tar residue on soil surfaces. Contaminated soils were removed and a soil vapor extraction system was installed to oxygenate groundwater and encourage organic biodegradation of existing hydrocarbons (Seattle Dept. of Parks and Recreation, 2000; Wright, 2000).

Byproducts of the gas plant remain under the soil. Ongoing concerns include

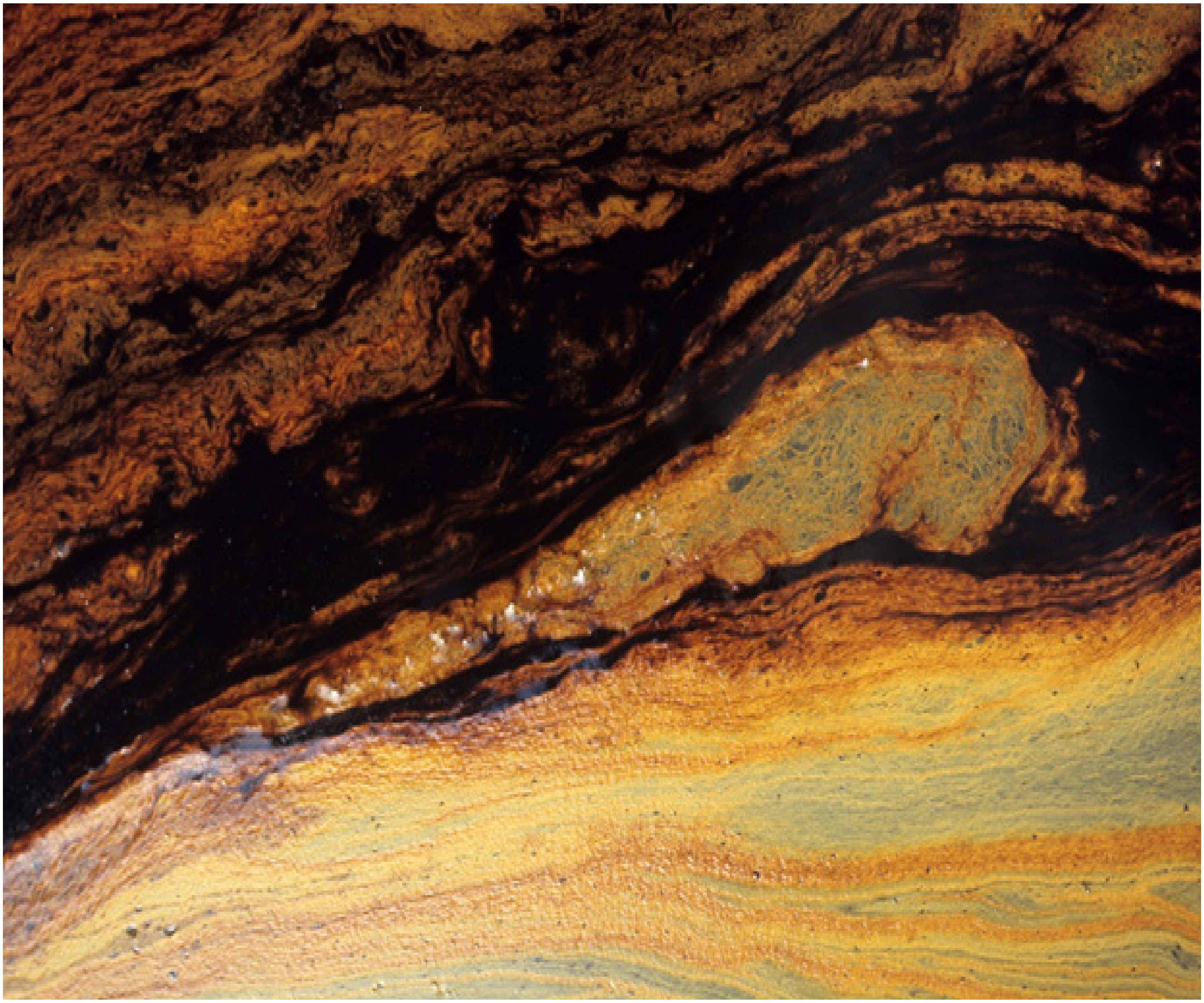


Fig 5.41 Oil slick as art, Gasworks Park 1970, by Richard Haag

contaminated groundwater flowing into Lake Union and contaminated soils. According to the Washington State Department of Ecology, "To reduce their risk of exposure to residual contamination in the soil, park users should observe basic personal hygiene such as washing hands after play and before eating; not digging in the dirt (other than in the play area) or letting their pets dig in the dirt; and not swimming, wading, or fishing in the lake. Hot weather requires additional caution. Hot weather can draw tar to the ground surface in the park. Park visitors should not touch coal tar deposits they may encounter on the ground" (WA Dept. of Ecology, 1997).

Access to Lake Union is restricted at Gas Works Park, as the lake sediment contains hazardous substances (Seattle Parks & Recreation, 2016). Entering the water or launching boats from the park is prohibited (SMC 18.12.070), no swimming, no fishing and no wading is allowed in the park. Occasionally, black tar oozes from the soil in the fenced off areas and a sign in the parking lot reads "Please DO NOT let children dig in or eat the dirt! Semi-toxic residue from the park's past remains in the soil."

5.5 WALLINGFORD NEIGHBORHOOD, NW SEATTLE, WA

Wallingford is a family neighborhood, with modest homes (Fig 5.42). It was named after John Wallingford, the original purchaser, in 1888, of much of the land which now makes up the neighborhood.

In the early 1900's the neighborhood began to grow quickly, including schools, homes and businesses, despite the nearly constant rain of soot and sparks from the Seattle Light Company. By 1920, Wallingford was one of the fastest growing neighborhoods in Seattle (Dorpat, 2001).

Many Wallingford residents who worked for Boeing were laid off in 1970. This resulted in a jump in a 9% jump in unemployment between 1968 and 1970, and many homes being abandoned. By the mid 1980's the economy had recovered and homes in Wallingford were once again in high demand. (Sturgis, 1970) This led, in many instances, to gentrification.

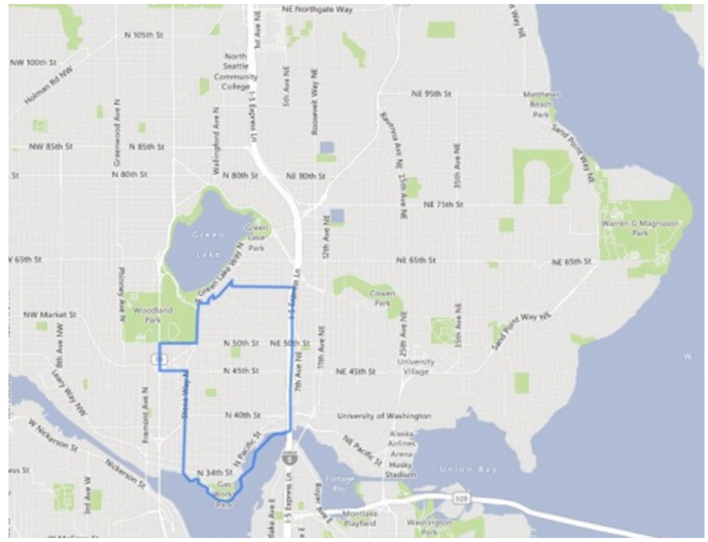


Fig 5.42 Wallingford Neighborhood

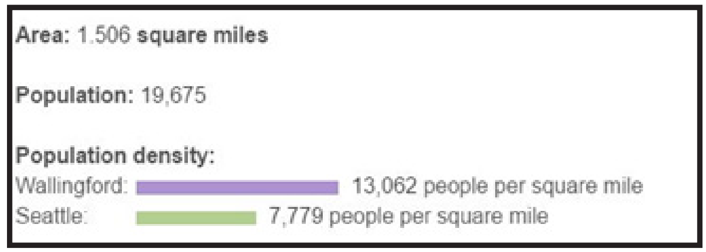


Fig 5.43 Wallingford Neighborhood Density

Wallingford has a population density higher than the Seattle average (Fig 5.43), with most residents completing college, but with a significant number only completing high school (Fig 5.44). Houses were mostly built in the 1920's and 1930's (Fig 5.45). Compared to the Seattle average, the median income is slightly higher, with fewer homeowners, more renters and fewer children in the neighborhood (Fig 5.46). Almost all amenities such as grocery stores, restaurants and schools are within the neighborhood, giving Wallingford a Walk Score of 96.

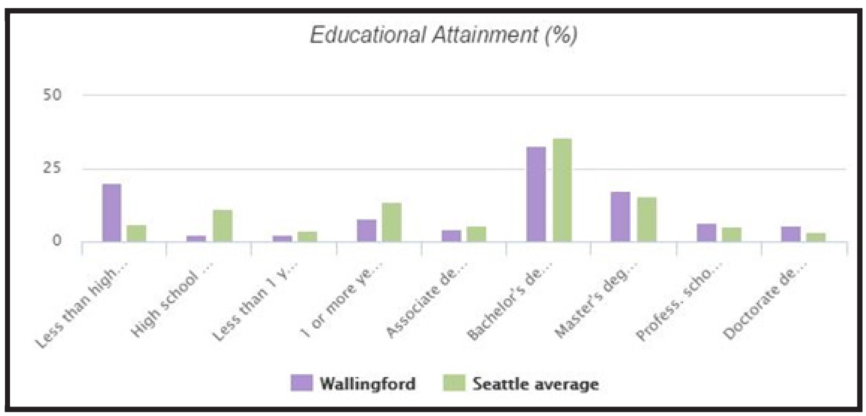


Fig 5.44 Wallingford Neighborhood Education

Fig 5.45 Wallingford Neighborhood Home Age

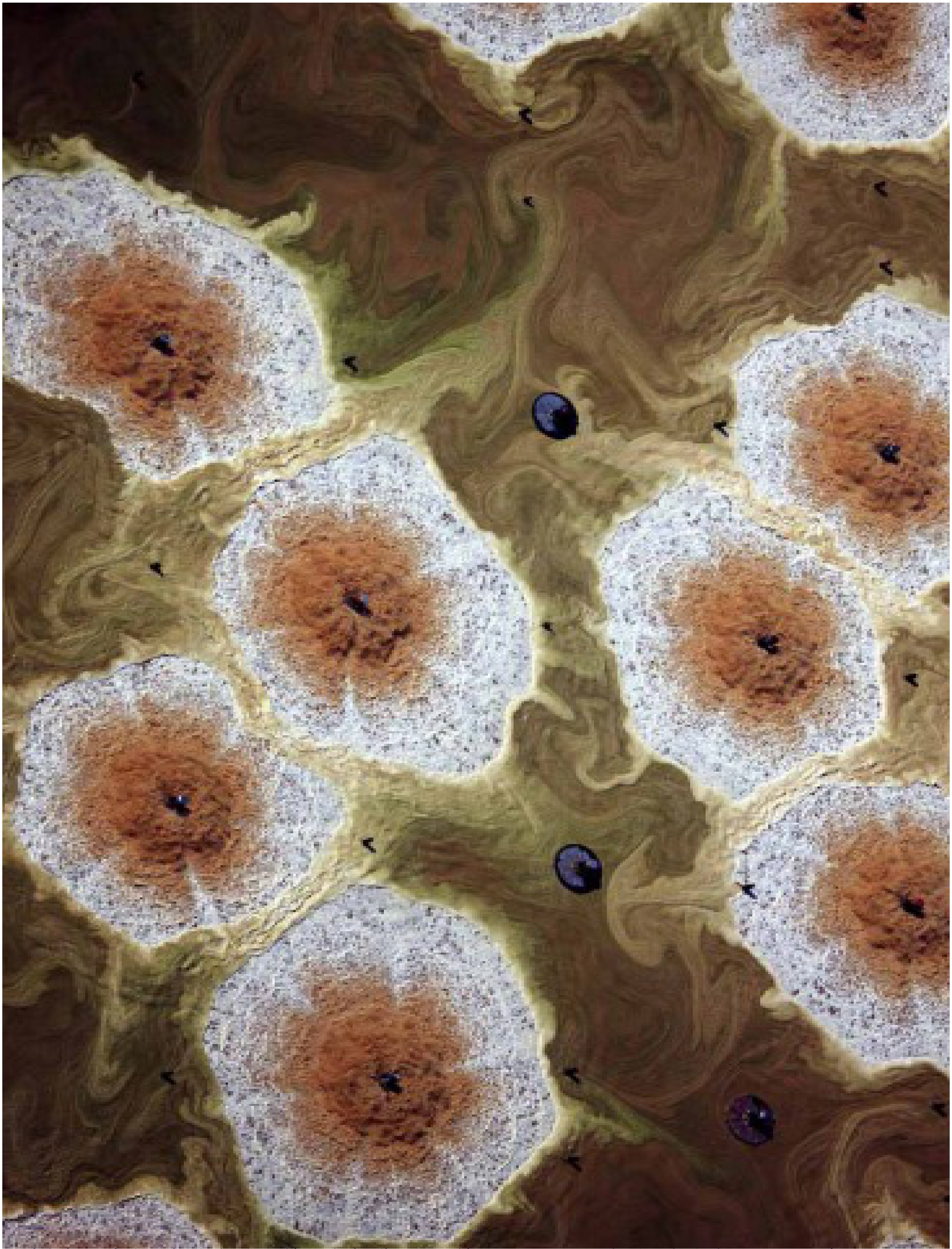
	Wallingford	Seattle
Median Household Income	$52,587	$45,736
Owners/Renters	43%/57%	48%/52%
Median Age	35	37
Single Males	29%	23%
Single Females	26%	19%
Homes With Kids	14%	18%
Household Size	2.0	2.1
Commute Time	25 min	27 min

Fig 5.46 Wallingford Neighborhood vs Seattle

5.6 CASE STUDY NEIGHBORHOODS SUMMARY

Warren G Magnuson Park is a regional park located in a more affluent, less walkable neighborhood. Gas Works Park is a neighborhood park located in a less affluent, more walkable neighborhood. These parks both have strong cultural heritages – Warren G Magnuson with its ties to aviation history and Gas Works with its ties to industry. Both sites played a major historic role in the development of Seattle and their respective neighborhoods.

Gas Works Park, unlike Warren G Magnuson Park, has visibly retained more of its industrial heritage with the preservation of the gasworks structures and, in doing so, has reinforced its perception problem as a brownfield park. Concerns about toxins, due to the nature of the industry previously occupying the site, remain to this day despite ongoing testing and remediation efforts.



Aerial view of chemical plant making derivatives used in consumer products, photo by J Henry Fair

CHAPTER 6: Results

6.1 THE ENVIRONMENTAL JUSTICE IMPACT OF BROWNFIELD PARKS

An investigation of the question 'Do Urban Brownfield Parks provide Environmental Justice to Nearby Residents" was made by evaluating how the selected metrics changed over time. By comparing the evaluative data over 40 years, the two parks reveal there is some influence by the parks on environmental justice within the surrounding neighborhoods.

Changes in Vacancy, Unemployment, Poverty, Age Diversity and the amount of Vegetative Cover / Parks bring not only positive outcomes, but also new challenges for residents. Vacancy is higher than in Seattle, but Poverty and Unemployment are lower. Age Diversity is higher and more variable compared to Seattle. Vegetative cover increases and decreases respective to their neighborhoods – both of which could be attributed to the creation of the neighborhood brownfield parks.

6.2 RESULTS

Overall Vacancy Rate versus Seattle Average (1970 – 2010)

For the time period studied (1970 – 2010), overall Vacancy rate trends within the Gas Works Park Neighborhood (Fig 6.1) decreased for 1970-1980, while the park was being constructed, and then began a steady rise which has continued across all census tracts since 2000. The data show an overall increase in the number of vacant houses within 1 mile of Gas Works Park, since the parks inception.

Overall Vacancy rate trends within the Warren G Magnuson Park Neighborhood (Fig 6.2) also increased for the time period studied. The majority of tracts show vacancy was either constant or slightly decreased between 1970 and1990, with a sharp increase across all census tracts beginning in 2000.

Compared to case study neighborhoods, the Seattle average for vacancy decreased sharply between 1970 and 1980 and then rose slightly over the next 20 years, only to return to the 1980 low in 2010, following the housing market crash of 2008. For both neighborhoods, vacancy rates were consistently slightly below Seattle averages until 2010, indicating relative economic health, and also an above-average impact of the financial crisis on these neighborhoods.

The findings indicate neighborhoods with brownfield parks fared worse, with higher vacancy than the city of Seattle as a whole. This shows a positive correlation between the construction of remediated brownfield parks and vacant houses within park-adjacent neighborhoods – as the number of neighborhood brownfield parks increase, the number of vacant houses in adjacent neighborhoods increase.

Overall Vacancy Rate for Houses For Sale versus Seattle Average (1970 – 2010)

To examine this further, the vacant house were examined by sale or rental status to determine if this trend affected only renters or homeowners, or both. Looking only at houses for sale, Vacancy rate trends within the Gas Works Park Neighborhood (Fig 6.3)

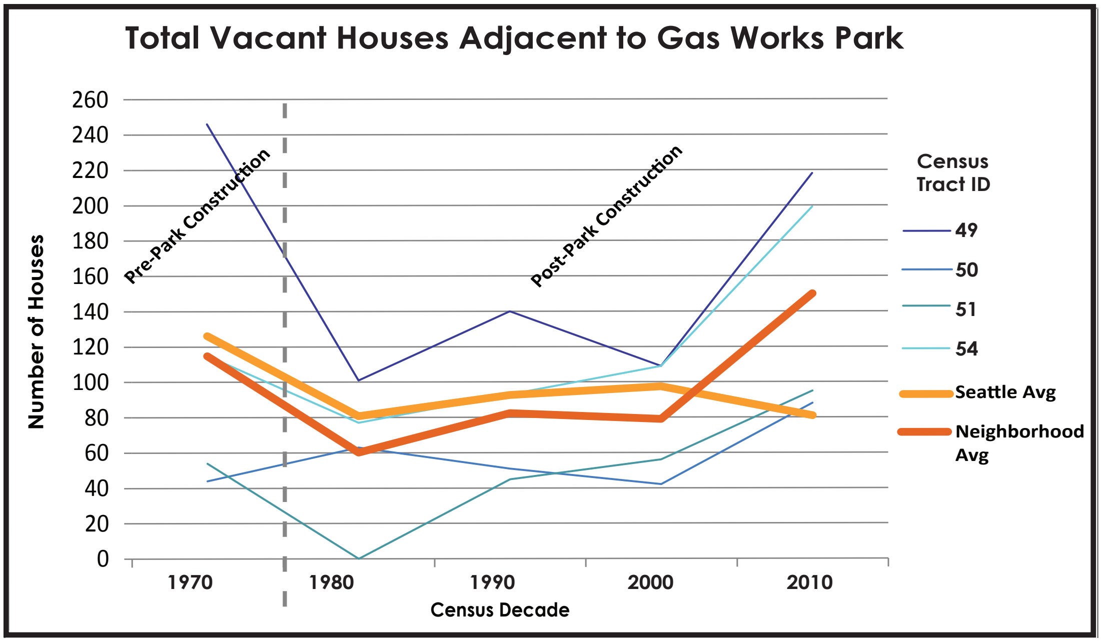


Fig 6.1 Number of Vacant Houses, in Gas Works Park neighborhood (1970-2010)

decreased between 1970 and 1980 in three

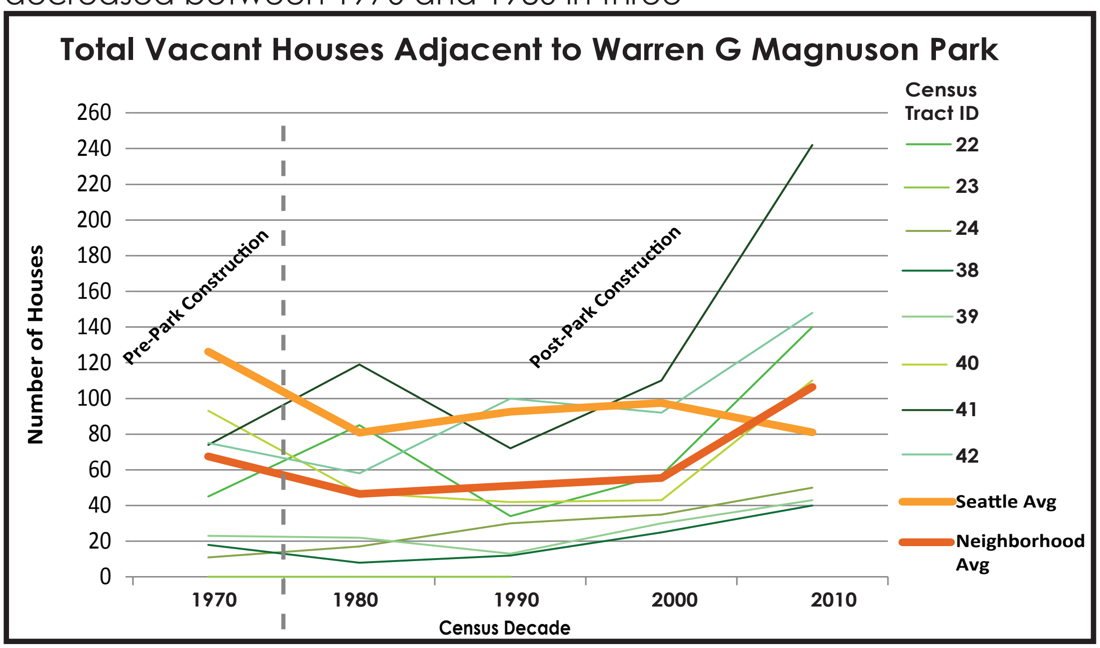


Fig 6.2 Number of Vacant Houses, in Warren G Magnuson Park neighborhood (1970-2010)

of the four tracts, but increased significantly for all remaining tracts from 1970 to 2010.

In Warren G Magnuson Park (Fig 6.4) the overall trend from 1970-1980 was an increase in vacancy, with a general decrease from 1980 to 2000 and a sharp increase for all but two tracts from 2000 to 2010. The overall trend from 1970-2010 was an increase in all but one of the tracts.

Comparing both case studies yields a strong increase across the majority of tracts. Compared to the Seattle average the case study neighborhoods fared better (decreased vacancy) between 1970 and1980, but followed the same trend of increased vacancies for the 2000 to 2010 time period.

This further evaluation indicates the trend in vacant homes for sale versus the average total Seattle vacancy was similar. Additionally, the number of vacant houses for sale is higher in six of the twelve tracts for the 2000 to 2010 census than the average number of houses for sale in Seattle.

Since the construction of Gas Works and Warren G Magnuson Parks, vacant houses for sale in adjacent neighborhoods is lower than the Seattle average, which is a negative correlation between park construction and vacancy – as the number of neighborhood brownfield parks increase, the number of vacant houses for sale in adjacent neighborhoods decrease. Both are hit harder by the housing recession of 2008 than Seattle in general - perhaps indicating larger trends of relative

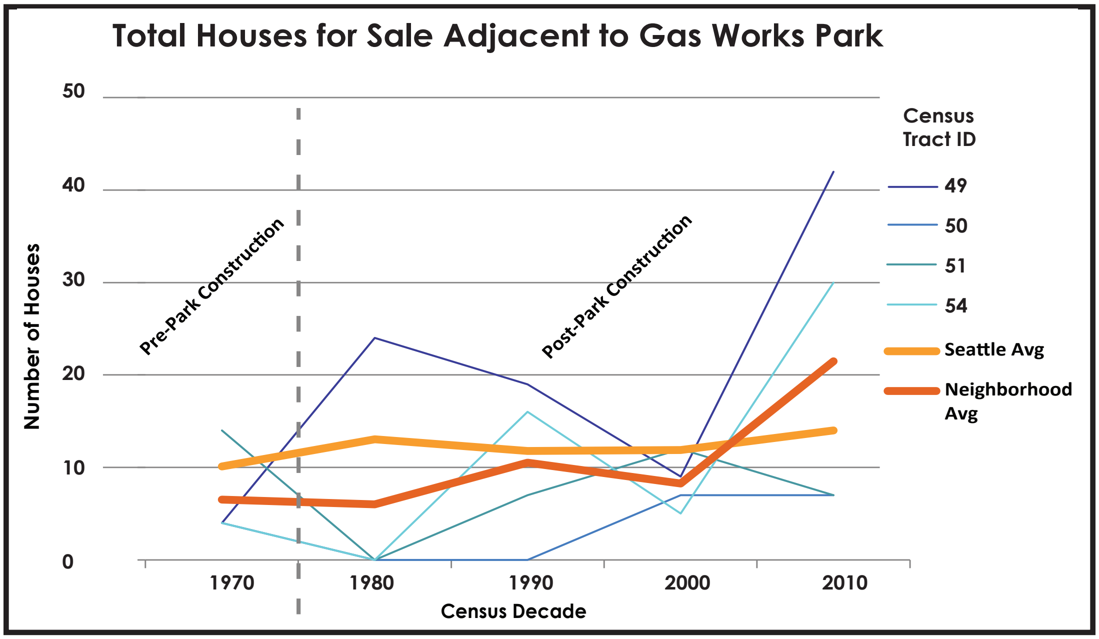


Fig 6.3 Houses for Sale, in Gas Works Park neighborhood (1970-2010)

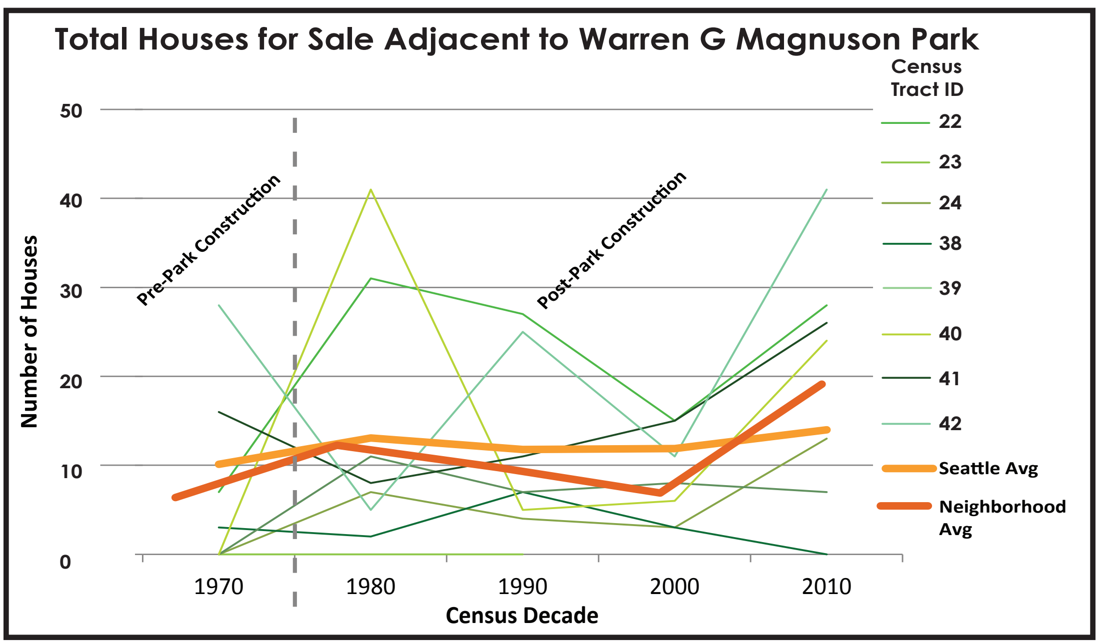


Fig 6.4 Houses for Sale, in Warren G Magnuson Park neighborhood (1970-2010)

robustness in urban sales, and possible weakness in the more suburban market. In summation, this below-average vacancy overall signifies an economically healthy neighborhood.

Overall Vacancy Rate for Houses For Rent versus Seattle Average (1970 – 2010)

Closer evaluation between houses for rent and park construction reveal the Gas Works Park neighborhood vacancies (Fig 6.5), with some fluctuation during the middle decades, were similar in 1970 and 2010, with the exception of a single tract, which experienced a significant decrease in vacancy.

This shows, on average, a slow, gentle decrease in rentals until a marked increase as a result of the 2008 housing crash, possibly indicating economic stability prior to the crash, and possibly indicating homes entering the rental market as a result of the crash.

The Warren G Magnuson Park neighborhood (Fig 6.6) followed a similar trend as the Gas Works Park neighborhood, with a slight increase in 1990, followed by a small drop in rental vacancies in 2000, and then the same marked increase in 2010.

This trend towards indicates there may be no correlation between neighborhood brownfield parks and rental vacancies in the Gas Works Park and Warren G Magnuson Park neighborhoods - as the number of neighborhood brownfield parks increase, the number of vacant houses for rent in adjacent neighborhoods, appear to be unrelated to park construction. Compared

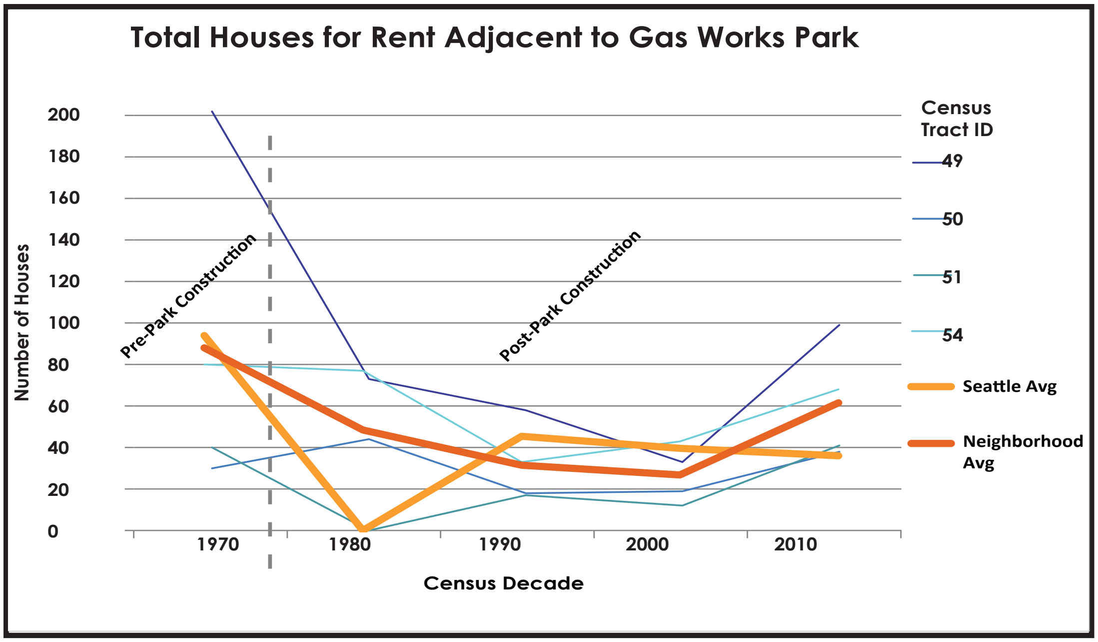


Fig 6.5 Houses for Rent, in Gas Works Park neighborhood (1970-2010)

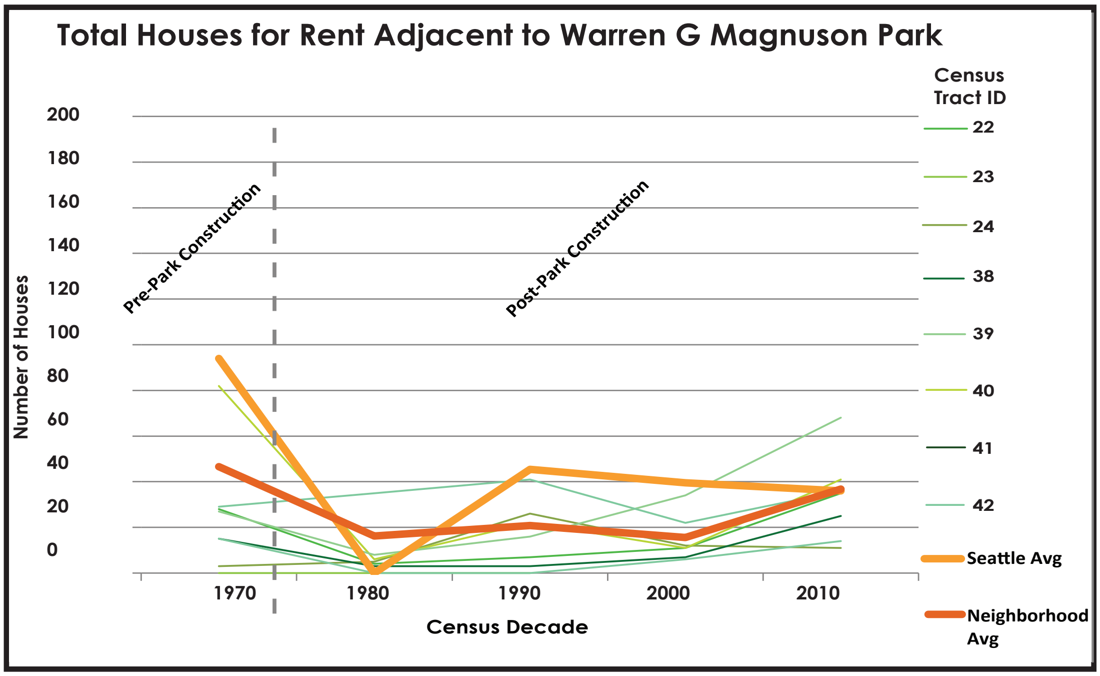


Fig 6.6 Houses for Rent, in Warren G Magnuson Park neighborhood (1970-2010)

to the Seattle average, the case study neighborhoods tended towards increased vacancies most significanly in the 2000-2010 decade.

This evaluation of vacant rental houses indicates the trend in the brownfield neighborhoods versus the average for Seattle vacancy was similar. This means the construction of Gas Works and Warren G Magnuson Parks have not significantly affected the number of vacant houses for rent in adjacent neighborhoods.

Percent Unemployment Versus Seattle Average (1970 – 1990)

For the time period studied (1970 – 1990), unemployment in both of the case study sites drops significantly (Figs 6.7, 6.8), with the exception of tract 42, which is part of the Hawthorne Hills / Bryant Neighborhood. As this is the only outlier in an otherwise clear trend towards decreased unemployment, the 2% unemployment increase in this tract is attributed to changes within that specific neighborhood, and not due to the case study parks. Any increases in unemployment experienced in 1980 were later reversed according to the 1990 numbers.

Seattle percent unemployment decreased steadily during the time period studied. When compared to the Seattle average, the case study neighborhoods findings indicate neighborhood unemployment has decreased since the construction of both Gas Works and Warren G Magnuson Parks, similarly to the unemployment decrease in Seattle. However, unemployment in the

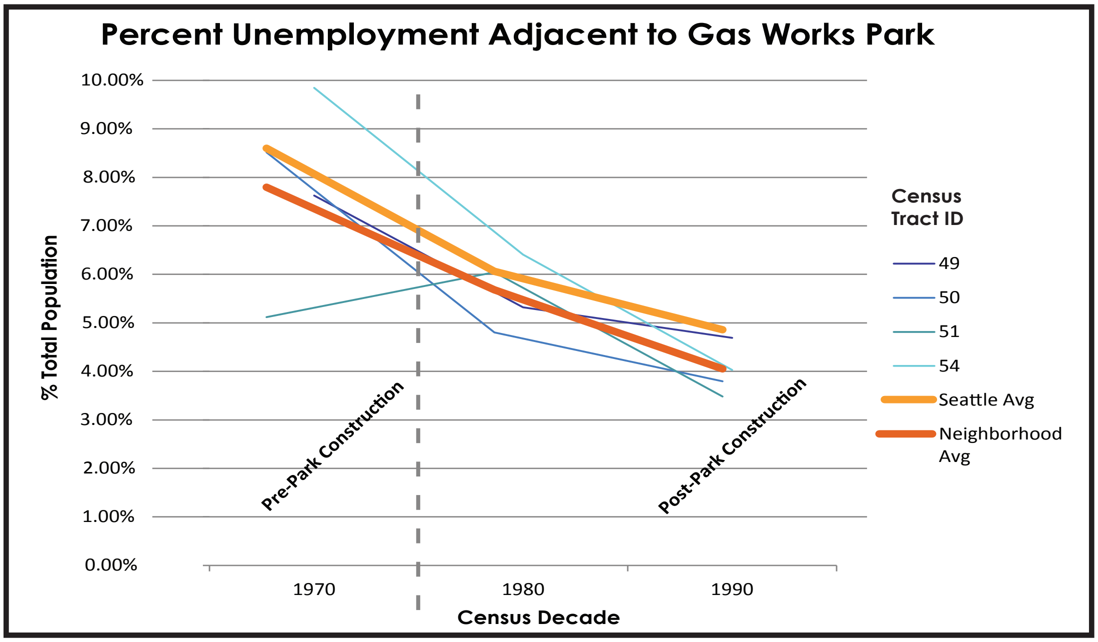


Fig 6.7 Percent Unemployment, in Gas Works Park neighborhood (1970-1990)

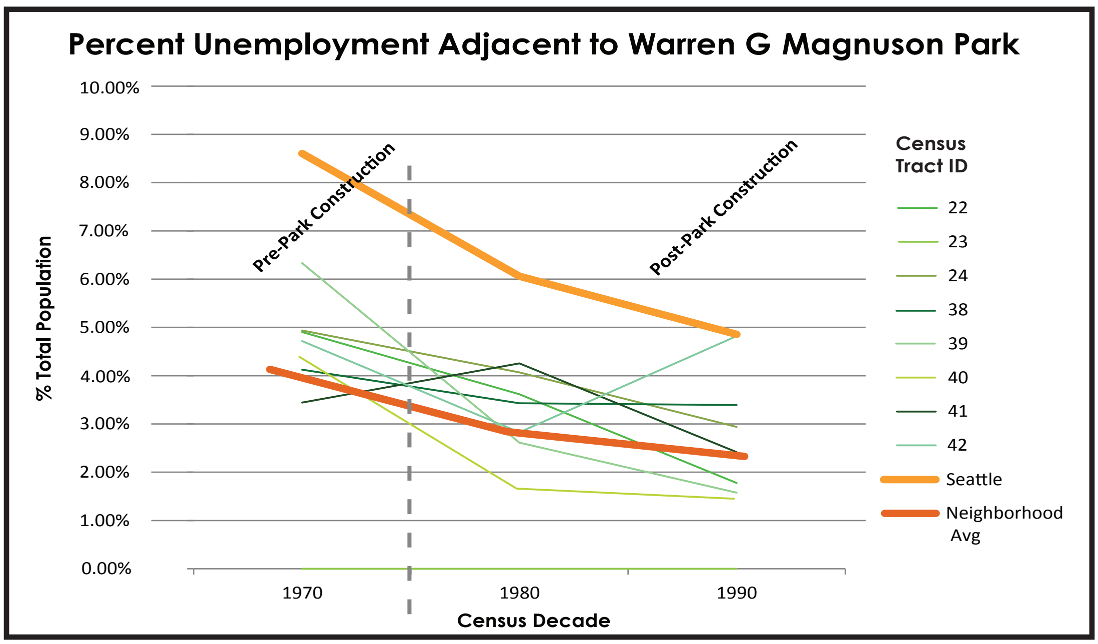


Fig 6.8 Percent Unemployment, in Warren G Magnuson neighborhood (1970-1990)

case study neighborhoods was consistently below the city average, indicating these neighborhoods are fairly economically stable.

No correlation may be made between neighborhood brownfield parks and unemployment in the Gas Works Park and Warren G Magnuson Park neighborhoods. Brownfield park construction and percent unemployment in adjacent neighborhoods appears to be unrelated for these case studies.

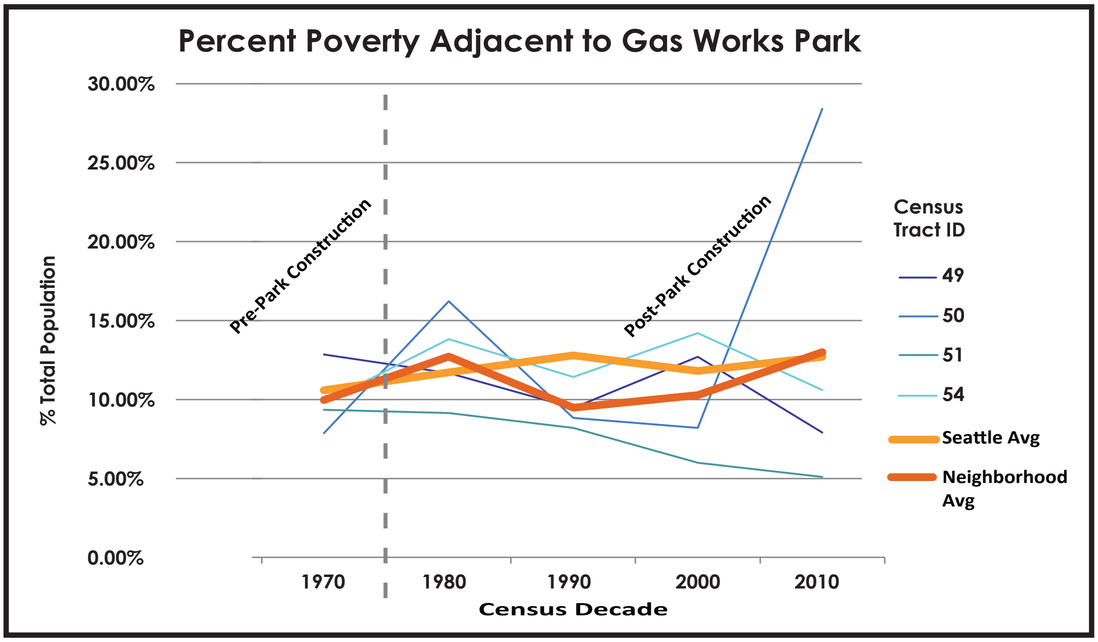


Fig 6.9 Percent poverty in Gas Works Park neighborhood (1970-2010)

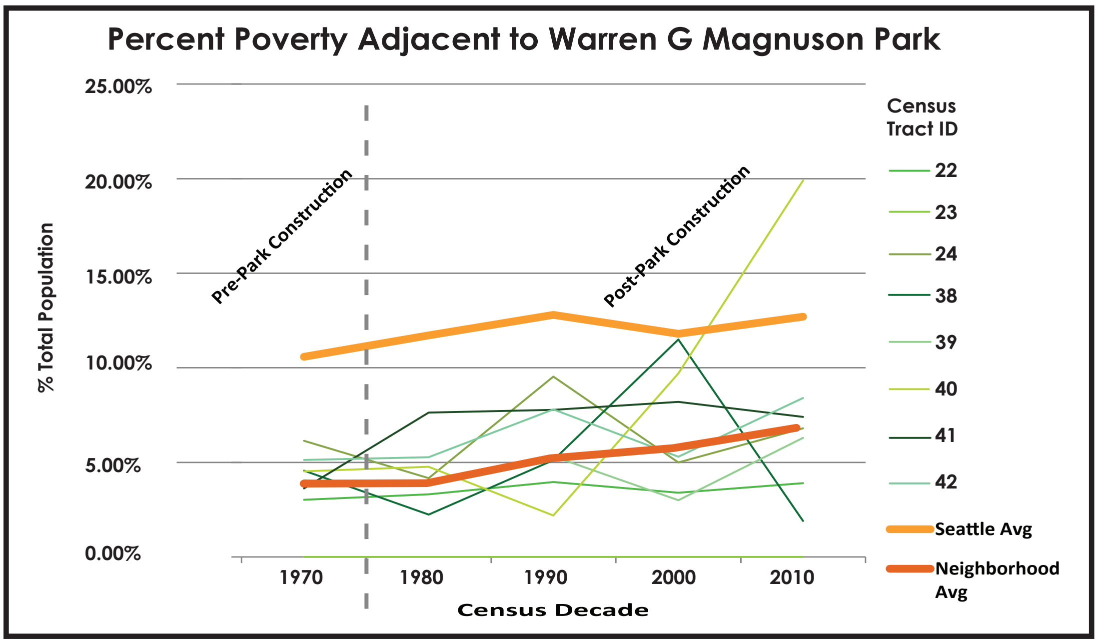


Fig 6.10 Percent poverty in Warren G Magnuson Park neighborhood (1970-2010)

Percent Poverty versus Seattle Average (1970 -2010)

The overall trend for Poverty between 1970 and 1980 (Figs 6.9, 6.10) is an increase for 5 out of 12 tracts, with one tract not reporting. The overall trend for Poverty between 1980 and 1990, is also 5 out of 12 tracts increasing, with one tract not reporting for 1980 and 1990. However, 6 of the tracts report opposite results for the decades in question, with either an increase or decrease in poverty for the first decade, and a switch to the opposite trend for the second decade.

The findings indicate neighborhood poverty has both increased and decreased since the construction of Gas Works and Warren G Magnuson Parks.

Compared to the trend in Seattle, which shows an increase in poverty overall for the decades studied, the majority of tracts within the case study neighborhoods fared better while some fared equally or slightly worse.

Similar to the unemployment results, the Warren G Magnuson neighborhood is consistently, on average, below the city average for poverty, indicating an economically healthy context for the park. Gas Works Park is in a more volatile neighborhood, with average poverty sometimes above and sometimes below the city average, indicating a more dynamic context for the park. This indicates the results for the time frame studied are not necessarily correlated to brownfield park construction in the neighborhoods.

Case Study Neighborhood Age Diversity versus Seattle Average (1970 – 2010)

In order to evaluate changes in age diversity within the case study neighborhoods since brownfield park construction, residents were split into 4 age groups: Children (0-14 years), Young Adults (15-24 years), Adults (25-54 years) and Seniors (55+ years).

Gas Works Park Neighborhood Age Diversity

Looking at the trend for the Gas Works Park neighborhood (Fig 6.11), from 1970 to 2010, there was a steady increase in age diversity. An increase in the percentage of working-age population, Adults 25-54 years of age, was accompanied by corresponding decreases in the percentages of Young Adult and Senior populations, while Children held steady. The 2010 census has a dramatic loss in Adults population and a jump in Young Adults, perhaps as a result of demographic shifts following the 2008 recession.

Up until the recession, there was a strong increas in working-aged adults, possibly indicating Gas Works Park has helped to make this neighborhood an attractive destination for this demographic, prior to 2010.

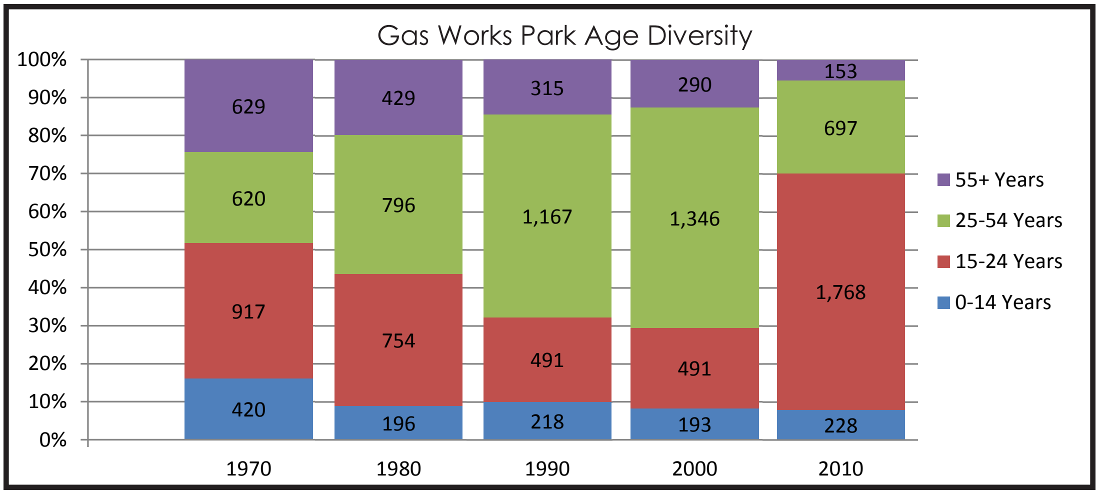


Fig 6.11 Age diversity, Gas Works Park neighborhood (1970-2010)

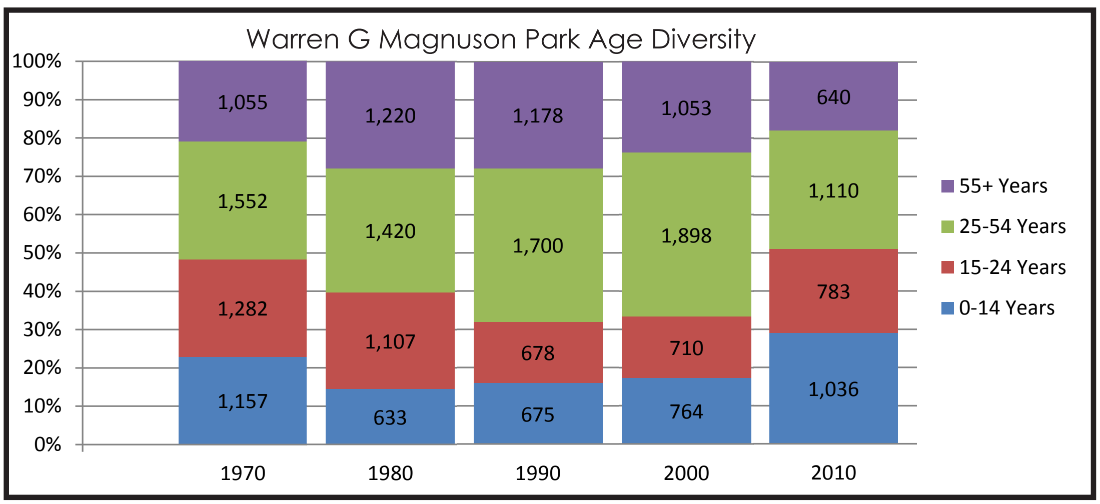


Fig 6.12 Ave diversity, Warren G Magnuson Park neighborhood (1970-2010)

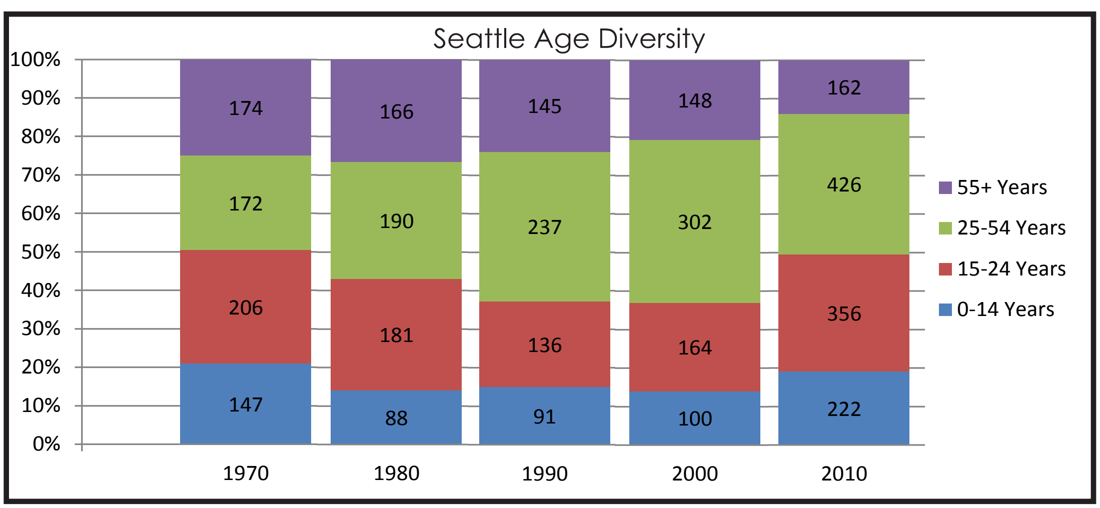


Fig 6.13 Age diversity, Seattle, WA (1970-2010)

Warren G Magnuson Park Neighborhood Age Diversity

Looking at the trend for the Warren G Magnuson Park neighborhood (Fig 6.12), the age diversity increased from 1970 to 2000, similar to the Gas Works Park neighborhood. An increasing the working-age population, Adults 25-54 years of age, was accompanied by decreases in Young Adult and Children populations. The 2010 census has a dramatic loss in Adults population and an increase in Children, perhaps as a result of demographic shifts following the 2008 recession.

Seattle Average Age Diversity Comparison

Average age diversity trends in Seattle (Fig6.13) were similar to age diversity in the case study neighborhoods of Warren G Magnuson Park. The comparison between Seattle and the Gas Works Park neighborhood is also similar, but exaggerated – there is an increase from 1970 to 2000 then decrease from 2000 to 2010 in Seattle in Adults, which is repeated and amplified in the Gas Works Park neighborhood. The number of children in the Warren G Magnuson case study neighborhood begins high, then decreases from 1980 to 2000, and then increases in 2010 to near the 1970 numbers identical to Seattle. Child age diversity in the Gas Works Neighborhood follows the same trend, but does not experience the increase in 2010.

Adult age diversity in the case study neighborhoods diverges from the Seattle average for both the 1970-1980 and the 2000-2010 census cycles. By comparison, the total number of Adults in Seattle has constantly increased since 1970. This indicates the number of adults in case study neighborhoods is not necessarily correlated to brownfield park construction, because the greatest difference between the case study sites and Seattle occurs over 30 years after the brownfield parks were constructed.

The decrease in Adults is especially interesting because unemployment within the case study parks decreased for this same time period (2000-2010), causing speculation as to a relationship between adults leaving the neighborhood and decreased unemployment, which would correlate if Adults were seeking work elsewhere. The increase in vacancy in half the studied tracts during the 2000 and 2010 census supports this idea, as does the increase in poverty for half the studied tracts during this same time frame. This does not explain the increase in total Children and Young Adults for 2000-2010.

Seniors in the Gas Works Park neighborhood have decreased significantly over the past 40 years. Because this has been a working-class family neighborhood for many decades, this drop in seniors could be due to individuals who moved to the neighborhood as adults or young adults becoming old and either moving to assisted care facilities or dying.

Gas Works Park Neighborhood Vegetative Cover

Vegetative cover in the Gas Works Park neighborhood has increased over the last 40 years. More tree cover is visible, planted areas along roadsides and within neighborhoods has grown. The creation of Gas Works Park, at 21 acres, increased the number of parks in the Wallingford study area from one, Wallingford Playfield, at 4.5 acres and built by the city in 1924, to two. This represented a 466% park increase for the neighborhood. The study area is comprised of a total of 1.05 square miles, which includes Gas Works Park. This is equal to a total of 672 acres.

In 1969, beyond Wallingford Playfield, the only vegetation in the neighborhood were a few areas alongside N Pacific Street, which runs parallel to Lake Union, and vegetation planted by home and business owners. These areas were mostly private or small

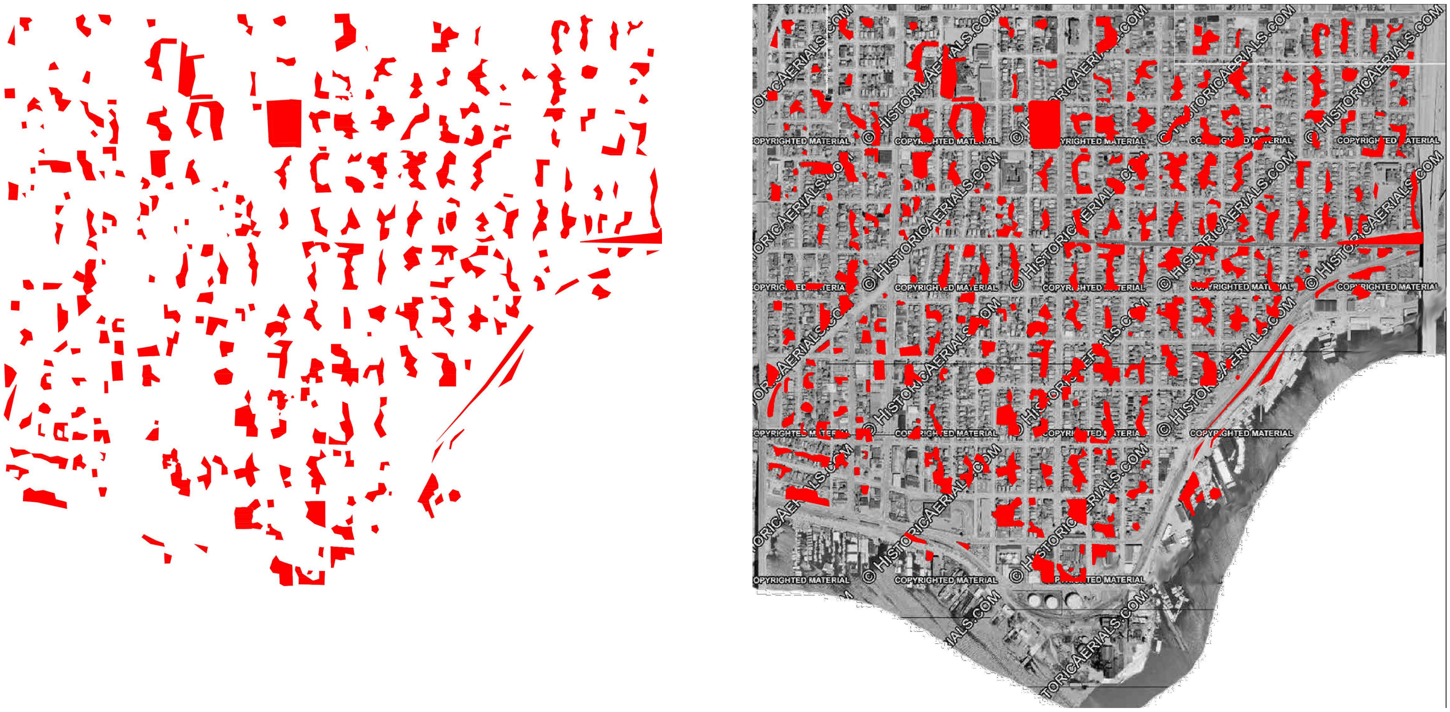


Fig 6.14 Gas Works Park neighborhood showing 67 acres (10%) Vegetative Cover, 1969

Fig 6.15 Gas Works Park neighborhood showing 94 acres (14%) Vegetative Cover, 1980

street side beds not conducive to play. Vegetative cover in 1969 was 10%, or 67 acres (Fig 6.14).

By 1980, vegetative cover increased both with the construction of Gas Works Park in 1975, and with more vegetation throughout the neighborhood. This vegetation still included street beds, but also yard and garden areas surrounding homes. This is the beginning of visible vegetation improvements within the neighborhood. Vegetative cover in 1980 was 14%, or 94 acres (Fig 6.15). This represents a 4% increase since 1969, equal to 27 additional acres of vegetative cover.

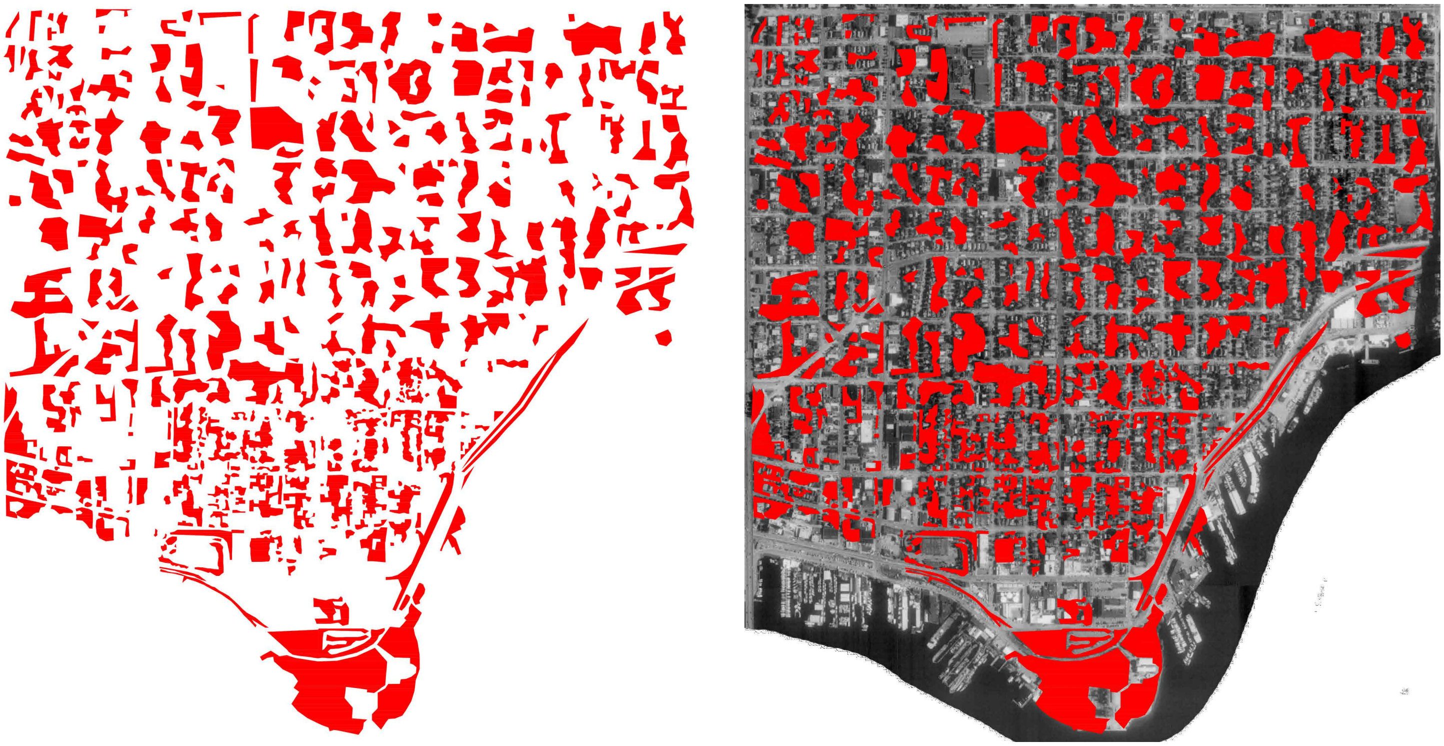


Fig 6.16 1990 Gas Works Park neighborhood showing 121 acres (18%) Vegetative Cover, 1990

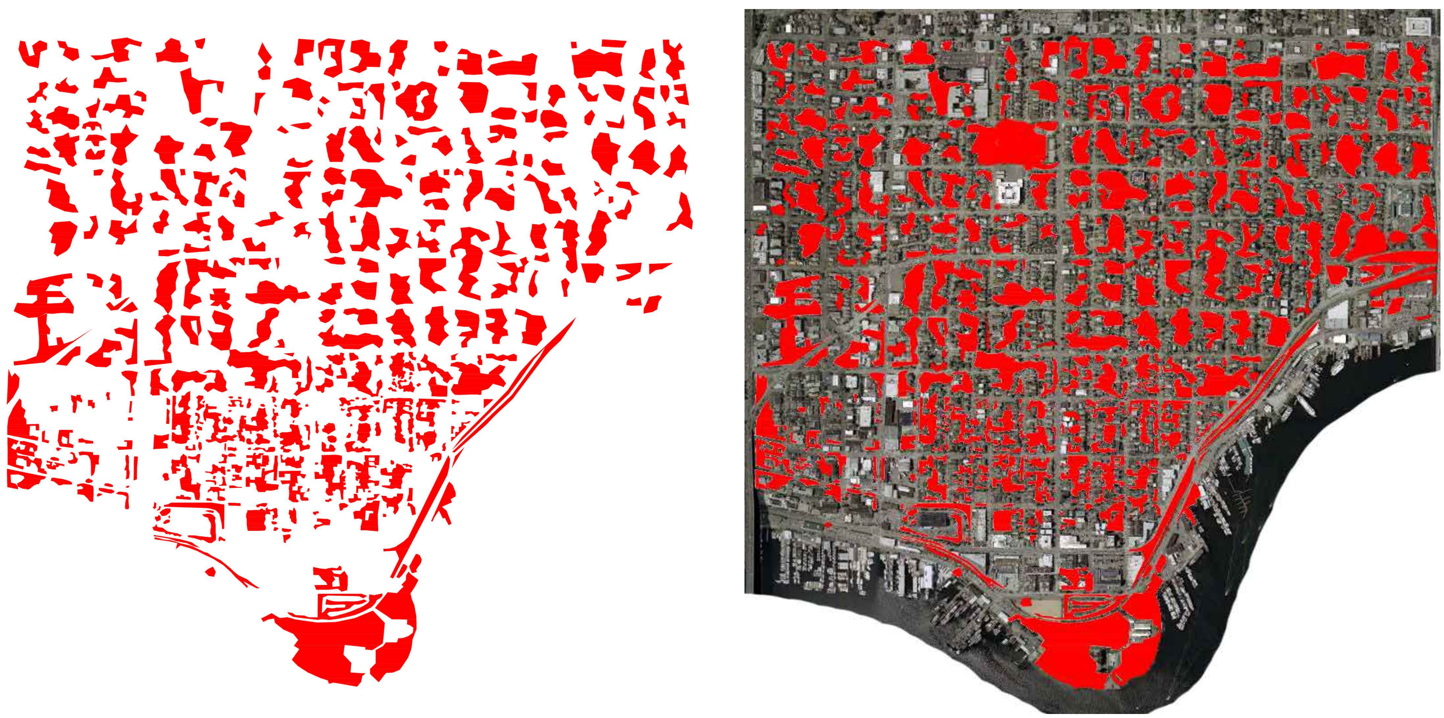


Fig 6.17 Gas Works Park neighborhood showing 128 acres (19%) Vegetative Cover, 2002

In 1990, new trees and shrubs provide increased vegetative cover. Trees planted previously continued to grow, providing a larger vegetative presence. As neighborhood building improvements took place, plant beds were included, adding to the vegetative inventory. Vegetative cover in 1990 was 18%, or 121 acres (Fig 6.16). This represents a 4% increase since 1980, equal to 27 additional acres of vegetative cover.

Between 1990 and 2002, there is only a slight visible increase in vegetative cover. This is due to no new parks being created as well as few additional planting areas being added to the neighborhood. Existing plant

Fig 6.18 Gas Works Park neighborhood showing 141 acres (21%) Vegetative Cover, 2010

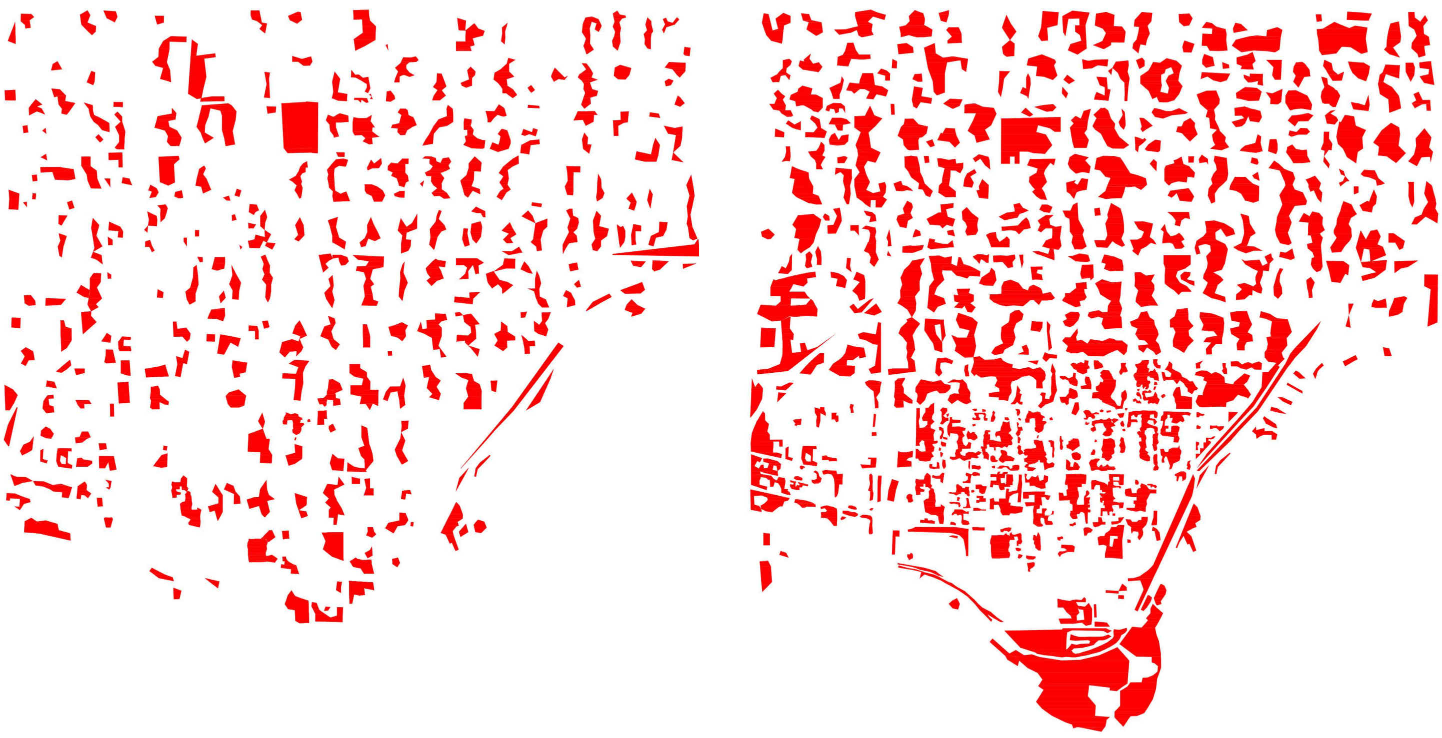


Fig 6.19 Comparison of 1969 (left) & 2010 (right) Gas Works Park neighborhood Vegetative Cover

areas had a small increase in vegetative cover, as shown on the map. Vegetative cover in 2002 was 19%, or 128 acres (Fig 6.17). This represents only a 1% increase since 1990, equal to 7 additional acres of vegetative cover.

As of 2010, vegetative cover continued to increase. Areas previously devoid of plants show vegetative cover. Existing vegetative areas continued to expand. Vegetative cover in 2010 was 21%, or 141 acres (Fig 6.18). This represents a 2% increase since 2002, equal to 13 additional acres of vegetative cover.

Fig 6.20 Wallingford Neighborhood reLeaf Tree Map

The visible trend over the last 40 years for the Wallingford neighborhood shows a significant increase in vegetative cover (Fig 6.19). Vegetative cover in 1969 was 10%, or 67 acres, and in 2010 vegetative cover was 21%, or 141 acres. This is a total increase of 11%, or 74 acres, of vegetative cover since the creation of Gas Works Park. This increase correlates to the construction of Gas Works Park by creating a more hospitable neighborhood, which is conducive to property owners adding vegetative cover to enhance the places they live. Also, existing trees are maintained and allowed to mature indicating a high level of care resulting in low street tree mortality, indicating a socially healthy neighborhood.

Like many major cities, Seattle has a robust street tree program. Seattle reLeaf, started in 2009, provides up to 8 free trees to property owners and the Trees for Neighbors project, a residential tree planting group under reLeaf, which has planted over 6,300 trees in Seattle yards since 2009 (City of Seattle, 2016). The reLeaf program has been voluntarily implemented in the Wallingford neighborhood (Fig 6.20), contributing to the increase in vegetative cover.

Warren G Magnuson Park Neighborhood Vegetative Cover

Vegetative cover in the Warren G Magnuson Park neighborhood has increased over the last 40 years. Similarly to Wallingford, more tree cover is visible, with an increase in planted areas along roadsides and within neighborhoods. Warren G Magnuson Park increased the number of parks in the study area over the 40 years considered in this study. The study area is comprised of a total of 3.35 square miles, which includes Warren G Magnuson Park. This is equal to 2,144 acres.

Prior to Warren G Magnuson Park, the neighborhood study area included a number of park options for residents. These included the Burke-Gilman Playground Park, a 7-acre public park in Laurelhurst; Windermere Park, a 6-acre private, gated park for fee-paying Windermere residents; Bryant Neighborhood Playground, a small 3-acre park on the east edge of the study area; View Ridge Playfield, a 9-acre park adjacent to View Ridge Elementary; Sand Point Country Club, a private 80-acre, 18-hole golf course opened in 1927; Inverness Ravine park, a 2.7-acre park deeded to the city in 1972; and Mathews Beach Park, a 22-acre park located on Lake Washington, purchased by the city in 1951. This is a total of 129.7 acres of park land. In addition, the Burke-Gilman trail, a 27-mile long by 50 foot wide rail trail, runs through the case study neighborhoods of Laurelhurst, Windermere, Sand Point and View Ridge. As Seattle's second largest park, the 350-acre addition of Warren G Magnuson Park increased vegetative cover for this area by 37%.

In 1969, with the Naval Air Base still in operation, the Warren G Magnuson Park neighborhood had a fair amount of vegetative cover. Many of the neighborhoods had vegetated back yards, the majority of the businesses along the west side of the study area had vegetation surrounding the buildings and some had

Fig 6.21 Warren G Magnuson Park neighborhood showing 579 acres (27%) Vegetative Cover, 1969

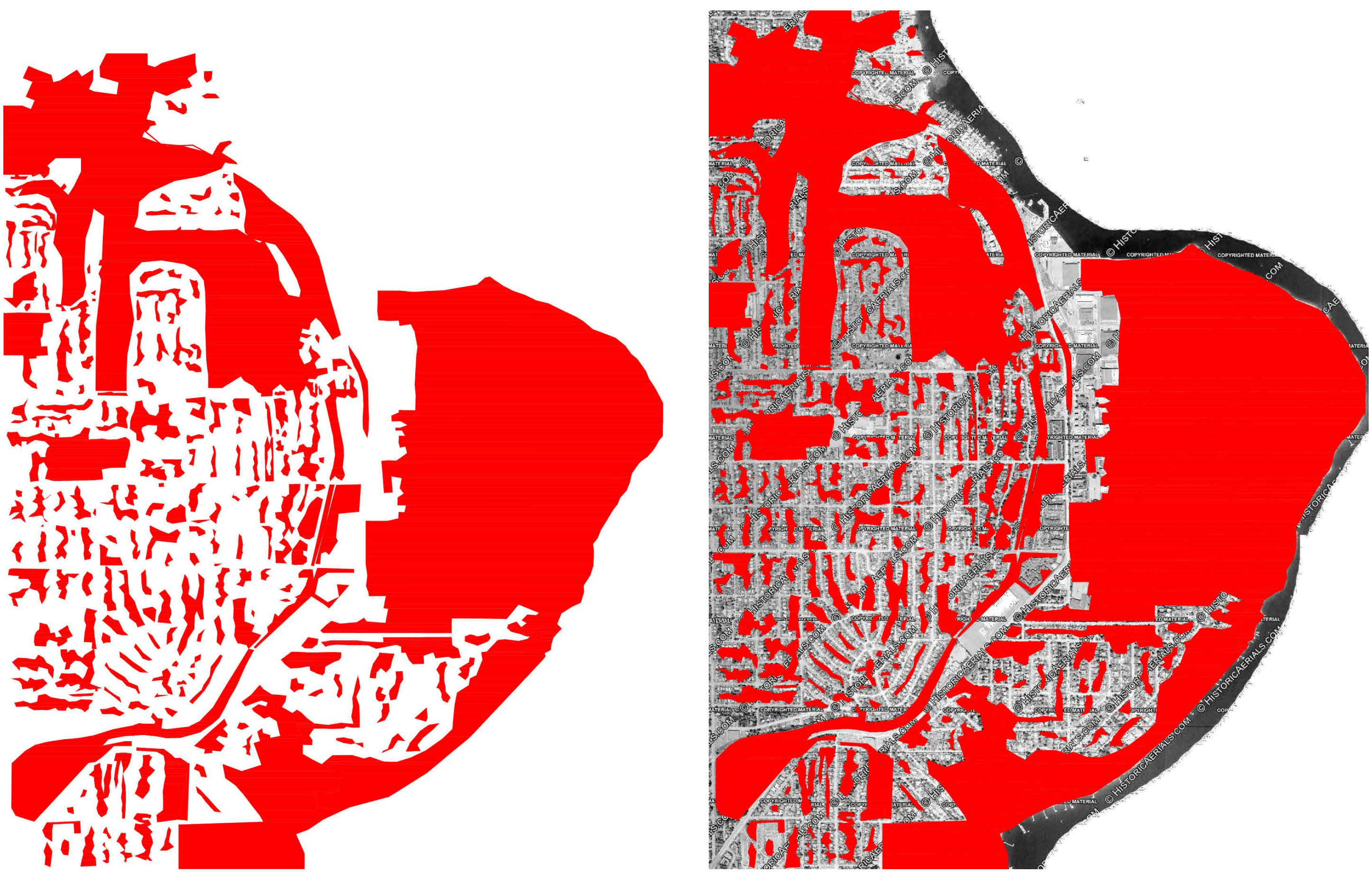


Fig 6.22 Warren G Magnuson Park neighborhood showing 986 acres (46%) Vegetative Cover, 1980

vegetation in the parking lots. There were a number of vegetated beds alongside major roadways, especially along Sand Point Way NE, the main arterial running through the study site and along the east boundary of Warren G Magnuson Park. Vegetative cover in 1969 was 27%, or 579 acres (Fig 6.21).

After the demolition of the Naval airfield runways and the opening of Warren G Magnuson Park in 1977, and prior to the NOAA building construction in 1982, there was significant vegetative cover in the neighborhood. Street beds contained visible vegetation and all of the currently existing parks had been constructed. Vegetated beds along major roadways remained unchanged. Vegetation in the northern part of the study site increased somewhat between 1969 and 1980, before the construction of homes in the area. Vegetative cover in 1980 was 46%, or 986 acres (Fig 6.22). This represents a 19% increase since 1969, equal to 407 additional acres of vegetative cover.

By 1990, existing trees had grown in size. These are cues of care, indicating a socially healthy and robust neighborhood since residents had an increase in the amount of vegetation surrounding their properties. Street bed plantings continued to grow, but vegetation was lost due to new home construction in the north end of the study area and some infill, resulting in an overall vegetation decrease. Vegetative cover in 1990 was 40%, or 858 acres (Fig 6.23). This represents a 6% decrease since 1980, equal to 128 fewer acres of vegetative cover.

Vegetated areas continued to decrease between 1990 and 2002. Construction to the south of the park at the time the aerial photo was taken shows reduced vegetation. Additionally, some of the neighborhood vegetation has shrunk, especially near

Fig 6.23 1990 Warren G Magnuson Park neighborhood showing 858 acres (40%) Vegetative Cover

Fig 6.24 Warren G Magnuson Park neighborhood showing 815 acres (38%) Vegetative Cover, 2002

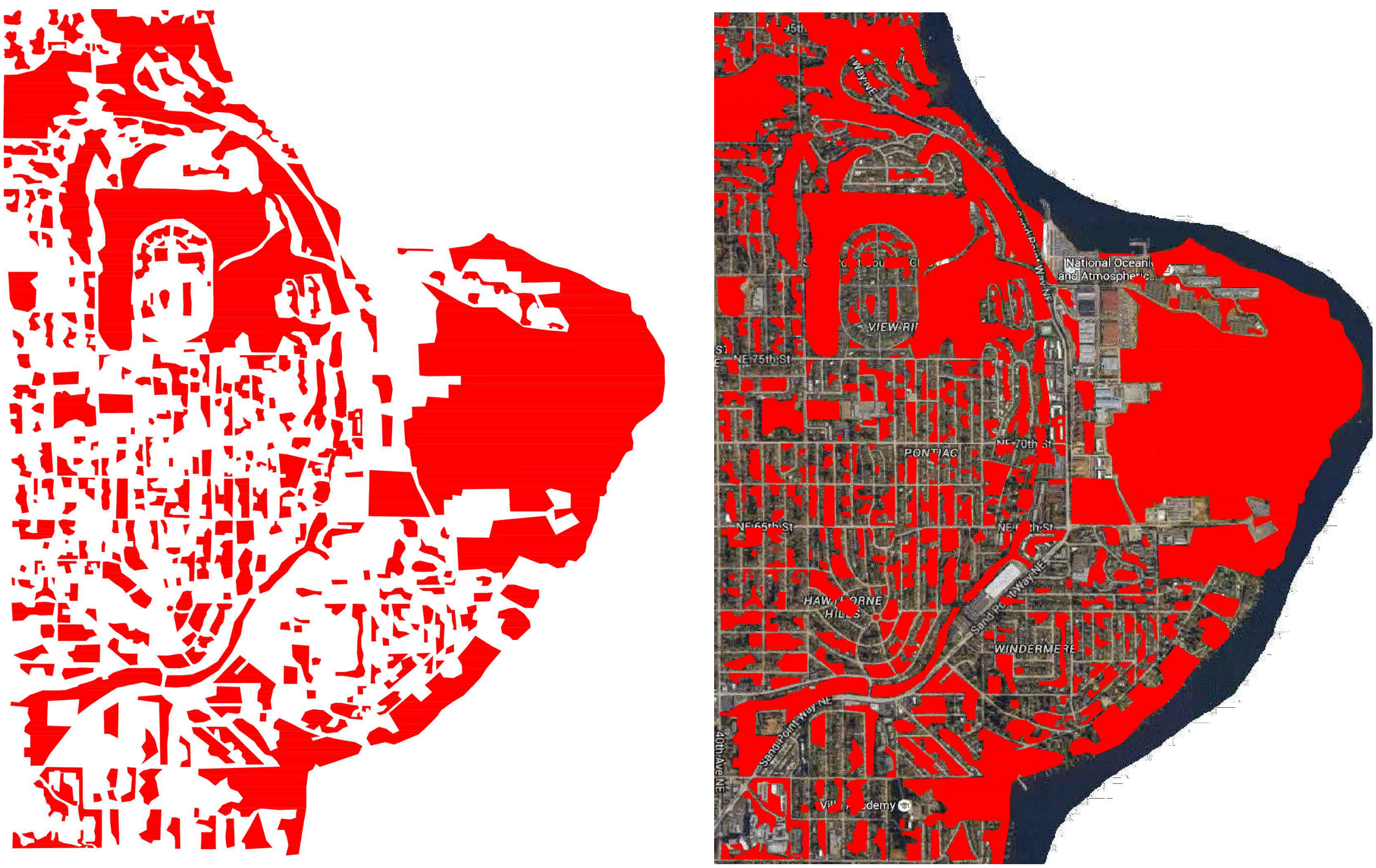


Fig 6.25 2010 Warren G Magnuson Park neighborhood showing 643 acres (30%)Vegetative Cover

the center of the study area, due to infill. Vegetated plantings along Sand Point Way NE have increased, as have vegetated areas to the south of the park. Vegetative cover in 2002 was 38%, or 815 acres (Fig 6.24). This represents a 2% decrease since 1990, equal to 43 fewer acres of vegetative cover.

The 2010 vegetation was further reduced since 2002. Neighborhoods have experienced reduced vegetation and roadside plantings have been removed. Vegetative cover in the neighborhood, with the exception of Warren G Magnuson Park, is similar to that in 1969. Vegetative cover in 2010 was 30%, or 643 acres (Fig 6.25). This represents an 8% decrease since 2002, equal to 172 fewer acres of vegetative cover. This reduction in active homeowner maintenance could be due to the increase in vacancies during this time frame.

The visible trend over the last 40 years for the Warren G Magnuson Park neighborhoods shows an increase in vegetative cover between 1969 and 1980, equal to a high of 986 acres total acres of vegetative cover, and then a decrease from 1980 to 2010, equal to a low of 643 total acres of vegetative cover (Fig 6.26). This is a loss of 343 acres of vegetative cover between 1980 and 2010. Total vegetative increase for the Warren G Magnuson Park neighborhoods over the last 40 years is only 64 acres of vegetative cover.

The initial increase in vegetation beyond that of the park could be correlated to the park construction. Improved neighborhoods attract individuals interested in high neighborhood aesthetics and livability, willing to invest in vegetation. The decrease in vegetation may also correlate to the construction of Warren G Magnuson Park (Fig 6.26). An improved neighborhood attracts people who want to live there and

Fig 6.26 Comparison of 1969 (left) & 2010 (right) Warren G Magnuson Park neighborhood Vegetative Cover

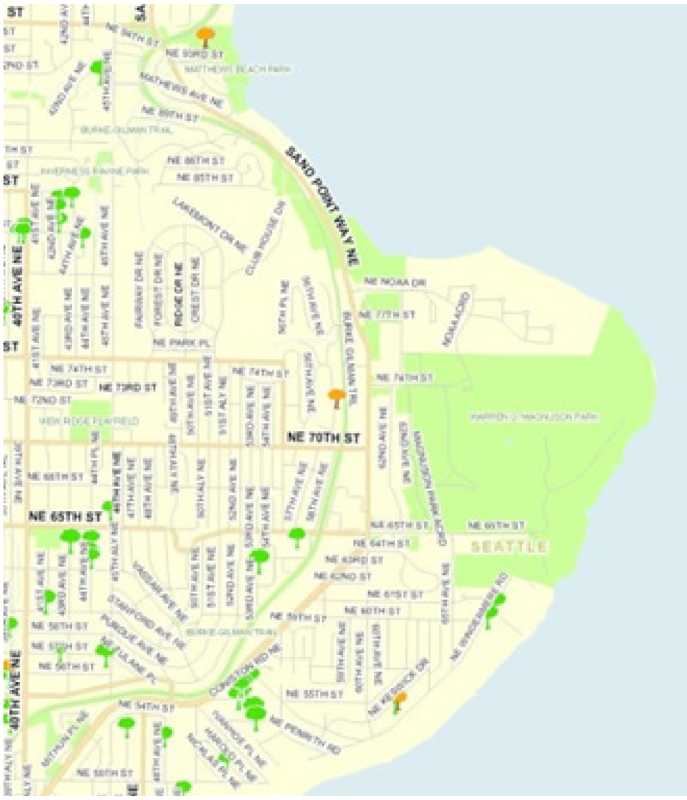


Fig 6.27 Warren G Magnus Park Neighborhood reLeaf Tree Map

take the opportunity to improve and/or develop available lots, thereby reducing existing vegetation. Seattle reLeaf has been much less successful in this case study neighborhood (Fig 6.27), contributing only nominally to an increase in vegetative cover.

The map regression results for the Gas Works Park and Warren G Magnuson neighborhoods correlate with one another, in opposing manners. The Wallingford neighborhood continues to increase vegetative cover, and therefore neighborhood investment and quality of life, throughout the entire study period after the construction of Gas Works Park. Unlike the Warren G Magnuson study area, the Gas Works neighborhood is built up, with few available lots for new construction.

The Warren G Magnuson neighborhood sees a reduction in vegetation after 1980. Just like the Wallingford improvements could be directly tied to the construction of Gas Works Park and increased livability, the Laurelhurst, Windermere, Sand Point and View Ridge neighborhood vegetation curve appears to be tied to an increase in home construction taking place immediately after the construction of Warren G Magnuson Park.

Result Summary

Based on the data gathered for the case study neighborhoods, it is difficult to determine the exact impact Gas Works and Warren G Magnuson Parks have played. The data paints a mixed picture of changes which could be attributed to these parks: homeowner vacancy is up while rental vacancy is down, Poverty and Unemployment are down, Age Diversity shows very little difference and Vegetative Cover/Public Parks shows an increase across the decades for both parks, except Warren G Magnuson after 1980, which shows a decrease which appears to be correlated to new construction.

Compared to Seattle city averages, poverty and unemployment in brownfield neighborhoods are typically below the city average, indicating an economically healthy and stable neighborhood context. Vacancy in brownfield neighborhoods are also lower, on average, than Seattle city averages. Age diversity in Warren G Magnuson Park neighborhoods is similar to Seattle averages, but is greater in the Gas Works Park neighborhood.

These results do not necessarilty correlate to the creation of neighborhood brownfield parks, so much as tell us about the relative stability and health of the neighborhoods around the parks.

Aerial view of coal ash waste at electricity generation station, photo by J Henry Fair

CHAPTER 7: Future Study

7.1 FRAMEWORK REPLICATION + TRANSFERABILITY

Post-occupancy evaluations (POE) are becoming more common in landscape architecture as a way to evaluate the use and effects of built projects on surrounding communities. Case studies are an effective way to examine and compare built projects to one another. Together, these methods work hand in hand to paint a complete picture of how brownfield parks impact the neighborhood in which they are built.

The framework proposed in this master's project is readily replicable and may be transferred to any brownfield park neighborhood for which metrics may be located. Methods for obtaining metric information used for this project include GIS (fine grain Tiger files are not available prior to 1980), census data, historic maps, state brownfield websites and the EPA.

Because data sources were limited, due to availability and time constraints, the metrics were constrained to only five for this study. There was a tension between the goals, scope and available/potential data for this project. Due to data limitations, this study was limited to a very small sampling of brownfield parks.

Additional metric sources not explored through the course of this project include, in part, old phone books (to track neighborhood services such as markets or restaurants) old maps (to track neighborhood street development over time), and old bus routes (to track public transportation). Historic photos would have allowed for a unique view of neighborhood structures and culture not visible in old aerial photos.

It would have also been very useful to create a survey for park visitors to evaluate their perception, use and understanding of these case study parks. Because Gas Works Park has remaining industrial ruins on-site, it is easy to understand it is a brownfield park. Warren G Magnuson is better described as a park on a brownfield.

The time frame required for applying the methods used here requires at least 10 years, or one census cycle, since the park creation, along with a thorough investigation into pre-construction site and neighborhood conditions. Newer parks must rely on alternate data sources due to the time frame limitations involved with census data.

Data sources for newer parks include tracking changes in home values (available at the city assessors office), the cost of home insurance (as a reflection of the risks involved with living specific locations) and crime date (which is more readily available for recent years due to current day crime trend tracking). Social welfare data, such as food stamp recipient populations and reliance on government funds for housing assistance (including grants to pay water and electricity bills) is also tracked and publicly available for recent years.

Goals and methods for achieving environmental justice for each site should be clearly established prior to study commencement.

7.2 CHALLENGES

The use of Census data was challenging. Census data collection is not performed in a manner which confirms or disproves environmental justice. Environmental justice and displacement are difficult to measure because the reasons for these shifts are not tracked. Many vulnerable people, such as those who are homeless or undocumented are likely missed. Many cities have contested the Census for the undercounting of minority populations. (NEJAC, 2006) In addition, Census data is complicated to understand and translate into metrics that are relevant and can be usefully compared.

Different spatial grains are available using Census data. Census tract is a relatively coarse grain representation of a neighborhood. A finer grain, such as census block, could have been achieved using GIS tiger files. However, GIS tiger files are only available for census data collected after 1980. This constrained the census data grain to the tract level for consistency across the project frame of 1970 to 2010.

Considering housing statistics or percent vacancy, the number of new houses built during the study time frame was not included as part of this study. If many new houses were built as a result of the parks construction, there would be more total houses available even if the percent vacancy went down. Having this information would have yielded a more thorough understanding of the vacancy changes over time.

Relying on census date restrained case study neighborhood selection to older parks. Using alternate metric sources would have allowed for a greater number of case study options.

7.3 EXPAND STUDY SITES

To most effectively utilize the framework proposed, application to an expanded number of case study sites is required. This will both test the framework efficacy and bring to attention any additional metrics required to complete a thorough evaluation of park performance and the level of environmental justice achieved.

Examining metrics for parks from different locations will identify areas, both by location and programmatically, where parks are not meeting the standards and criteria for environmental justice. Running additional case study neighborhoods through the evaluative method would identify additional data sources and, potentially, other metrics which could be viable in other locations. It is from this further study that a universal standard of environmental justice may be clearly defined for brownfield parks. Establishing a nationally accepted monitoring program and review process based on environmental justice will further these goals.

The two case study neighborhoods chosen for this project are not primarily made up of people of color or those who are economically challenged. Different results may have occurred had the case study sites been selected for their adjacency to poor or racially diverse neighborhoods.

7.4 APPLICATIONS

The goal for this project to was create a framework by which to evaluate the environmental justice of existing and planned brownfield parks. It is generally accepted brownfield parks improve the lives of nearby residents, though few studies have been performed to verify this claim. Without case studies and the application of POE, countless opportunities to learn from these projects are forfeit.

POE is best performed when sites are evaluated prior to remediation, to establish an information baseline on which to base future studies, along with in-depth and multi-pronged follow up evaluations. Without this information, the full effects these projects have on surrounding communities are difficult to measure.

It is estimated there exist more than 450,000 brownfields in the US, and that approximately 27 million people live within a mile of hazardous waste management facilities (EPA, 2006). In 2015, an estimated $161 million was budgeted for brownfield remediation projects across the US (EPA, 2014). EPA's Environmental Justice strategic plan is to "clean up communities, advance sustainable development, and protect disproportionately impacted low-income and minority communities. Prevent releases of harmful substances and clean up and restore contaminated areas."

In order to achieve this in an environmentally just manner, it is necessary to establish evaluations and protocol which supports environmental justice for all those living near brownfield parks.

7.5 DISCUSSION + FURTHER STUDY

The literature review identified a robust master list of metrics. The pilot study determined which metrics were viable, within the allowed time frame, for Seattle, WA. Other parks or other cities will likely provide different final evaluative metrics based on data availability.

Both case study parks chosen for this study are in relatively affluent and stable neighborhoods, making it hard to evaluate changes in environmental justice, as they are likely already rather "just." The results from the case study parks reinforce and perpetuate this. Case study parks in economically challenged neighborhoods might provide very different results.

Alberta oil sands factory, www.endecocide.org

CHAPTER 8: Conclusion

8.1 CONCLUSIONS

The goal of this project was to evaluate the environmental justice impact of brownfield parks on their surrounding neighborhoods. Based on the mixed results from the case studies, it is difficult to determine the environmental justice impact of Gas Works and Warren G Magnuson Parks on their respective neighborhoods. These mixed results point to the need for further evaluation.

The evaluative model was sound and gave good results for the chosen metrics. The data proxies were appropriate. By establishing the POE framework based on metrics from the five literature identified categories, Financial, Health, Quality of Life, Neighborhood Completeness and Brownfield Park Design Standards, the impact of brownfield parks on their surrounding neighborhoods begins to be revealed. Given more time to evaluate additional metrics, a clearer picture would have resulted from this investigation.

Because so many of the evaluative metrics are intertwined, such as the connection between new home construction and the resulting reduction of vegetative cover, the results could have been made clearer if additional metrics were evaluated as part of this study.

It was difficult to pull apart correlation and causality, and the impact of external factors. The most obvious of which is the 2008 housing market crash. The best result would be achieved using as robust an analysis as possible, to be able to see a gestalt portrait of the neighborhood pre- and post-park construction. Perhaps causality can never be teased out, because so many factors are at play. As a result, evaluating environmental justice based on interconnected or a limited number of viable metrics poses an ongoing challenge.

The two case study parks were chosen for the availability of tractable metrics in addition to their proximity to one another, and not on the demographic makeup of their respective neighborhoods. Different parks may have provided different results. Further study is the best way to further evaluate and refine the POE framework proposed here.

8.2 FINAL COMMENTS

Brownfield remediation faces may challenges. Among them are higher cleanup standards which must be met for brownfield parks because users are typically younger and have a higher level of anticipated soil exposure than sites slated for commercial use (DeSousa, 2014). In addition, these parks face tremendous pressure to maintain high performance and functionality, and better the community.

Untreated brownfields contribute to deteriorated community health, low property values and poor social conditions (Faust, 2010). The addition of public green space to urban locations improves public health, creates a healthier environment, increases property values and stimulates economic growth (Garvin, 2011). It follows removing brownfield blights from neighborhoods will ameliorate many, if not most, of these negative neighborhood conditions. However, an unintended consequence of brownfield remediation may be high vacancy due to unaffordable rent and loss of employment due to changing neighborhood conditions (Lee and Mohai, 2012). In addition, remediation failures expose park users to hidden toxins and health risks.

Few post-occupancy evaluations have been done to examine the tangible effects of urban brownfield parks. Not until President Clinton's 1994 passing of Executive Order 12898 were brownfield remediation projects undertaken with consideration of environmental justice – "the fair treatment and meaningful involvement of all people…with respect to the development, implementation and enforcement of environmental laws, regulations and policies" (United Church of Christ, 2007). By combining case studies and POE with criteria for achieving environmental justice, brownfield parks will be held to the highest standards, and provide the greatest long-term benefits for all.

By pre-envisioning landfills and industrial sites as future parks, steps can be taken to prepare these places for re-use before they transition to the public realm. Incorporating POE and case study evaluations, viewed through the lens of environmental justice, into brownfield park projects will reveal the means to create green space in urban environments while supporting a stronger and more stable neighborhood community.

As landscape architects, we should be demanding better baseline data prior to project construction, and should be tracking projects post-construction. This should be a routine untertaking applied to all built projects, but especially those which carry a high risk to adjacent populations.

Perhaps the master list of metrics complied here provides a starting point for a tool landscape architects can use to quantitatively and qualitatively measure the impact of our projects. I would encourage any practicing landscape architect to take note and expand on the metrics and methods produced by this project.

Bibliography

1) Alston, D. "The Summit: Transforming a Movement." Reimagine, RP&E Journal. Vol. 2, No. 3/4: The Summit. Reprinted in The 20th Anniversary Issue, Vol. 17, No. 1, Spring, 2010. http://www.reimaginerpe.org/20years/alston. Accessed March, 2016.

2) AMD&ART. "The AMD&ART Project in Vintondale, Pennsylvania." 2016. http://www.amdandart.info. Accessed May, 2016.

3) ATSDR (Agency for Toxic Substances and Disease Registry). "Clearwater Brownfields Area, Clearwater, Florida Community Involvement Leads to Community Health." Leading Change for Healthy Communities and Successful Land Reuse. 2010. http://www.atsdr.cdc.gov/sites/brownfields/docs/ATSDR_LandReuse.pdf. Accessed March 2016.

4) Berman, L. & Forrester, T. "An Indicator Framework to Measure Effects of Brownfields Redevelopment on Public Health." Journal of Environmental Health. 2013.

5) Byrnea, J. et al. "Planning for environmental justice in an urban national park." Journal of Environmental Planning and Management Vol. 52, No. 3, 365–392. 2009.

6) CDC. "Community Health Status Indicators (CHSI 2015)." Centers for Disease Control and Prevention. www.cdc.gov/communityhealth. Accessed April 2016.

7) Checker, M. "Wiped Out by the 'Greenwave': Environmental Gentrification and the Paradoxical Politics of Urban Sustainability." City & Society, Vol. 23, Issue 2, pp. 210–229. 2011.

8) Chilton, et al. "Verifying the Social, Environmental and Economic Promise of Brownfield Programs." Brownfield Training, Research, and Technical Assistant Grants and cooperative Agreements Program. BFRES-04-02. 2008.

9) City of Seattle. "WGM Strategic Development Plan." Seattle.Gov. 2013. www.seattle.gov/parks/magnuson/docs/buildings.pdf. Accessed March 2016.

10) City of Seattle. "Seattle reLeaf: Keep the Emerald City Green." City of Seattle. http://www.seattle.gov/trees/. 2016. Accessed May 2016.

11) Cohen, A. "Development atop a city dump? Policy fiasco comes back to haunt Upper 9th Ward." The Lens. 2012. http://thelensnola.org/

12) Cohen, D., et al. "Neighborhood Physical Conditions and Health." Journal of American Public Health, Vol. 93:3. 2003.

13) Creighton, J. "The Public Participation Handbook: Making Better Decisions through Citizen Involvement." Jossey-Bass. 2005.

14) Dai, D. "Racial/ethnic and socioeconomic disparities in urban green space accessibility: when to intervene?" Landscape and Urban Planning, 102:234-244. 2011.

Bibliography

15) Dale, A & Newman, L. Sustainable development for some: green urban development and affordability." Local Environment, 14:7, 669-681(2009)

16) Deming, E & Swaffield, S. "Landscape Architecture Research: Inquiry, Strategy, Design." John Wiley & Sons, Inc. 2011.

17) Dept. of Ecology, State of Washington. "U.S. Navy Station Sand Point Site." Toxics Cleanup Program. Publication Number: 13-09-1841. October 2014

18) DESA. "Dependency Ratio: Indicators." World Population Prospects, United Nations Department of Economic and Social Affairs. 2006. http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/demographics/dependency_ratio.pdf. Accessed April 2016.

19) De Sousa, C. "Unearthing the Benefits of Brownfield to Green Space Projects: An Examination of Project Use and Quality of Life Impacts." Local Environment: The International Journal of Justice and Sustainability, Vol. 11, No. 5, 577–600. 2006

20) De Sousa, et al. "Assessing the Effect of Publicly Assisted Brownfield Redevelopment on Surrounding Property Value." Economic Development Quarterly,23:2, Sage Publications online.sagepub.com. May 2009.

21) De Sousa, Christopher. "The Greening of Urban Post-Industrial Landscapes: Past Practices and Emerging Trends." Local Environment: The International Journal of Justice and Sustainability, Special Issue: Urban Post-Industrial Greenspace 19.10:1049-67. 2014, Print.

22) Dixon, Tim et al (Editor). "Sustainable Brownfield Regeneration: Livable Places from Problem Spaces." Blackwell Publishing Ltd., 2007. Print.

23) Dorpat, P. "Seattle Neighborhoods: Wallingford." HistoryLink.org, Essay 3461. July 24, 2001

24) ENC (Emerald Necklace Conservancy). "Back Bay Fens." Emerald Necklace Conservancy. 2016. www.emeraldnecklace.org/park-overview/back-bay-fens/ Accessed April 2016.

25) EPA. "Soil Bioremediation." National Environment Protection (Assessment of Site Contamination) Measure 1999: Environmental Protection Agency Guideline. 2005.

26) EPA. "Brownfields 2006 Assessment and Cleanup Grant Fact Sheet New York, NY." Environmental Protection Agency Publication 560-F-06-216. May 2006.

27) EPA. "Addressing Environmental Justice in EPA Brownfields Communities, Brownfields and Environmental Justice: A Demographic Analysis of Brownfields Communities." US Environmental Protection Agency. 2009. Print.

Bibliography

28) EPA. "Interim Guidance on Considering Environmental Justice during the Development of an Action." US Environmental Protection Agency, department of Environmental Justice. 2010.

29) EPA. "Air and Water Quality Impacts of Brownfields Redevelopment: A Study of Five Communities." US Environmental Protection Agency, Office of Brownfields and Land Revitalization. 2011.

30) EPA. "Environmental Justice Federal Interagency Working Group." US Environmental Protection Agency. EPA Publication 300F12004. July 2012. https://www.epa.gov/sites/production/files/2015-02/documents/fact-sheet-iwg.pdf. Accessed May 2012.

31) EPA. "EPA Superfund Program: Love Canal, Niagara Falls, NY." United States Environmental Protection Agency. 2016. www.cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0201290. Accessed March 2016.

32) EPA. "EJSCREEN: Environmental Justice Mapping and Screening Tool." EJSCREEN Technical Documentation, US. Environmental Protection Agency. 2015. https://www.epa.gov/sites/production/files/2015-05/documents/ejscreen_technical_document_20150505.pdf Accessed April 2016.

33) EPA. "National Environmental Justice Advisory Council." United States Environmental Protection Agency. www3.epa.gov/environmentaljustice/nejac/index.html. 2016. Accessed March 2016.

34) EPA. "Environmental Justice." Environmental Protection Agency. 2016. www.epa.gov/environmentaljustice. Accessed March 2016

35) EPA "FY 2015 EPA Budget in Brief." United States Environmental Protection Agency. Publication No: EPA-190-S-14-001. March 2014. www.epa.gov. Accessed April 2016.

36) EPA. "Brownfields Fact Sheet: Brownfields Public Health and Health Monitoring." Publication No. EPA-560-F-06-210. July 2006. www.epa.gov/brownfields. Accessed April 2016.

37) EWG. "17 Principals of Environmental Justice." Environmental Working Group. http://www.ewg.org/enviroblog/2007/10/17-principles-environmental-justice. Accessed March 2016.

38) Essoka, J. "The Gentrifying Effects of Brownfield Redevelopment." The Western Journal of Black Studies. Vol 34:3, 299-315. 2010.

39) Fainstein, Susan S. "The Just City." Cornell Univeristy Press: Ithica and London, 2010. Print.

40) Farr, D. "Sustainable Urbanism: Urban Design with Nature." John Wiley & Sons, Inc. 2008.

Bibliography

41) Faust, J. “Perspectives on Cumulative Risks and Impacts.” International Journal of Toxicology Vol. 29:1, 58-64. 2010

42) Felten, J. “Brownfield Redevelopment 1995-2005: An Environmental Justice Success Story?” 40 Real Property, Probate and trust Journal. 679 2005-2006.

43) Ferguson, L. “Secrets of Sand Point.” Magnuson Park News: News and information from Warren G. Magnuson Park. Winter 2015. http://www.seattle.gov/parks/magnuson/docs/MagnusonWinterNewsletter.pdf. Accessed March 2016.

44) Francis, M. “A Case Study Method for Landscape Architecture.” Landscape Journal, 20:1-01, pg. 15-29. 2001

45) Freeland, William T.D. “Environmental Justice and the Brownfields Revitalization Act of 2001: Brownfields of Dreams or a Nightmare in the Making.” Gender Race & Justice, Vol. 183. 2004-2005.

46) Freeman, L. “Displacement or Succession: Residential Mobility in Gentrifying Neighborhoods.” Urban Affairs Review, Vol. 40:4, 463-49. 2005.

47) Frickel & Elliott. “Environmental Dimensions of Urban Change: Uncovering Relict Industrial Waste Sites and Subsequent Land Use Conversions in Portland and New Orleans.” Journal of Urban Affairs, Volume 33, Number 1, pages 61–82. 2011

48) GAO (General Accounting Office). “SUPERFUND: Extent of Nation’s Potential Hazardous Waste Problem Still Unknown.” GAO/RECD-88-44. 1987.

49) Garvin, A. “Public Parks: The Key to Livable Communities.” W.W. Norton & Company, Inc. 2011.

50) GeoEngineers for Puget Sound Energy. “Supplemental Investigation Work Plan: Gas Works Park Sediment Site, Seattle Washington.” File No. 0186-846-01. 2013.

51) GeoLytics, Urban Institute. “CensusCD Neighborhood Change Database (NCDB) 1970-2000 US Census Tract Data.” The Rockefeller Foundation. 2002.

52) Greenberg, M & Lewis, M. “Brownfields Redevelopment, Preferences, and Public Involvement: A Case of Ethnically Mixed Neighborhood”, Urban Studies, Volume 37, Number 13, 2000.

53) Harnik, Taylor and Welle. “From Dumps to Destinations: The Conversion of Landfills to Parks.” Places 18.1, pg 83-88. The Trust for Public Land Forum, 2006.

54) Harnick, P. “Urban Green: Innovative Parks for Resurgent Cities.” Island Press, Pg 90-93, 2010.

Bibliography

55) Harnik & Donahue. “Turning Brownfields into Parks On once-polluted properties, bold new public spaces deliver the green.” Trust for Public Land. 2011.

56) Hirsch, C. “Seattle Parks and Recreation completes voluntary radiological survey at Magnuson Park.” Parkways:Seattle Parks and Recreation. 2016. http://parkways.seattle.gov/2016/03/07/seattle-parks-and-recreation-completes-voluntary-radiological-survey-at-magnuson-park/#sthash.8zVZhJFS.FKOO91Pd.dpbs. Accessed March 2016.

57) Hollander, J., Kirkwood, N., Gold, J. “Principals of Brownfield Regeneration: Cleanup, Design and Reuse of Derelict Land.” Island Press, 2010. Print.

58) Karaoglu, Lora. “Brownfields Redevelopment: The Criteria for Environmental Justice and Public Participation (Cases from Worcester and Lawrence, Massachusetts).” Environmental Justice Research Collaborative (NEJRC) at Northeastern University Working Paper Series (2004). Print.

59) Kirkwood, Niall. “Manufactured Sties: Rethinking the Post-Industrial Landscape.” Spoon Press, NY, 2001. Print.

60) LAF (Landscape Architecture Foundation). “Summit on Landscape Architecture and the Future.” Landscape Architecture Foundation. 2016. https://lafoundation.org/news-events/2016-summit/Accessed April 2016

61) Lee, S. and Mohai, P. “Environmental Justice Implication of Brownfield Redevelopment in the United States.” Society & Natural Resources: An International Journal 25.6:602-09. Print. 2012.

62) Litt, Jill et al. “Examining Urban Brownfields through the Public Health ‘Macroscope’.” Environmental Health Perspectives. The National Institute of Environmental Health Sciences (NIEHS) 110.2: Community, Research and Environmental Justice (2002): 183-93. Print.

63) Logan & Molotch. “Urban Fortunes: The Political Economy of Place.” University of California Press, Ltd. 1987.

64) Loures, Luis and Burley, Jon. “Post-Industrial Land Transformation - an Approach to Sociocultural Aspects as Catalysts for Urban Redevelopment.” Advances in Spatial Planning. Ed. Burian, Jaroslav, 2012. Print.

65) Loures, T & Panagopoulos, L. “Sustainable reclamation of industrial areas in urban landscapes” Department of Landscape Architecture, Faculty of Engineering of Natural Recourses, University of Algarve, Faro, Portugal. WIT Press, Transactions on Ecology and the Environment, Vol 102, 2007.

66) Loures, L. & Crawford, P. “Finding Public Consensus: The Relevance of Public Participation in Post-industrial Landscape Reclamation.” 1st WSEAS International Conference on LANDSCAPE ARCHITECTURE (LA ‘08), Algarve, Portugal, June 11-13, 2008.

Bibliography

67) Mah, Alice. “Industrial Ruination, Community, and Place: Landscapes and Legacies of Urban Decline.” University of Toronto Press, 2012. Print.

68) Martinez, H. “Seattle’s Safest Neighborhood: Sand Point.” Seattle PI. seattlepi.com. 2010. Accessed March 2016.

69) McRoberts, P. “Magnuson Park.” History Link. Essay 2287. www.historylink.org/ HistoryLink.org. May 15, 2000. Accessed March 2016.

70) Meyer, Elizabeth. “Uncertain Parks: Disturbed Sites, Citizens and Risk Society.” Large Parks. Ed. Hargreaves, Georgs and Czerniak, Julia. Princeton Architectural Press, New York, 2007. Print.

71) Meyer, P. “Brownfields, Risk-Based Corrective Action, and Local Communities.” Cityscape: A Journal of Policy Development and Research • Volume 12, Number 3. 2010

72) Misrach, Richard and Orff, Kate. “Petrochemical America.” Aperture, 2014. Print.

73) NEJAC (National Environmental Justice Advisory Council, A Federal Advisory Committee to the U.S. Environmental Protection Agency). “Environmental Justice, Urban Revitalization and Brownfields: The Search for Authentic Signs of Hope. A Report on The ‘Public Dialogues on Urban Revitalization and Brownfields: envisioning Healthy and Sustainable Communities’.” Ed. NEJAC Waste and Facility Siting Subcommittee, Charles Lee, Chair. A Federal Advisory Committee to the U.S. Environmental Protection Agency, 1996. 18-40. Print.

74) NEJAC (National Environmental Justice Advisory Council, A Federal Advisory Committee to the U.S. Environmental Protection Agency). “Unintended Impacts of Redevelopment and Revitalization Efforts in Five Environmental Justice Communities”. 2006. Web. <http://www.epa.gov/environmentaljustice/resources/publications/nejac/redev-revital-recomm-9-27-06.pdf>.

75) NEJAC (National Environmental Justice Advisory Council, A Federal Advisory Committee to the U.S. Environmental Protection Agency). “Unintended Impacts of Redevelopment and Revitalization Efforts in Five Environmental Justice Communities.” National Environmental Justice Advisory Council a Federal Advisory Committee to the U.S. Environmental Protection Agency. 2006.

76) NNIP. “Public Health – Seattle & King County.” National Neighborhood Indicators Partnership. http://www.neighborhoodindicators.org/partner/140 Accessed April 2016.

77) NYC Parks. “Freshkills Park.” City of New York. 2016. www.nycgovparks.org/park-features/freshkills-park. Accessed April 2016

Bibliography

78) Oregon DEQ. “Environmental Cleanup Site Information (ECSI) Database Site Summary Report - Details for Site ID 4028, Martin & Wright Paving Co. (Former).” Land Quality Program, Oregon Department of Environmental Quality. 2004. http://www.deq.state.or.us/lq/ecsi/ecsidetail.asp?seqnbr=4028. Accessed March 2016.

79) Perez-Escamilla, R & Segall-Correa, A. “Food insecurity measurement and indicators.” Revista de Nutricao, vol.21,pg.15s-26s. 2008. www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-52732008000700003&lng=en&nrm=iso. ISSN 1678-9865. Accessed April 2016.

80) Raymond, V. “Gasworks Park History.” Lake Union Virtual Museum. 2008 www.lakeunionhistory.org/Gasworks_History.html. Accessed May 2016.

81) Rochester, J. History Link. “Seattle Neighborhoods: Laurelhurst” Essay 3345. June 2001. http://www.historylink.org/. Accessed April 2016.

82) Rowan, G & Fridgen, C. Brownfields and Environmental Justice: The Threats and Challenges of Contamination. Environmental Practice 5:58–61 (2003)

83) Seattle Parks & Recreation. “Gas Works Park.” City of Seattle. http://www.seattle.gov/parks/park_detail.asp?id=293. Accessed February 2016.

84) Siegel, L. “Community Loses a Notorious Brownfield and Gains a New, LEED-certified (Gold) School.” CPEO Brownfields List Archive: Buel Elementary School project, McMinnville, Oregon. 2010. http://www.cpeo.org/lists/brownfields/2010/msg00007.html. Accessed April 2016.

85) Siikamäki, J & Wernstedt, K. ”Turning Brownfields into Greenspaces: Examining Incentives and Barriers to Revitalization.” Journal of Health Politics, Policy and Law, Vol. 33, No. 3, June 2008.

86) Smith, S. “Parks invites public to meeting on Gas Works Play Area project.” 2014. http://parkways.seattle.gov/2014/09/03/parks-invites-public-to-meeting-on-gas-works-play-area-project/#sthash.4fKIQ0LS.dpbs. Accessed Feb 2016.

87) Soltare & Greenberg. “Is the U.S. Environmental Protection Agency Brownfields Assessment Pilot Program Environmentally Just?” Environmental Health Perspectives, Vol. 110, Supplement 2: Community, Research, and Environmental Justice, 249-25, 252-3, 255-6. 2002

88) State of Washington. “Toxics Cleanup Program Web Reporting.” Departmento fEcology, State of Washington. 2016. https://fortress.wa.gov/ecy/tcpwebreporting/Report.aspx. Accessed March 2016.

89) Sturgis, K. “Boing Slump Hits Seattle.” Kentucky News Era. 1970

Bibliography

90) SUNY-ESF. "Willow/Woody Biomass at ESF." State University of New York, College of Environmental Science and Forestry. 2016 http://www.esf.edu/willow/projects.htm#Bioremediation. Accessed April 2016.

91) TCEQ (Texas Commission on Environmental Quality). "Crestview Station: Connecting Austin." Examples of Successful Redevelopment from the Brownfield Site Assessment Program. 2015. http://www.tceq.state.tx.us/remediation/bsa/SuccessStories.html. Accessed March 2016.

92) Trust for Public Land, Harnik & Donahue. "Turning Brownfields into Parks On once-polluted properties, bold new public spaces deliver the green." Planning magazine. December 2011.

93) Trust for Public Land, Harnik, Taylor & Well. "From Dumps to Destinations: The Conversion of Landfills to Park. " Places 18.1. 2006

94) United Church of Christ. "Toxic Wastes and Race at Twenty 1987—2007." A Report Prepared for the United Church of Christ Justice & Witness Ministries. 2007. Print.

95) University of Washington. "Seattle North." DOQ Files in the 1° × 2° quadrangle.http://rocky2.ess.washington.edu/data/raster/doqs/seattle.html

96) USDA (US Department of Agriculture). "Heavy Metal Soil Contamination." Soil Quality Institute: Urban Technical Note No. 3. 2000.

97) USDA (US Department of Agriculture). "USDA Defines Food Deserts." Nutritional Digest, 3:4. 2010. http://americannutritionassociation.org/newsletter/usda-defines-food-deserts

98) Veith, T. "A Preliminary Sketch of Wallingford's History 1855 – 1985." Seattle.gov, PDF. 2005. Accessed March 2016.

99) Warren, Walker, and Nathan. "Environmental Factors Influencing Public Policy and Medicine: Policy Implications." National Medical Association 94:187. 2002

100) Washington Dept. of Ecology . "Gas Works Park Environmental Cleanup Public Participation Plan." Washington Dept. of Ecology. April1997.

101) Washington Dept. of Ecology, "First Five - Year Review Report Gas Works Park Site Seattle, Washington." Washington State Department of Ecology, Northwest Regional Office, Bellevue, Washington. April 2005.

102) Washington Dept. of Ecology, "Open House and Public Meeting at Magnuson Park." Publication Number: 13-09-184. Oct 2014.

103) Seattle Dept. of Parks and Recreation. "Final Engineering Design Report: Gas Works Park." ThermoRetec. 2000.

Bibliography

104) Way, Thaïsa. “Landscapes of Industrial Excess: A Thick Sections Approach to Gas Works Park.” Journal of Landscape Architecture 8.1 (2013): 28-39. Print.

105) Wedding, G & Crawford-Brown, D. “Measuring site-level success in brownfield redevelopments: A focus on sustainability and green building.” Journal of Environmental Management. 85: 483-495. 2007

106) Wiegard, S. “The Brownfields Act: Providing Relief for the Innocent or New Hurdles to Avoid CERCLA Liability?” William & Mary Environmental Law and Policy Review, Vol 28:1, Issue 6. 2003. http://scholarship.law.wm.edu/wmelpr/vol28/iss1/6. Accessed March 2016.

107) Wilma, D. “Seattle Neighborhoods: View Ridge -- Thumbnail History.” HistoryLink.org, Essay 3460 July 24, 2001. Accessed April 2016.

108) Wolch, et al. “Urban Green Space, Public Health, and Environmental Justice: The challenge of making cities ‘just green enough’.” Landscape and Urban Planning. 125:234-244. 2014.

109) Wright, D. “Remediation of Contaminate Sites.” University of Idaho. 2000. https://www.webpages.uidaho.edu/larc301/lectures/remediation2.htm. Accessed April 2016.

110) Wright, J. “Risks and Rewards of Brownfield Redevelopment.” Lincoln Institute of Land Policy. 1997.

Appendix A: Definition of Terms

Brownfield: A brownfield is a former industrial or commercial site (real property) where future use, expansion or development is affected by real or perceived/ potential environmental contamination, hazardous substance or pollutant. Examples include parking lots, gas stations, industrial sites, transportation corridors, sites of infrastructure and landfills.

Environmental Justice: Environmental Justice is defined as the right to fair treatment and meaningful involvement of all people, regardless of demographic circumstances, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. It is achieved when everyone enjoys the same equal access to the decision-making processes to establish a healthy environment in which to live, learn, and work, access to equal economic and social opportunities to function and flourish in society, and a fair distribution of environmental benefits and burdens exists.

Gentrification: Gentrification is the transformation of neighborhoods from low to high property value, which causes displacement of long-time residents and businesses due to higher rents, mortgages, and property taxes. Gentrification is a housing, economic, and health issue that affects a community's history and culture and reduces social capital. It often shifts a neighborhood's characteristics (e.g., racial/ethnic composition and household income).

Industrial Park: A park built on the site of a former industrial site.

Landfill Park: A park built on the site of a former landfill.

Urban Renewal: Land redevelopment program used in urban areas of moderate to high density land use, typically implemented in economically depressed or blighted areas to improve land value and use for residents.

Post-occupancy Evaluations: In Landscape Architecture, POEs involve comparing data collected about a site both prior to and after construction, based on specific standards and criteria (Deming & Swaffield, 2011).

Redlining: The practice of drawing a red line around an area in which a financial institution will not make a loan. Redlining has a variety of forms, but the most common is the denial of loans. It can also take more subtle forms such as shorter repayment periods, higher interest rates, low loan-to-value ratios, and under-appraisal property values.

Appendix B: List of Figure Sources

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Appendix C: Raw Census Data

COMBINED TOTAL - PROPORTION POVERTY

	1970	1980	1990	2000	2010	
TRCTCD1	POVRAT7	POVRAT8	POVRAT9			
22	0.03021	0.033172	0.039616	0.034	0.039	WGM
23	0	0	0			WGM
24	0.061361	0.041712	0.095359	0.05	0.068	WGM
38	0.045656	0.0224	0.051129	0.115	0.019	WGM
39	0.040548	0.038049	0.053179	0.03	0.063	WGM
40	0.045246	0.047667	0.02194	0.097	0.199	WGM
41	0.036215	0.076351	0.077761	0.082	0.074	WGM
42	0.051346	0.052727	0.078052	0.053	0.084	WGM
49	0.128492	0.116765	0.09471	0.127	0.079	GWP
50	0.07858	0.162141	0.088377	0.082	0.284	GWP
51	0.093526	0.091411	0.081957	0.06	0.051	GWP
54	0.0982	0.138239	0.114278	0.142	0.106	GWP
Trendline GWP	0.0996995	0.127139	0.0948305	0.10275	0.13	
Trendline WGM	0.03882275	0.03900975	0.0521295	0.057625	0.06825	

SEATTLE AVERAGE - POVERTY

	1970	1980	1990	2000	2010
	0.1058586	0.117104	0.127939	0.118	0.127

COMBINED TOTAL - PROPORTION UNEMPLOYMENT

	1970	1980	1990	
TRCTCD1	UNEMPT7	UNEMPRT8	UNEMPRT9	
22	0.049023	0.036181	0.017792	WGM
23	0	0	0	WGM
24	0.049356	0.040682	0.029411	WGM
38	0.041259	0.034297	0.033898	WGM
39	0.063322	0.026126	0.015759	WGM
40	0.043927	0.016611	0.014505	WGM
41	0.034419	0.042553	0.024155	WGM
42	0.047158	0.028283	0.048195	WGM
49	0.076246	0.053204	0.046912	GWP
50	0.085147	0.048019	0.037974	GWP
51	0.051282	0.060549	0.034968	GWP
54	0.098456	0.064079	0.040307	GWP
Trendline GWP	0.07778275	0.05646275	0.04004025	
Trendline WGM	0.041058	0.028091625	0.022964375	

SEATTLE AVERAGE - UNEMPLOYMENT

	1970	1980	1990
	0.086017	0.060624419	0.048591

Appendix C: Raw Census Data

COMBINED TOTAL - VACANT HOUSES

	1970	1980	1990	2000	2010	
TRCTCD1	VACHU7	VACHU8	VACHU9	VACHU0	VACHU0	
22	45	85	34	57	140	WGM
23	0	0	0			WGM
24	11	17	30	35	50	WGM
38	18	8	12	25	40	WGM
39	23	22	13	30	43	WGM
40	93	47	42	43	110	WGM
41	74	119	72	110	242	WGM
42	75	58	100	92	148	WGM
49	246	101	140	109	218	GWP
50	44	63	51	42	88	GWP
51	54	0	45	56	95	GWP
54	115	77	93	109	199	GWP
Trendline GWP	114.75	60.25	82.25	79	150	
Trendline WGM	67.5	46.5	51.125	55.5	106.375	

SEATTLE AVERAGE - VACANT HOUSES

	1970	1980	1990	2000	2010
	126.144	80.8062	92.571428	97.447154	81

COMBINED TOTAL - HOUSES FOR SALE

	1970	1980	1990	2000	2010	
TRCTCD1	VACFS7	VACFS8	VACFS9	VACFS0	VACFS0	
22	7	31	27	15	28	WGM
23	0	0	0			WGM
24	0	7	4	3	13	WGM
38	3	2	7	3	0	WGM
39	0	11	7	8	7	WGM
40	0	41	5	6	24	WGM
41	16	8	11	15	26	WGM
42	28	5	25	11	41	WGM
49	4	24	19	9	42	GWP
50	4	0	0	7	7	GWP
51	14	0	7	12	7	GWP
54	4	0	16	5	30	GWP
Trendline GWP	6.5	6	10.5	8.25	21.5	
Trendline WGM	6.375	12.25	9.75	6.875	19.125	

SEATTLE AVERAGE - HOUSES FOR SALE

	1970	1980	1990	2000	2010
	10.12	13.054263	11.766917	11.869918	14

Appendix C: Raw Census Data

COMBINED TOTAL - HOUSES FOR RENT

	1970	1980	1990	2000	2010	
TRCTCD1	VACRT7	VACRT8	VACRT9	VACRT0	VACRT0	
22	28	4	7	11	35	WGM
23	0	0	0	0	0	WGM
24	3	5	26	12	11	WGM
38	15	3	3	7	25	WGM
39	15	0	0	6	14	WGM
40	82	6	22	11	41	WGM
41	27	8	16	34	68	WGM
42	29	35	41	22	36	WGM
49	202	73	58	33	99	GWP
50	30	44	18	19	38	GWP
51	40	0	17	12	41	GWP
54	80	77	33	43	68	GWP
Trendline GWP	88	48.5	31.5	26.75	61.5	
Trendline WGM	46.625	16.25	20.75	15.625	36.75	

SEATTLE AVERAGE - HOUSES FOR RENT

1970	1980	1990	2000	2010
94.024	31.124	45.46616	39.59349	36

WARREN G MAGNUSON PARK 0-14 YEARS OF AGE

	1970	1980	1990	2000	2010
22	235.1428571	111.8571429	114.7142857	129.7142857	151.00
23	0.571428571	1.428571429	0	0	0
24	116.2857143	67.42857143	63.57142857	70.57142857	98.17
38	65.28571429	43.42857143	31	43	61.00
39	120.7142857	63.57142857	62.71428571	65.85714286	98.33
40	53.14285714	25.42857143	34.71428571	45.14285714	83.50
41	331.5714286	189	217.5714286	235.1428571	298.00
42	234.7142857	131.2857143	150.2857143	174.2857143	245.50
TOT	1157.428571	633.4285714	674.5714286	763.7142857	1035.5

GAS WORKS PARK 0-14 YEARS OF AGE

49	116.1428571	56	62.42857143	48.28571429	66.50
50	75.85714286	39.28571429	42.42857143	39.71428571	65.33
51	127.8571429	55.57142857	61.85714286	62.42857143	96.50
54	99.85714286	45	51.42857143	43	0.00
TOT	419.7142857	195.8571429	218.1428571	193.4285714	228.3333333

Appendix C: Raw Census Data

WARREN G MAGNUSON PARK 15-24 YEARS OF AGE

	1970	1980	1990	2000	2010
22	255	239.5 1	20.25	128.5	122.25
23	24.25	37.25	26.5	0	0
24	123.25	102.25	58.25	61	71.5
38	70	51.5	38	45	63.75
39	152.5	131.75	66.5	63	52
40	70	75.25	34.75	57.75	62.25
41	294	239.75	163.5	171.5	199.5
42	293	229.25	170.5	83	211.75
TOT	1282	1106.5	678.25	709.75	783

GAS WORKS PARK 15-24 YEARS OF AGE

49	309.75	264.5	180.25	173.75	185.25
50	182	140.5	86.75	101	118.75
51	214.75	158.25	99.25	94.75	92.5
54	210	191	124.25	121.75	1371.5
TOT	916.5	754.25	490.5	491.25	1768

WARREN G MAGNUSON PARK 25-54 YEARS OF AGE

	1970	1980	1990	2000	2010
22	302.8571429	282.8571429	316.1428571	323.2857143	173
23	7	8.5	6.666666667	0	0
24	140	145	146.7142857 2	13.8333333	111.5833333
38	103.8571429	88.14285714	121.8571429	131.2857143	80.5
39	170.8571429	133.2857143	140	165.1428571	99.5
40	98.14285714	103.2857143	118.4285714	148	97.25
41	372.8571429 3	44.2857143	422.1428571	429	262.5833333
42	356.5714286	314.7142857	427.8571429	487.5714286	285.25
TOT	1552.142857	1420.071429	1699.809524	1898.119048	1109.666667

GAS WORKS PARK 25-54 YEARS OF AGE

49	207.7142857	246.2857143	383.8571429	417.5714286	341.75
50	128.4285714	162.1428571	238.7142857	301.8571429	176.9166667
51	151	190.8571429	263.428571	287.8571429	161.4166667
54	133.2857143	196.8571429	280.5714286	338.2857143	16.75
TOT	620.4285714	796.1428571	1166.571429	1345.571429	696.8333333

Appendix C: Raw Census Data

WARREN G MAGNUSON PARK 55+ YEARS OF AGE

	1970	1980	1990	2000	2010
22	140.8571429	208.1428571	239.7142857	225.2857143	122.3333333
23	0	0	0.714285714	0	0
24	94.42857143	106.2857143	109.5714286	86.57142857	50.53333333
38	108.5714286	98.71428571	80.42857143	67.57142857	88.84615385
39	95.28571429	125.8571429	118.7142857	101.7142857	55.71428571
40	63	96.42857143	111.1428571	105.8571429	51.53333333
41	260.5714286	288.1428571	265.8571429	258	136.8
42	292.4285714	296.8571429	251.8571429	208.4285714	133.9285714
TOT	1055.142857	1220.428571	1178	1053.428571	639.689011

GAS WORKS PARK 55+ YEARS OF AGE

49	220.2857143	160.4285714	119.2857143	89.71428571	59.86666667
50	108	72	51.14285714	69.42857143	40.66666667
51	143.4285714	103.8571429	71.14285714	64.42857143	51.73333333
54	157.4285714	93	73.28571429	66	1.071428571
TOT	629.1428571	429.2857143	314.8571429	289.5714286	153.3380952