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# NEW URBANISM AND BROWNFIELDS REDEVELOPMENT: COMPLICATIONS AND PUBLIC HEALTH BENEFITS OF BROWNFIELD REUSE AS A COMMUNITY GARDEN

**by**
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A Capstone Project Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the
Requirements for the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA
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**APPROVAL**
**for**

NEW URBANISM AND BROWNFIELDS REDEVELOPMENT:
COMPLICATIONS AND HEALTH BENEFITS OF REUSE A BROWNFIELD AS A COMMUNITY GARDEN

by

JULIA N. MCPEEK CAMPBELL

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**ABSTRACT**

JULIA N. MCPEEK CAMPBELL
New Urbanism and Brownfields Redevelopment: Complications and Public Health Benefits of Brownfield Reuse as a Community Garden
(Under the direction of JOHN STEWARD, MPH)

Brownfields have an important impact on health. They can influence physical health by increasing risk for health hazards such as the potential for injury hazards, disease transmission, or exposure to chemicals. They can also influence social health determinants like neighborhood level social capital or behavioral risk factors. Reusing brownfields for community gardens reduces environmental hazards and associated health hazards. It further promotes public health, and sustainable quality environment. Community gardens increase nutrition access, especially for many in low income populations, and community aesthetic. They also strengthen social cohesion and create recreational or therapeutic opportunities for a community, becoming part of the urban green space network. Special care must be taken to protect public health when reusing a brownfield for a community garden, like sampling for chemicals, cleaning up soil, and using protective garden designs. The overall benefit to the community is worth the initial investment required.

INDEX WORDS: brownfields, contamination, garden, community, cohesion, nutrition, health disparities, healthy behaviors

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# CHAPTER I: INTRODUCTION

*The success or failure of any government in the final analysis must be measured by the well-being of its citizens. Nothing can be more important to a state than its public health; the state's paramount concern should be the health of its people.*

~ *Franklin Delano Roosevelt*

The built environment has an important impact on health. It can influence physical health by increasing risk for health hazards such as injury hazards, the potential for transmission of disease, or the potential for exposure to chemicals; and it can influence social health determinants like neighborhood level social capital or behavioral risk factors. Vacant, idle, or otherwise unused property is blight. Vacant properties that remain idle can encourage crime, negatively affect social cohesion, lower property value, and reduce tax base (Greenstein and Sungu-Eryilmaz, 2004; Cohen, 2000). Blighted properties such as brownfields may also pose health hazards from former industrial operations and dilapidated buildings. Because of the on-site and community health hazards, the fact that these properties remain idle is itself the greatest hazard to public health, leaving the community vulnerable. Cleaning up brownfields can improve public health by removing hazards and by putting unproductive property back to use, thus improving the local community economy (EPA Brownfields, 2011). Introducing public health principles into brownfields redevelopment, however, can offer an opportunity to create healthier communities through smart growth (Brill, 2009).

Community gardens promote healthy communities and provide nutrition resources regardless of socioeconomic status, but especially for many in low income populations. In urban areas, community gardens can be part of the green space network. The gardens, and those who participate in community gardening, contribute to the preservation of green space, providing access and creating sustainable use. Community gardens strengthen social cohesion (community bonds or social capital), provide a nutritious food source, and create recreational and therapeutic opportunities for a community (EPA Urban Agriculture, 2011). They can also promote environmental awareness and provide community education (EPA Urban Agriculture, 2011). Developers in the brownfields industry are becoming keenly aware of the increase in brownfields reuse as community gardens (Kastman, 2010).

***Background***

The “Healthy Places” and “Live, Work, Learn, Play” planning concepts are increasing in popularity, and the New Urbanism movement is gaining momentum. New Urbanism is a planning movement that promotes the creation and restoration of diverse, walkable, compact, vibrant, mixed-use communities composed of the same components as conventional development, but assembled in a more integrated fashion, in the form of complete communities (NU, 2012). Behind the New Urbanism movement is the Smart Growth theory, defined as a planning concept comprised of strategies and design techniques that foster health, equity, and neighborhood identity (SGA, 2012). According to the International City/County Management Association and the U.S. Environmental Protection Agency:

> Growth is "smart" when it gives us great communities with more choices and personal freedom, good return on public investment, greater opportunity across the community, a thriving natural environment, and a legacy we can be proud to leave our children and grandchildren.

Brookings Institute Urban Land-Use Expert Christopher Leinberger has found that there is pent up demand for walkable, “Smart Growth” communities. Using New Urbanism and Smart Growth principles for urban “in-town” development (or redevelopment) will help meet this demand for walkable, connected, sustainable communities that foster a high emphasis on quality of life (SGA, 2012; NU, 2012). Urban (re)development focused on improving public health can promote healthy behaviors for all ages, encourage physical activities, increase access to nutrition and health care, provide local jobs, and reduce urban heat island effects.

Redeveloping in-town communities, however, also requires redeveloping brownfields (Greenstein and Sungu-Eryilmaz, 2004). Brownfields are idle land parcels in which contamination, or perceived contamination, complicates productive development and reuse of the property (EPA, 2012). In Georgia, brownfields are properties that are known to be contaminated. The Georgia Environmental Protection Division estimates that there are approximately 350 brownfields properties amounting to more than 500 acres of contaminated land (GEPD, 2009). Redeveloping brownfields is often difficult because of fears of liability, cost of remediation, length of time that may be required to complete the regulatory process prior to development, or other costs such as loss of a tax write-off of an industrial asset (GEPD, 2011; Greenstein and Sungu-Eryilmaz, 2004). In addition to chemical contamination, properties may have also incurred negative legal judgments against the property's title (Greenstein and Sungu-Eryilmaz, 2004). Development is driven by economics, whether on unused properties or on previously developed land. Although redeveloping brownfields improves communities, bringing contaminated land back into compliance with environmental regulations can be costly, time consuming, and/or not cost-effective for the current owner or prospective purchaser (GEPD, 2011; Greenstein and Sungu-Eryilmaz, 2004).

Brownfields are a form of neighborhood blight which has negative economic and public health impacts to the hosting community. Brownfields introduce the potential for exposure to toxic substances (chemical, bacterial, disease) and injury hazards, exacerbates problems with dumping and pests (vectors of disease), and depreciate properties surrounding them which has health consequences tied to socioeconomic status. Also among the negative social and economic impacts on the communities around where they are located, brownfields are often disproportionately located in under-served, low-income areas in inner-cities (RWJF, 2010; Paull, 2008). Brownfields site locations in Atlanta, Georgia were mapped using GIS software, and the map is available in Appendix 2. Poverty by Census Tract in Atlanta, Georgia created by the City of Atlanta is available in Appendix 3.

Multiple factors of the built environment interact to impact health or influence health outcomes. These factors can be grouped as physical, mental, or social, and are not mutually exclusive. Physical factors of the built environment that impact health may include a specific design or intended function. An individual's health can affect how the built environment is perceived and used (for example asthmatics, arthritics, disabled, unhappy or feeling unsafe), and built environment features can influence incidence of chronic or communicable disease and immune response (Cohen et al. 2000, Freedman et al. 2011). Regardless of income or other economic determinants, if approached as a collaborative community engagement opportunity, brownfields redevelopment can create stronger bonds, bridging networks, and linkages for economically and demographically mixed communities, and as a result sustainably improve health and quality of life (Smets, 2011; Muir, 2011; and Bijl, 2011).

Community gardens are one way to respond to increasing pressure of the New Urbanism movement, increasing demand for "smart growth" and "live, work, learn, play" communities, as well as to promote healthy communities and provide increased access to nutrition resources, especially among low income populations (EPA Urban Agriculture, 2011). According to the U.S. Department of Agriculture, approximately 15 percent of global food is now grown in urban areas. City and suburban agriculture takes the form of backyard, roof-top and balcony gardening, community gardening in vacant lots and parks, roadside urban fringe agriculture and livestock grazing in open space (USDA, 2011). Current First Lady Michelle Obama also included community gardens and urban agriculture in her "Let's Move" initiative to combat childhood obesity (LetsMove, 2011). In densely populated urban areas, community gardens can also serve as green space. The gardens, and those who participate in community gardening, contribute to the preservation of green space, providing access and creating sustainable use (EPA Urban Garden, 2011). Community gardens strengthen social cohesion (community bonds or social capital), provide a nutritious food source, and create recreational and therapeutic opportunities for a community (EPA, 2011). They can also promote environmental awareness and provide community education (EPA Urban Agriculture, 2011).

### ***Capstone Project Statement***

The interest in living in-town and popularity of the community gardens is on the rise; however vacant lots chosen for urban agriculture can often be contaminated with toxic chemicals, and may be a listed brownfield. The purpose of this capstone project is to review the public health benefits and concerns about reusing contaminated vacant land such as brownfields sites for urban agriculture, and to create an easy-to-understand handbook for the general public in the state of Georgia. This handbook is being designed as a modifiable state-level template to supplement the existing national *Brownfields and Urban Agriculture* handbook prepared by the U.S. Environmental Protection Agency (EPA). As a template, it can be modified to include site-specific information and recommendations for the residents living in the community hosting a brownfield reused as a garden.

This capstone is seeking to respond the following question: what are the hazards of planting a food garden on a documented brownfield site for local residents' consumption? The focus of this project is to identify the potential health concerns and benefits of reusing brownfields as urban community food gardens in general, and to determine the possibility for exposure to chemicals through all aspects of the gardening. This project will attempt to weigh the complications and benefits of this particular reuse, but also provide simple, low-cost recommendations for avoiding exposure to chemicals from gardening on a former brownfield site.

This capstone project also includes a brief health assessment of a specific brownfield site case study located along the Atlanta BeltLine redevelopment in the Oakland City neighborhood of southeast Atlanta, a few miles from Georgia State University. The literature search was based on one selected brownfield case study and two general scenarios: a well-planned community garden and guerrilla gardening. The capstone project will explore the public health benefits of reuse as a community garden using research conducted, toxicological studies (oral exposure to chemicals from biota) and toxicological tools provided by EPA and the Agency for Toxic Substances and Disease Registry (ATSDR), and social and behavioral health studies.

Although brownfields redevelopment and community gardens impact a community's socioeconomic health (such as cost barriers or access to jobs, health care, and health screenings, etc.), this project will not explore the economic impacts to public health of the redevelopment of a brownfield as a community garden. There is a need for additional research in this area, however.

## CHAPTER II: LITERATURE REVIEW

Within the brownfield redevelopment community, developers are aware of an increasing trend of brownfields sites being reused for urban agriculture, such as community gardens. Since 2010, the topic has been more often discussed. In articles published in industry magazines since early 2000s, key words like “urban agriculture” and “community gardens” return pages of results. In these articles are descriptions of projects being conducted in Detroit, Chicago, Philadelphia, and throughout Ohio, and discussions of complications encountered.

Urban agriculture is a term that encompasses a broad spectrum of types of community gardens for a variety of purposes from individual plots to commercial farming, but the commonality is the use of land within a densely populated area for growing edible or ornamental crops (USDA, 2011; EPA Urban Agriculture, 2011; Hodgeson, et al., 2011). Urban agriculture can refer to community garden projects, commercial farm projects, schools' lunch or education programs, farmer's markets and community supported agriculture, or rooftop gardens. Community gardens are typically smaller gardening programs that may grow edible or ornamental crops, or keep bees or other small farm animals, and are often a series of individual plots or are one large garden run by a volunteer garden organization (Hodgeson, et al., 2011; USDA, 2011). Residents benefit from community gardens by becoming directly involved as volunteer gardeners, or indirectly by consuming the products of the harvest (Hodgeson, et al., 2011; USDA, 2011). Municipalities benefit from the productive use and the therapeutic land reclamation of gardening and city-wide composting. At least 18,000 community gardens are scattered throughout the United States and Canada, 52 of them in the state of Georgia; Georgia's number of community gardens is similar to Oregon (52) and Pennsylvania (59), half as many as Ohio, but far less than New York state (797) (AGCA, 2012). Several municipalities have already begun reusing brownfields as community gardens for urban revitalization projects. Examples will be discussed in greater depth under the Community Garden Municipal Case Studies section below.

Brownfields in many states are being cleverly reused to supplement the local food supply, and gardens are being innovatively and creatively designed for safe, high quality foods. Among several problems cited by developers for these sorts of projects is the misunderstanding or misinformation of community members- residents who are fearful of contamination, and municipalities who fear liabilities and cost (Davis, 2002; Greenstein and Sungu-Eryilmaz, 2004). Over the last twelve years, developers have changed water cooler discussions from looking at community gardens as an interesting reuse, to discussing specific innovative details of garden projects from raised beds or hydroponics and plant type, to building rehabilitation fitted for growing specialty crops using alternative energies (Kastman, 2010). Developers are becoming increasingly excited, but are running into external snags that must be ironed out. For example, Detroit is developing 5000 acres of urban farms from its 139 square mile stockpile of brownfield lands, called the Hantz Project (Kastman, 2010). Although widely supported, developers' and public officials' concerns include who will pay to clean up contaminated land, use or removal of utility infrastructure, rewriting local ordinance and zoning laws to accommodate urban agriculture, and property tax adjustment allowing for commercial farming (Kastman, 2010).

Municipalities hosting vacant urban lands such as brownfields are also wary of reuse for urban agriculture. While recognized for their social detriments, public officials and developers are concerned about contamination and exposure to chemicals from the plants harvested, clean-up costs, necessary capital for garden start-up, and impacts to neighbors from agricultural activity (Greenstein and Sungu-Eryilmaz, 2004; Hodgeson et. al, 2011). Vacant properties such as brownfields are often cited as contributing to criminal activity, social disorder, and high risk behaviors however municipalities are nervous about reusing vacant and possibly contaminated land for vegetable gardens. (Cohen et al., 2000; Hodgeson, et al., 2011)

To answer toxicological questions about the potential for exposure to chemicals in soil or edible plants from brownfield sites, ATSDR has created tools like the Brownfields Land Reuse Site-assessment tool to assist health departments with assessing the public health concerns and potential health hazards like exposures (Berman, et al., 2010). Public health hazards also related to brownfields include the potential for injuries from dilapidated buildings or equipment, or pests harbored from dumped waste. Brownfields also influence social health factors related to socioeconomic status, social capital or cohesion among neighbors, health disparities, stress and anxiety, and crime.

The Centers for Disease Control and Prevention, EPA, ATSDR, and many state health departments recognize the impacts to public health of brownfields in general (Berman, et al., 2010; Caroll, 2005). EPA's "health monitoring" includes conducting activities for populations living adjacent to a brownfield such as assessing the health status identifying barriers to health care access, conducting blood lead testing for adults and children, studying asthma rates, examining vital statistics, and environmental sampling based on assessment results (Berman, et al., 2010; Caroll, 2005). Some behavioral factors associated with the community may also be addressed by redevelopment of the brownfield. For example, redevelopment as a park or green space is in high demand in all communities, and can improve the community health behaviors by providing recreational space (Siikmaki and Wernstedt, 2008; Cohen et al., 2000).

Among public officials, residents, environmental and health agencies, and developers, two main concerns remain: what is the potential for exposure to chemicals (or risk) from growing fruits and vegetables on a former brownfield, and what is the impact to health? The capstone project explored these questions and prepared a response in the form of a handbook.

### *Healthy Soils and Exposure to Chemicals*

Chemical contamination issues that may create public health concern from brownfields and for brownfields reuse as a community garden can include soil and groundwater contamination, or plant uptake of chemicals (EPA Urban Agriculture, 2011). Whether brownfields or not, most urban soils have some kind of contamination, especially lead deposits from gasoline emissions; however, brownfields often have additional chemical contamination on-site. On-site chemicals at the soil surface can pose a direct hazard by incidental ingestion and dermal contact for gardeners, children, and pets. Chemicals in soil also leach deeper into the ground and pollute groundwater, which can sometimes resurface in streams and rivers nearby. Surface waters such as streams and rivers are inviting places for children and pets to play, and if contaminated, they can present another potential indirect exposure to chemicals from the brownfield site. Removing the source of the contamination, and therefore reducing chemicals to allowable residential levels, becomes key. In his “Healthy Soils” project conducted at Cornell University in New York, Dr. Spleithoff sampled soil from 20 gardens being used as urban gardens. Results showed polycyclic aromatic hydrocarbons detected in soil from sources like heavily trafficked roads, asphalt or cinders, tires used for garden beds, creosote-treated timber, and deciduous tree mulch exceeded state guidance values in 61% of the samples taken from 8 of the 20 gardens.

The main message from the EPA and Spliethoff's research is that not only might soil be contaminated, but it may also require nutritional supplement (like calcium, phosphorous, or compost fertilizers) to be able to grow fruits and vegetables. The only way to know is to determine soil quality by sampling the soil and analyzing them. Sampling for chemicals common in urban areas like PAHs, metals including cadmium, arsenic, and lead, and polychlorinated biphenyls becomes necessary because of the potential for soil uptake and aerial deposition.

### *Chemical Uptake by Plants*

Chemicals in soils pose a potential health hazard from ingestion of fruits and vegetables grown in contaminated soil. This capstone project sought to answer questions posed by public officials, developers, and residents: do plants take up chemicals? How much chemical gets taken up? Which plants, and what about the parts we eat? To be able to answer these questions through the handbook and to identify the potential for exposure to chemicals in plants, this capstone project explored phytoremediation and vegetable gardening studies.

Phytoremediation is a remediation method in which plants are used specifically for the purpose of removing chemical contamination from soil. It is defined as “the ability of plants to degrade, extract, or immobilize pollutants” (Willey, 2007). A benefit of using phytoremediation methods for chemical removal from soil is that it is fairly easy to implement. The drawbacks of using phytoremediation are that it is a comparatively slow process, requires a great deal of upkeep, can be costly, and is limited by root depth. Plants used for phytoremediation also require proper hazardous waste disposal when clipped, cut, trimmed, or pulled.

Often chemical pollution is not readily bioavailable, or easily taken up. A chemical’s bioavailability depends on ionic or molecular form, soil type, soil pH, and plant capability for uptake (Murray, 2011; Oluwatosin, 2010; Maimon, 2009; Willey, 2007; Aspen, 2006; Fismes, 2004). Chemical pollution adheres to clay soil and organic matter, and therefore remains stabilized better than sandy or sedimentary soil (Murray, 2011; Maimon, 2009; Aspen, 2006). If chemical pollution is available to the plant, however, there is still some basic plant biology that may reduce the potential for uptake. If a chemical is not bioavailable to a plant, then the plant's ability to take up the chemical is irrelevant for phytoremediation. Plants are able to differentiate nutrients from toxic chemicals in soil, however some plants like the wild mustard flower *A. thaliana* are less sensitive or the chemical is in a more bioavailable form (Willey, 2007). Also, the molecular or ionic form of the chemical can make it more available or not. For example, metals are not highly bioavailable whereas organic pollutants are moreso (Aspen, 2006). To assist with phytoremediation, soil treatment can enhance or reduce bioavailability to plants. For example, applying ethylene diamine tetraacetic acid (EDTA) can convert a metal to a less toxic form and make it available to plant roots, therefore increasing chemical pollution bioavailability and enhancing phytoremediation (Willey, 2007). Further, treating soil with calcium or phosphorous compost can reduce the plant's ability to take up metals.

Multiple types of plants are used for phytoremediation, but the plants used are predominantly in the mustard family Brassicaceae, genus *Arabidopsis*, species *thaliana*. The rapid lifecycle, high biomass, easy cultivation, and high tolerance for climatic extremes (Willey, 2007). Edible plants in the mustard family are the *Brassica* and *Sinapsis* species which include commonly used spices or flavorings, cabbages, cauliflower, and turnips (Oluwatosin, 2010). The mustard families of plants also extract the highest ratio of chemicals compared with other plants. Plants used for phytoremediation are not only used to extract chemicals from soil (for example as with some metals and persistent organic pollutants), but are also used to stabilize and immobilize the chemical (for example, lead), or in the case of some chemicals, to break them down (for example volatile or chlorinated chemicals) (Willey, 2007). A plant's biology is relatively complex; however plants can be divided into four main parts: roots, shoots, leaves, and fruits (Fismes, 2004; Willey, 2007).

To greatly simplify a complex botanical/biological system, plant roots are the first interface with chemical pollution. Roots may bind chemicals and stabilize them where they are, or these roots excrete enzymes that help to break down "nutrients" in the soil. The roots may also take-up and metabolize the basic nutrients needed for their life cycle, such as water, nitrogen, phosphorous, calcium, and iron. Chemical pollutants may be degraded by the enzymes excreted at the root-soil interface or taken-up in place of another nutrient such as iron and stored in the vacuoles (Willey, 2007). A chemical pollutant may be stored in vacuoles of the roots, stems, leaves or fruits; however chemicals must be pumped against gravity by the plant in order to store chemical pollutants further up the stem.

Research is continuously trying to determine which plants extract chemicals, and where these chemicals are stored. Studies conducted on plants exposed to varying concentrations of toxic chemicals which controlled for climatic factors found that depending on the chemical (metals versus organic chemicals) most often the plant does not take up the chemical, but in fact immobilizes or degrades it (Willy, 2007). For example, J. Stearns, S. Shah, and B. Glick, (2007) showed that plant stress response causing defoliation in tomato plants would kill the plant if metals were present in soil at high concentrations, and that the metals themselves taken up into the plant were not the cause, but that inserting a gene into the tomato plant to reduce the stress response gave greater tolerance (Willey, 2007 Chapter 2). Researchers S. Sonoki, S. Fujijiro, and S. Hisamatsu used genes from *Phanerochaete chrysoporium* (White Rot Fungus) that increase the secretion of oxidative enzymes to expand the ability of *A. thaliana* to break down PCBs (Willey, 2007, Chapter 1). Metals research shows that phytoremediation may not be the best option for lead. Some metals are not as easily taken up by even the best phytoremediators.

Similarly, the principles of phytoremediation apply to the uptake of chemicals by garden vegetables, however these plants are grown with a different purpose in mind. Many edible plants commonly grown in gardens easily take up persistent organic pollutants including pesticides such as aldrin, chlordane, DDT, toxaphene, dieldrin, endrin, or hexachlorobenzene, and industrial chemicals such as PCBs, dioxins, furans, and polycyclic aromatic hydrocarbons including petroleum byproducts (Willey, 2007, Chapter 6; Aspen, 2006). Researchers J. White and D. Zeeb discussed the early Lichentstein experiments showing that POPs were taken up in variable amounts into roots and shoots of carrots, peas, cucumber, lettuce, alfalfa, and soybeans, and in fruits of squashes, cucumber, pumpkin, and sweet potato (Willey, 2007).

Several studies have shown, however, that often chemicals taken up by roots of the plant are not taken up into the shoots, leaves, or fruits of a plant. For example, Fismes et al. (2004) found that PAHs were taken up in far greater concentrations in the roots than the leaves of carrot, lettuce, and beans, but that overall the plants would take up more PAHs if soil concentration was greater than 2000 parts PAH per million parts of soil. Other studies have found that these chemicals were taken up in significant amounts into the roots and shoots of pumpkins and zucchini (*C. pepo*) (Willey, 2007, Chapter 1;

Aspen, 2006). This shows that unless the edible portion of the vegetable was the root, most vegetables would not take up chemicals into the edible portion of the plant. One exception to this is pumpkin. Pumpkin (a squash, and member of the gourd family) did show significant uptake of POP chemicals, however accumulation remained primarily in roots and stems (Willey, 2007).

Metals such as cadmium, lead, and zinc follow a slightly different trend. Maimon (2009) found that higher concentrations of metals (iron, cadmium, lead, chromium, copper, and manganese) accumulated in fruit and root vegetables as compared to leafy vegetables when grown in metals rich agricultural soil, although levels were lower than the standards outlined in the Malaysian Food Act (1983) and Food Regulations (1985). Oluwatosin et al. (2010) found that for leafy green vegetables grown in Africa, uptake for cadmium was more likely than for zinc and lead (based on calculated bioconversion factors), but more than 50% of cadmium and lead taken up were stored in the roots, and approximately 15% were stored in the leaves. The study also found that despite the low percentage that was transferred into the edible portion, the amount transferred was still higher than international regulatory and government authorities' allowable levels for health (Oluwatosin, 2010).

These studies contradict Murray, et. al (2009) findings that elevated metal levels in soil do not necessarily pose a health hazard. Regardless, this poses concern for communities wishing to use contaminated land sites for vegetable gardens. Although a low percentage of the chemicals may be taken up with regard to chemical pollution levels found in the soil, the amounts that are taken up must be considered in terms of consumption and health, especially metals.

Table 1 shows a matrix that results from multiple studies reviewed. To create this matrix, chemicals were grouped by type (metals, polychlorinated biphenyls or PCBs, polycyclic aromatic hydrocarbons or PAHs, volatile organic compounds or VOCs, and persistent organic pollutants or POPs), and plants were grouped by type (roots/tubers, leafy greens, herbs, grasses, flowering plants, fungus, weeds, or fruiting plants) and by part (root, shoots, leaves, fruits). The "mechanism used" refers to the plant's response to the chemical pollutants: degradation, immobilization, or extraction. The uptake/storage likelihood was determined based on numerous studies' experimental results.

Some plants included are used specifically for phytoremediation; others are known edible varieties commonly grown in gardens. Extraction likelihood of the various plants reviewed was loosely determined by percentage of removal from soil, concentration in plant, or the bioconcentration factor calculated from the concentration in the edible portion of the plant divided by the concentration detected in soil (Aspen, 2006). A three-tiered scale was based on data available from Willey (2007) and Aspen (2006) for edible garden variety vegetables to take up chemicals. The concentrations were listed as concentration in the plant/concentration in the soil: Low (0-10%), Moderate (11-29%), High (30% or greater).

**Table 1. Matrix of plant, chemical, and likelihood of uptake.**

| Plant Type | Chemical Type | Mechanism Used | Plant Part | Uptake Likelihood | Research Citation |
|---|---|---|---|---|---|
| ***Plants Used Specifically for Phytoremediation*** | | | | | |
| *A. thaliana* (Flower) | Metals | Uptake | Shoots | High | Willey, 2007 |
| *P. chrysoporium* (Fungus) | PCBs, POPs | Degradation | Roots | Low | Willey, 2007 |
| Cotton (Shrub) | POPs | Degradation | Roots | Low | Willey, 2007 |
| Grasses | PAHs | Uptake | Roots | High | Willey, 2007<br>Aspen, 2006 |
| ***Edible Plant Varieties Commonly Grown in Gardens*** | | | | | |
| Carrot, radish, potato (Root, tuber) | Metals<br>PAHs<br>POPs | Uptake | Roots, Shoots | High | Murray, 2009<br>Willey, 2007<br>Aspen, 2006<br>Fismes, 2004 |
| Beans (Legumes) | Metals, POPs, PAHs | Uptake | Roots, Fruits | High, Low | Fismes, 2009<br>Maimon, 209<br>Willey, 2007 |
| Clover, alfalfa (Herbs) | POPs | Uptake | Shoots, Leaves | Low | Fismes, 2009<br>Aspen, 2006 |
| Spinach, lettuce (Leafy greens) | Metals, POPs | Uptake | Leaves | Moderate to High | Abiye, 2011<br>Willey, 2007<br>Aspen, 2006<br>Oluwatosin, 2010 |
| Squash, zucchini, cucumber, pumpkin* (Gourd) | Metals, POPs | Uptake | Roots, Shoots, Fruits | Moderate, High, Low | Willey, 2007<br>Aspen, 2006 |
| Peppers, tomatoes (Fruit) | Metals, POPs | Uptake | Fruits | Low | Maimon, 2009<br>Willey, 2007 |
| Corn (Grain) | Metals, POPs | Uptake | Seeds | Moderate | Willey, 2007<br>Aspen, 2006 |

* Aspen (2006) found a bioconcentration factor of 16 (1600%) for pumpkin, showing that pumpkin will hyperaccumulate chemical pollutants. Other squashes like zucchini have also shown high levels of uptake, so gardeners should avoid planting these vegetables in soil with chemical pollutants detected at higher than allowable levels.

**It is important to note that soil type and pH greatly influence bioavailability of some chemicals; amounts found in soil may not be predictive of amounts found in plants.

One important aspect of protecting health is based on the public health mantra, "Wash your hands, wash your hands, wash your hands". Or in this case, "wash your vegetables, wash your vegetables, wash your vegetables!" In a study comparing detected levels of lead, cadmium, chromium, nickel, and zinc on washed and unwashed vegetables, Suruchi, et al. (2011) found that metals in soil were adhering to the vegetables from air deposition. This brings about another aspect of protecting public health in urban community gardens: aerial deposition can occur with any of the contaminants discussed in this section, and although edible portions of the vegetables may not have high levels of chemicals, that point may be moot if the vegetables are left unwashed. Hence, a best practice measure is to be sure to wash and peel vegetables from urban gardens (Martin, 2010).

Remediation reduces risk of exposure to chemicals from soil and plants (EPA Brownfields, 2012). Remediation is expensive, time consuming, and often shifts chemical contamination from one site to another (EPA Urban Agriculture, 2011; Greenstein and Sungu-Eryilmaz, 2004). Although some brownfields require remediation to be brought back into compliance and be safe for gardening, some brownfields do not require remediation and risks can be better resolved by growing plants above the ground surface (EPA Urban Agriculture, 2011). On the other hand, sites that are logistically too difficult to remediate might only require engineering controls, such as concrete slabs, to create a barrier between contaminants and people (GEPD, 2012). Engineering controls can also include protective above ground surface garden designs, such as raised bed gardens, container gardens, hydroponics, vertical gardens, greenhouses, and rooftop gardens (Hodgeson, 2011; EPA Urban Agriculture, 2011; Kastman, 2010).

### *Social Health Factors and Health Disparities*

Although often the most typical concern, contamination may not always be the greatest public health concern in brownfields redevelopment. Vacant lots with degraded buildings further provide inviting places for children to play, increasing the risk for injury or for others to engage in risky or criminal behaviors.

Brownfields (and other vacant or hazardous waste sites) are often disproportionately located in disadvantaged neighborhoods (Landrigan, 2010; RWJF, 2010); and may have greater social cost if left idle- reflected in socioeconomic issues, issues of access, physical community degradation, decreased property values, and blight (Greenstein and Sungu-Eryilmaz, 2004; Hodgeson et. al, 2011). Neighborhoods hosting hazardous waste sites or who are subject to illegal dumping like brownfields are frequently low-income and/or minority residents including African American, Hispanic, Native American populations, and health disparities in asthma, cancer, and chemical poisoning, obesity, diabetes, and mental health or developmental problems are prevalent among these populations (Gee and Payne-Sturges, 2004, Landrigan, 2010). In the 1980s, studies conducted looking at the location of waste sites in the Southeast United States identified that these sites were disproportionately located in African American, Native American, or other marginalized populations; a similar pattern was identified in studies conducted in the Northeast (Landrigan, 2010). In their work in environmental justice, Gee and Payne-Sturges (2004) suggest that health promotion efforts may need to focus on removing the chemical hazards, but also require focus on interventions targeting the gaps in advantage itself. Landrigan (2010) suggests that long-term research on the human health effects of exposure to chemical, physical, and social factors is needed from pre-conception to old age across populations, and that interventions not be focused on individual behavioral factors.

There are notable and well documented health disparities that exist in low-income populations, and minority populations such as African-Americans and Hispanics. According to the Health Disparities and Inequalities Report (2011) prepared by the Centers for Disease Control and Prevention Office of Minority Health, death rates from heart attack and stroke are significantly higher for African-Americans and Hispanics than for whites; among African-Americans, 40% of women and 60% of men died of heart attack before age 75, which is up to two times higher than that of Whites (20% of women and 40% of men respectively). Additionally, obesity rates are lower among Whites than among African-Americans and Hispanics, regardless of income; however, obesity and diabetes rates are higher for lower-income Whites than for higher-income whites (CHDIR, 2011). Although rates for diabetes were not significant among races and ethnicities, they were significant with respect to income, the highest rates among the lowest-income (CDHIR, 2011).

Idle and vacant properties can have a subtle but marked impact on health status and disease prevalence in a community. For example, a cornerstone study conducted by Cohen, et al. (2000) clearly showed the relationship between social disorder and sexually transmitted disease using the Broken Windows Social Disorder Theory, developed in 1989 by J. Q. Wilson and G. L. Kelling, and identified the role of the built environment (like brownfields) in public health. Cohen’s study showed how low visual aesthetic, vacant land or buildings, and dilapidation facilitate signs of social disorder and increase opportunities for risky behaviors that result in disease and illness. Brill (2009) found that during redevelopment projects, government priorities of increases in job creation and tax base often compete with quality of life factors and residents’ preferences for community, recreation, or affordable housing facilities. Brill suggested that increasing the influence of non-economic issues when addressing economic priorities will help to achieve all preferred objectives. Brill further suggested that “the lack of integration with public health and the physical environment has been suggested as a reason behind the obesity epidemic in the United States.”

Furthering Brill's idea, Neff et al. (2009) suggests that the very public systems designed to support disadvantaged communities are also the same systems that perpetuate disparity, especially with food and related health outcomes (obesity, heart disease, and stroke). Direct observation has shown that areas with the lowest category of food availability had a significantly less healthy diet. Neff et al. (2009) argues that our current food system favors health disparities in minorities of nearly two times the mortality rate of whites for stroke, heart disease, and diabetes. Neff et al. suggest that this disparity is increased by supporting commercial agricultural structures that promote processed, calorie dense, high fat and high sugar foods. Food security disparities are further increased by limited geographic access to healthier foods such as fruits and vegetables, increased cost for these items, limited transportation options to obtain/access healthier foods, obstacles of high crime in the neighborhood, and limited options provided by federal support programs. Neff et al. (2009) also argue that federal farm subsidy structures promote production of high fat, high calorie foods, and companies heavily market these foods at high profit margin.

Research into the effectiveness of farmer's markets as an intervention in low-income communities suggests that when residents in disadvantaged communities participate in farmer's markets, more residents increased daily fruit and vegetable consumption by at least one additional serving (Neff et al., 2009). When prices at farmer's markets are further reduced, consumption increased 1.5 times (Neff et al., 2009). Food Trust in Philadelphia, PA is an example of a comprehensive program that incorporates community education and sustainable localized farming to provide access to farmer's markets in low-income areas (Food Trust, 2012). Costs are subsidized by donation and grant funding. Overall, residents who were better educated about their food and interacted with agriculture on a more personal level were more likely to eat healthier, and sustain these habits throughout their lives (Litt, et al., 2011; Kingsley, 2009; Neff et al., 2009; Libman, 2007; Alaimo, 2010).

Freedman et al. (2011) found a predictive and significant correlation between increased incidence of heart problems, high blood pressure, and diabetes for women in economically disadvantaged neighborhoods when they analyzed the association between neighborhood features such as connectivity, housing density, vacant land, air pollution, and economic factors. Freedman, et al. also found predictive correlation of increased incidence of cancer in males and females. Similarly, Freedman et al. found the reverse for more affluent populations. These factors specifically were not shown to be causative in this study, but economic status was. However, economic status and built environment features are often linked through maintenance, aesthetic, or dilapidation (and broken windows theory) which this study did not account for. Therefore through this connection, factors such as vacant properties and brownfields or dilapidated buildings may likely have significant causative effects. Further, the authors concluded that there may be internal biological interactions like stress response and affiliated hormone release that could interfere with immune response and the body’s ability to fight these diseases.

Based on Cohen and Freedman’s findings, chronic stress response may be facilitating chronic disease, and is frequent in lower income, run-down neighborhoods for many reasons. Coupled with increased opportunity to engage in risky behaviors (such as drugs, criminal activity, homicide/suicide, unprotected sexual activity, etc.), stress responses would be expected to increase. Further compounded by poor diet and fewer options for healthy food choices is a recipe for high prevalence and mortality rates of chronic diseases like obesity, heart disease, stroke, and cancer. A stress response in neighborhoods is a measurable biological indicator of the neighborhood and the health impact for the neighborhood population. Highly stressed communities may also facilitate risky behaviors as a means of coping (Gee and Payne-Sturges, 2004).

Gee and Payne-Sturges (2004) suggest that stress, on both the individual and community level, may directly lead to health disparities and that stressors amplify the effects of toxicants such as lead, asthma triggers, or poor nutrition. Gee and Payne-Sturges (2004) argue that stress may influence a toxicant's dose by decreased defense against the exposure, increased absorption from eating, breathing, and sweating more during stressful situations, and amplification from a positive feedback loop. In exploring the interaction between individual level vulnerability and community level vulnerability, Gee and Payne-Sturges (2004) offer that a person's location can be the cause of stress, and that environmental hazards or pollutants compound the problem. In their model, community level vulnerability factors of race and ethnicity influence location. This influences neighborhood resources, community stressors, structural factors, and environmental hazards or pollutants. These all interact to increase stress on a community level. In addition, environmental hazards influence various exposures (chemical, injury, infectious disease, etc.).

At the individual level, vulnerability is influenced by individual stressors and coping and internal doses of pollutants, each influencing individual stress. The internal dose of pollutants may become a biologically effective dose, and when combined with increased stress the combination impacts health reflected in health effects. On a population level, increased prevalence of disease can be viewed as health disparities. In this model, increasing any single factor increases vulnerability. Although increasing an individual's level of stress may only slightly impact a community's vulnerability, increasing a community level factor has a profound effect on the individual. Working with this model at the community level would have the greatest impact on individual vulnerability. Designing interventions or health promotion strategies at the community level like reducing environmental pollution sources (for example brownfields) and therefore potential exposure will reduce overall community stress, and give individual community members less to stress about individually.

That said, although working to reduce vulnerability on a community level may be the most effective way to reduce individual health outcomes, but may not be the most feasible way. Interventions and health promotion programs targeting individual stressors on a population scale may be easier, and still have a positive overall impact on the community, reducing overall community stress. Working with both levels of community vulnerability interactively is ideal.

In addition to stress factors influencing public health outcomes, there is a school of thought that focuses on the theory of deprivation amplification. Pabayo, et al. (2011) conducted a study identifying links between environmental conditions and obesity in children 11-15 years old in economically disadvantaged neighborhoods. Based on the "deprivation amplification" argument, Pabayo, et al. suggests that individuals at greater risk for obesity from deprived families are more likely to live in lower income neighborhoods where they are exposed to environments that exacerbate obesity. These environments often discourage physical activity, and like the stress vulnerability model, personal and environmental risks may be compounded by other environmental risks. Pabayo, et al. (2011) further explain that areas with high economic deprivation are likely to have fewer resources such for recreation, sidewalks, parks and safe play areas for children, thus fewer opportunities for young people to participate in physical activity, which may have negative impacts on their health. Also, Pabayo el al (2011) suggests if neighborhoods are "dilapidated and appear unattractive or dangerous, outdoor play and physical activity may be discouraged, as well as healthy activity such as walking or cycling to school." These neighborhood social factors may have a strong influence on children at an early age when lifelong habits are formed.

Social cohesion is another factor impacting community health that can be influenced by built environment features such as brownfields, or their creative (re)use. Additionally, Pabayo et al. identified social cohesion (the strength of the network and familiarity among neighbors in a community) as a significant factor that influences children's level of physical activity which is itself also influenced by the built environment. Specifically, Pabayo et al. (2011) aimed to investigate relationships between indicators of area environmental conditions associated with physical activity in childhood (when behaviours first become established); particularly whether these continue to relate to subsequent accelerometer-measured physical activity of young people aged 10 through 15 years participating in the National Institute Study of Early Child Care and Youth Development (NISECCYD). The authors found that increasing levels of economic deprivation consistently decreased levels physical activity among boys, however it increased physical activity among girls; and that as social cohesion increased physical activity increased proportionally regardless of economic deprivation.

Landrigan (2010) states that certain chronic diseases are more prevalent in low-income, minority neighborhoods such as asthma, blood lead poisoning, and obesity, and make the argument that disproportionate numbers of contaminated land sites contributes to the problem. Landrigan (2010), and Gee and Payne-Sturges (2004) suggest that these conditions, plus lead poisoning exposure, and the lack of access to many of life's necessities amplifies physiological stress response. Gee and Payne-Sturges (2004) discuss the effects of stress on health disparities, and vice versa in detail. In a model the authors designed, race and ethnicity was directly associated with residential location, which in turn directly led to several factors affecting stresses and exposures, including Neighborhood Resources, Community Stressors, Structural Factors, and Environmental Hazards or Pollutants. Gee and Payne-Sturges (2004) pointed out that these factors heavily influence individual vulnerability, and through a positive feedback loop can spiral into negative health effects.

These community stressors can compound the perception of a lack of control in life among low-income populations. Studies conducted have shown that low-income individuals tend to feel that they have no control over their success in life, and that their lack of perceived achievement is explained through external context. Kraus et al. (2009) conducted several studies with college students to determine if perception of low-income, whether defined objectively or subjectively, influenced a sense of control and a culture of attributing disparity to external contextual explanation. Kraus et al. (2009) found that most low-income people, whether measured by objective census statistics or participant perspective, engaged in explaining their economic disparity through a broader external context such as prejudice, economic or social structure, politics, or lack of opportunities. This cultural acceptance of external explanation further fueled a perception of a lack of control over their lives. This apathetic belief can accelerate a downward spiral reaching broadly to allow unsupportive social constructs (for example, lack of access or otherwise widening disparity of haves and have nots) through a lack of community response and hopeless acceptance. This can translate in a community's environment by not only accepting a poorer quality environment, such as a high number of vacant or unsightly properties like brownfields, but also contributing to their own environment's poor quality. Kraus et al. (2009) also indicated that this may explain high engagement in risky behaviors, and low propensity to participate in preventative or healthier behaviors. Kraus's work highlights social cohesion working against a community's overall health, but also how such community based projects as reusing a brownfield for a community garden may begin to instill a better sense of community efficacy, as well as better access and healthier habits.

According to perceptions of individual risk models, people will accept a high risk if they perceive that they can control it, whereas people will not accept a low risk if they perceive that they cannot control it. Community health behaviors affect how a community will respond to brownfields and redevelopment. For example, if a brownfield in a community is being redeveloped as a community garden, but the community is has a greater need for employment and income, the community may not consider the redevelopment as being beneficial, and not use it. Community perception can strongly influence the brownfield redevelopment and the management of a community garden. Without community support, an improvement to a community may be lost. To get community support, the community must be approached as a partner in the project. Handbooks, guides, information, and education materials can assist with gaining community support.

Brownfields, vacant buildings, and social disorder are not specific to low income or disadvantage. With the recent housing crash, these same features can be found in middle class suburban areas, and still yield similar results. Based on findings from the studies presented above, however, people are more likely to engage in risky behaviors in communities hosting brownfields because they feel that they have nothing to lose.

### ***Community Garden Municipal Case Studies***

Urban agriculture has become more popular in communities all over America in response to demand for localized food production and smart growth. Farmer's markets, rooftop gardens, and living walls are among the more functional and creative types of urban agriculture, however interest in community gardens is growing. Four industrial seats have already begun a campaign to reuse brownfield sites for urban gardens: Philadelphia, Detroit, Cleveland, and Kansas City. Community garden examples and lessons learned in these cities have set the stage for other cities in the nation to learn from and follow.

#### *Philadelphia, Pennsylvania*

Philadelphia has made a reputation for being among the most rigorous municipalities for community gardens. For decades there have been zoning laws allowing urban gardens, and non-profit technical support systems through the Pennsylvania State University Urban Gardens Program and the Pennsylvania Horticultural Society Philadelphia Green Program (Goldstein, 2011; Hodgeson, et al., 2011). These programs have linked gardeners to distribution outlets, and several gardening projects have gotten national interest, but since the 2000s these organizations have been defunded and have struggled to provide additional support (Hodgeson, et al., 2011). Municipal funding and other support had not been offered because of the reliance on these organizations, but in 2009, the city of Philadelphia has stepped up its support and made new effort to re-invest in community gardens again (Hodgeson, et al., 2011). Although not specifically focused on reusing brownfields sites for gardens, Philadelphia does have community garden brownfields reuse projects.

The Greensgrow project in Philadelphia is a wildly successful brownfield-to-garden reuse project in which the garden started small, and grew into a $100,000 revenue farm (Greenstein and Sungu-Eryilmaz, 2004). Many of the vegetables are grown hydroponically (above ground) in this former steel galvanizing plant. Although funding to maintain the farm is limited, the Greensgrow project is an example of how non-profits can work with regulators and the private sector in partnership to achieve a highly beneficial outcome: municipal and property value, job creation, positive and sustainable development, and nutrition access through grass roots efforts.

#### *Detroit, Michigan*

Detroit is home to almost 1 million people, approximately 70 thousand vacant land parcels, and roughly 10,000 acres of brownfields (Greenstein and Sungu-Eryilmaz, 2004; Hodgeson, et al., 2011, U.S. Conference of Mayors, 2008). Grass roots efforts have created over 800 community gardens throughout the city, despite zoning laws that do not permit it (Goldstein, 2011; Hodgeson, et al., 2011). Detroit is currently undergoing a massive zoning overhaul, however, to include urban agriculture among its allowable sustainable uses so as to overcome these shortcomings in local ordinance (Goldstein, 2011). In addition to the problem of contamination, the other primary hurdle in Detroit is the legal barrier of the Michigan Right to Farm Act (1981) which prohibits municipalities from taking any policy action for or against agriculture; this was specifically designed to protect farms and farmers, as suburbs expand onto former farmland (Goldstein, 2011).

This hasn't prevented community gardens! In fact, the city offers its support of urban agriculture by providing free seeds and tilling to residents who choose to garden on municipal property through the Farm-a-Lot program (Hodgeson, et al., 2011). Major questions have arisen, however, since a large project proposed claiming hundreds of acres area of vacant urban lands for a large commercial farm in the inner city, called the Hantz project (Hodgeson, et al., 2011). The proposal has forced the city to reconsider its 2010 Zoning Ordinance Draft. The conflict between state and local legislation is a hurdle that Detroit will have to overcome before it can officially support urban agriculture on a large scale. If large commercial farms are allowed within the inner city, the farm becomes subject to state law and circumvents local ordinance protecting the surrounding residents and urban quality of life (Hodgeson, et al., 2011).

*Cleveland, Ohio*

The City of Cleveland is among on the forefront with its bold new vision of combating social and public health factors with urban land reuse. Cleveland has suffered a population loss of 53% since 1950 (13% in the last decade), and industrial divestment vacating 3000 acres of land (Goldstein, 2011; Hodgeson, et al., 2011). To counter balance the losses, the City of Cleveland has begun to invest in urban agriculture. By actively incorporating public health into planning and zoning reform to purposefully address social inequity, chronic disease, obesity, and food deserts while reclaiming and reusing an increasing number of vacant lands, Cleveland is remaking itself into a “cleaner, healthier, more beautiful and economically sound city” (Hodgeson, et al., 2011).

The city views urban agriculture and zoning laws as a solution to meet the needs for localized food production, offer jobs and job training, preserve green space, enhance the environment, and enrich surrounding communities, and has even created the “Urban Garden District” zone as local ordinance to support urban agriculture (Goldstein, 2011). The Cleveland Department of Public Health worked together with Ohio State University's cooperative extension program to establish the Cleveland-Cuyahoga Food Policy Coalition, which gathered political and financial support to assist urban agriculture start ups, and established a licensing process through the department of health for keeping small livestock in an urban area to protect urban public health (Hodgeson, et al., 2011).

Both Cleveland and Philadelphia offer model approaches to reusing vacant lands like brownfields, yet beyond local ordinance, funding mechanisms, and technical support structures, there is still more that can be done.

*Kansas City, Missouri*

Kansas City, Missouri has developed a brownfields reutilization program for urban agriculture called the Kansas City Brownfield Initiative. The initiative provides guidance for safe agricultural production on brownfields sites, including particular techniques, materials, and procedures to minimize risk (Hodgeson, et al., 2011; KSU, 2012; KCMO, 2012). Through an EPA funded grant managed by Kansas State University (KSU), the governments of Kansas City and Jackson County are working with KSU to conduct an assessment of brownfields sites including petroleum contaminated sites, and in partnership with the Kansas City Center for Urban Agriculture are using part of the funding to identify possible sites for community gardens (Hodgeson, et al., 2011).

***Handbook Design and Readability***

Several readability models are available including SMOG, Flesch Kincaid, Dale-Chall, Spache, FORECAST, Fry, and RIX (Burke and Greenburg, 2010). Very few are recommended as appropriate to test the readability of short health education materials such as brochures, factsheets, or handbooks. SMOG, Flesch Kincaid, and Dale-Chall are the most useful and appropriate for use on health education materials because they are specific to short educational works which use graphics (Burke and Greenburg, 2010). Others are more appropriate for longer articles, websites, survey questions or lists, or texts brought to a 3$^{rd}$ grade level Burke and Greenburg, 2010). To ensure that the handbook readability is appropriate for the general public, I used common practices recommended in the literature, and the readability scores from the SMOG, Flesch Kincaid, and Dale-Chall models.

Common practices recommended within the context of an 8.5”x11” page included using 12-point font, keeping lines of text between 50 and 70 characters, breaking text into chunks, using plain language, and keeping at least 30%-50% whitespace (Suebert, 2008; Karten, 2007). Suebert (2008, 2009) also suggests breaking information into sections (or chunks) that answer questions. This helps to focus the writer, as well as the reader. Common practice also recommends using 1” margins for 8.5”x11” paper (Suebert, 2009).

Content is as important as layout and design. Suebert recognized a need in the field of health education materials development, so he developed the “Layout and Readability Toolkit”. The toolkit provides comment on positive and negative aspects of design and layout: font size and style, line length, paragraph length, grouping, graphics, colors, and whitespace. The toolkit offers a maximum score of 65, and a score of 45-50 requires minor edits or design flaw fixes. Below 45, the document requires redevelopment. For example, the toolkit detracts points every time an education material uses italics, or bold, or less than 12 point font. The tool looks for opportunities to group information under bullets or numbering or figures, and it looks for ways to graphically display information rather than using body text. Despite requests, the author was unsuccessful in obtaining one.

The Flesch Kincaid readability score is a score that reviews sentence length, grammar structure, passive language, syllables in each word, and number of sentences per paragraph. It produces an overall readability score, equivalent grade level, and passive sentences percentage.

## CHAPTER III: METHODS AND PROCEDURES

For this Master's of Public Health capstone project, the author created an environmental public health education handbook template about reusing a brownfield for a community food garden. The handbook template is designed to be modifiable for different brownfields sites, and is intended to be readable by the general public. Methods used to develop this handbook included a literature review, a review of applicable agencies and organizations, review of articles in industry professional journals such as Brownfields Renewal, review of online blogs and discussion forums of active community garden organizations for practices in the field, and extensive web searches. The project approach was to use tools and literature available online to inform the decision making process and to develop the final product, the handbook template.

The literature reviewed for the handbook and the site health assessment focused on environmental management of brownfields, urban agriculture, toxicological considerations, and plant uptake of hazardous chemicals (using phytoremediation as a basis), and health in garden planning and design.

The literature review also included studies that identify relationships between urban agriculture and social health benefits such as access to nutrition and social cohesion. To complete a literature review, the author used EbscoHost, ScienceDirect, and PubMed to access health promotion, nursing, and environmental management databases to identify research published in peer reviewed journal articles related to keywords: brownfields, urban gardens, chemical uptake of fruits and vegetables, community gardens, nutrition, behavioral health, social capital, health disparities, and health education materials development. Relevant books about brownfields and urban agriculture were located using the Georgia State University Library Catalog and online book stores. Agency websites including the Centers for Disease Control and Prevention, U.S. Environmental Protection Agency (EPA), Georgia Environmental Protection Division (GEPD), Georgia Department of Public Health (GDPH), and the U.S. Department of Agriculture (USDA) were searched for keywords: brownfields, built environment and health, and urban agriculture.

A web search using popular search engines (Google, Yahoo, Babylon, and AVG) of keywords: community garden, grant funding, and non-profit organization was conducted to identify community garden organizations' current practices in the field, and funding resources for community based projects reusing brownfields as food gardens. Funding source organizations listed were contacted directly by the author to verify brownfield-to-garden project funding eligibility, and permission to print as part of the funding resource list.

The site specific assessment included in the handbook of the Allene Avenue Community Garden located along the Atlanta BeltLine was also conducted. The author completed an assessment of the potential for exposure to chemicals of a brownfield site selected for reuse as an urban garden using site investigation protocol and toxicological tools developed by the Agency for Toxic Substances and Disease Registry (ATSDR). Under this protocol, the author reviewed available site history and environmental sampling data as reported to GEPD, available environmental data from EPA, and appropriate literature available through EbscoHost.

The author used online mapping tools and aerial photographs (Google Earth, Google Maps/Mapquest, and the City of Atlanta GIS interactive online mapping tool) to identify the location, zoning, city planning and neighborhood boundaries, and general built environment features of the site.

To identify population demographics and health status of the residents living within walking distance of the site (defined by the American Planning Association as ¼ to ½ mile), the author used U.S. Census 2010 data and Georgia Department of Public Health Online Analytical Statistical Information System (OASIS). OASIS data was used in lieu of National Health and Nutrition Examination Survey (NHANES) data for this project to better reflect population and health data at the neighborhood or community ("micro"- population) scale.

Walkability and food desert data were used as indicators of built environment features and amenities (or lack thereof) which contribute to the health status and public health needs of the community. The author also used USDA/ESRI Food Desert map and Walk Score's online walkability scoring tool, to assess the community food environment and accessibility barriers of the garden to area residents, a potential volunteer base. The food desert map is a web accessible map tool created through partnership between ESRI geographic information systems software developers and the USDA to identify food deserts in major U.S. cities. Walkable access (within 1 mile) to large grocery stores or supermarkets (grossing at least $1 million or more in annual sales) was mapped for under-served populations living in poverty for major cities across the U.S. For the purposes of this project, a food desert is defined as lack of walking access (within ½ mile) to a supermarket or large grocery store in a low-income area. The Healthy Food Finance Initiative defines "low-income" as having a poverty rate of 20% or median income below 80% of the area's median income.

Walk Score is an organization dedicated to the promotion of walkability in neighborhood planning and urban development. The Walk Score advisory board is comprised of urban planning, environmental, and technical experts from research institutions such as The Sightline Institute (an independent non-profit research center), and The Brookings Institution. Walk Score combines city and neighborhood boundaries, street map data, real estate and amenities built environment data, and population data to create a walk score index. This index provides a score that is a general indicator of pedestrian friendly features in a community. This score may be used to inform planners at the BeltLine and the City of Atlanta about community alternative transportation needs and barriers to access, and can serve to assist with planning and design of the community garden.

The author used this literature review and the environmental, demographic, and health data collected to assess the impact to public health of the garden site and make site-specific recommendations. The assessment completed for the handbook and the data used to complete it is included in the Appendices. Health education material was designed to achieve a layout and design score of 65 on the Suebert scale (Suebert, 2009), and a Flesch Kincaid readability score of sixth to eighth grade.

For this project, the author chose years potential life lost (YPLL) as a health status measure to follow for this community. YPLL is a measure of *premature* mortality. It is defined as the difference between a predetermined end point age (usually age 75 reflecting an average life span), and the age at death that occurred prior to the selected end point age.

For example, if the average life span is 75 yrs, but an individual died from a heart attack at 55, this individual contributes 20 years to that community's YPLL. The potential years of life lost attributed to each death (usually among residents of a specified geographic area for a specific time period) are added to represent the total years of potential life lost for that area.

YPLL is primarily used to sum up the leading causes of death and then to rank them, showing causes of death with the highest numbers of years of potential life lost for a specific geographic area or specific demographic/s. Further, the Georgia Department of Public Health, from which the YPLL data for this project was obtained, also analyzes the data to include specific causes of disease to increase data accuracy beyond what is available from the National Center for Health Statistics. YPLL, therefore, allows insight into potentially effective interventions at earlier life stages based on current premature death data.

Based on known health disparities, the commonly monitored health indicators relevant to community gardens include heart disease and stroke, obesity, diabetes, and other metabolic diseases. Although mortality rates, prevalence, and incidence may be relevant indicators to track, these indicators do not often change significantly on an annual basis within such a small population. Significant changes in epidemiological data for chronic diseases can take decades, often because of latency of onset. Also, chronic disease data can be inaccurate or difficult to identify an association from chance in such small populations. Alternatively, YPLLs are frequently used to compare leading causes of death for the purpose of prioritizing intervention efforts.

The benefit of using YPLL is that it is accurate among smaller populations, and is available at the census tract level. The disadvantage is that this sort of data is not as intuitive as mortality, prevalence, or incidence data, and which can it difficult to work with and share. Despite this disadvantage, the strengths of using YPLL for this project outweigh the disadvantages. Additionally, behavioral indicators such as diet or eating habits as discussed in the literature were not included in this assessment because behavioral risk factor data is not captured at a scale that could accurately reflect the community level.

Initially, the author prepared to conduct a "Built Environment Condition Evaluation" using the "Built Environment Condition Evaluation" checklist tool (designed by the author) to document existing conditions of the site and the relevance to health, and to assist planners with identifying public health needs of the community. However, the author felt that for this capstone project, such an evaluation was a redundancy of effort and better suited as a stand-alone project.

Throughout the capstone project process, the author considered two different scenarios: a guerrilla garden and a well-planned, well-designed community garden. Content decisions about how to approach gardening on a vacant (possibly brownfield) property were made with the guerrilla garden in mind (eg. if residents made no effort to discover the property's history, potential for chemical contamination, or information about health protective garden design). The handbook content was specifically selected to encourage interested parties to protect and promote public health by:

1. investigating property history and environmental management records
2. determining onsite soil chemistry and "health"
3. exploring protective garden design options
4. encouraging gardeners to use caution and health-protective practices

Soil chemistry and soil "health" refer to not only the potential for chemical contamination from an industrial history (brownfield), but also agricultural suitability of the soil and location. Soils (contaminated or not) may need to be augmented with vital nutrients necessary for plant growth to facilitate plant growth, as well as reduce plant uptake of chemical contamination. Health-protective practices considered were intended to be protective of gardener's health, as well as the gardener's family's health (eg. tracking soil inside the home.) Integrated Pest Management practices onsite at the garden also promote health in the garden and at the gardeners' homes.

The author sent initial drafts of the handbook to various audiences for review and preliminary evaluation to ensure fewer errors and to test readability, layout, and graphics. Through each phase of the process, edits were considered and comments were addressed. In addition to being asked to find grammatical errors, all reviewers were asked "Is this handbook easy to understand? Does it make sense?" The first draft was sent to friends and family including the following individuals. These individuals have a varied, non-technical background which reflected a non-science residential perspective. The handbook was reviewed for readability as well as grammatical errors. Reviewers were from various educational backgrounds and occupations including artists, songwriters, students, doctorates in psychology and education.

The second draft was sent to public service professionals in public health, environmental protection, and planning to obtain insight from the public service perspective. Reviewers included individuals from backgrounds including health education, transportation and redevelopment project planning, and environmental protection. The final draft was sent to community garden organizers and garden designers.

## CHAPTER IV: COSTS, BENEFITS, AND BARRIERS TO BROWNFIELD REUSE FOR URBAN AGRICULTRE

*Costs*

While sounding like a great idea to simply redevelop an idle vacant property that is depreciating the value of a community and may possibly be contaminated, there is a great deal of cost required to do so. Brownfields sites are costly in terms of money, time, legal liability, patience, and expertise. Brownfields require a great deal of technical expertise to be able to ensure public health and safety, and consultant costs can vary into the hundreds of dollars per hour.  Legal liabilities externalities can be alleviated through enrollment in a state brownfields program, however one must first know about the state brownfields program, and also meet eligibility requirements.

Brownfields also require a lot of money and time devoted to research, sampling, and remediation. While some brownfields might be redeveloped for a mere $60+, many often require millions to thoroughly research the site, identify contaminants, remediate contaminants to safer levels and satisfy regulators (Martin, 2010). Often the cost of soil remediation includes purchasing in clean soil to replace the contaminated soil removed. Then there is the cost of the investment to reuse the site for a community garden.

Community gardens and farmer's markets require more than just a few seeds and good intentions. There are start-up costs which can range in the tens of thousands of dollars for design, equipment costs, food transport costs, security costs, utilities costs, staffing and leadership costs, consultation and expertise costs, and the costs for maintenance; and on former brownfields, added construction costs of raised beds and more soil or compost can further drive costs up. Brownfields can take years to fully assess and remediate, and for some the amount of time is of greater cost or consequence than the redevelopment is worth. To assist with the cost of a project, public-private partnerships are often leveraged to complete a redevelopment (EPA, 2012).

Project leader's patience, as well as community members’ patience may also be considered a cost. If a project is too complicated or involved, project leaders may abandon it. Brownfields redevelopment requires a great deal of patience and dedication.

*Benefits*

Community benefits of remediating brownfields are multi-fold. Hazardous chemicals are removed or reduced. Vacant, idle properties are put back into productive use, and community and property values increase. The social benefits of redevelopment within the context of factors previously mentioned include improved community aesthetic, fewer opportunities for engaging in risky behaviors, and a potential increase in safety. The social benefits of involving community members in the project are reflected in measures of social cohesiveness and community efficacy.

Community gardens are known to be beneficial to both the physical and social health of communities. They provide access to nutritional foods, often in areas with very few options. They offer a place for neighbors to get together and socialize, exercise, or work toward a common goal. Community gardens can reduce stress for individual volunteers through the act of gardening, or reduce stress throughout the community by improving the community aesthetics. Improving aesthetics not only increases individual sense of well-being and promotes healthy behaviors (such as walking), but also increases a community's sense of identity and pride.

Studies have shown that volunteering with community gardens increases vegetable consumption and improves healthy behaviors. Households that have at least one gardener consume almost twice as many fruits and vegetables than households that did not have a gardening member (Alaimo, et. al, 2008). Children and youth who have access to a community garden, or who garden themselves, are more likely to enjoy eating fresh fruits and vegetables as snacks than other children who do not garden (Libman, 2007). Infrastructure barriers such as location and transportation, not lack of knowledge or motivation, have the greatest impact on some populations' fruit and vegetable consumption (Kingsley, 2009).

Community gardens may also address other obstacles to fruit and vegetable consumption including preference, quality, selection, cost, and transportation difficulties (Alaimo, et. al, 2008). Researchers have found that the likelihood of volunteership from within the community is not dependent on an individual's employment status, education, marital status, or number of children in the household. It is also not dependent on health status, weight, physical activity, smoking, or alcohol consumption (Alaimo, et. al, 2008).

Community gardens are excellent places for neighbors and enthusiasts to bond and create a strong social network. Alaimo (2010) also found that gardening alone increased social bonding, but when coupled with public meetings, social networking increased more significantly. Kingsley (2009) found that volunteering with community gardens helped to reduce stress, provide sanctuary, and reconnect with spirituality. If used as an education tool, gardens can also promote changes in attitudes and behaviors (Kingsley, 2009; Libman, 2007).

The aesthetics of a neighborhood plays a significant role in a community's health and perceptions of well-being. A community garden can improve community aesthetics. Neighborhood environmental aesthetics have been shown to influence health behaviors, such as the walking habits of adults. Additionally, a highly favorable perception of a community or of garden aesthetics has been shown to increase fruit or vegetable consumption.

A community's sense of attachment or identification with their community is shaped by aesthetics. Aesthetics and attachment can promote stability, involvement, and personal or social investment in the characteristics and culture of the neighborhood. Positive neighborhood attachment has been shown to lead to higher levels of social involvement and facilitate healthy behaviors (Litt, et. al, 2011).

Social, psychological, and aesthetic setting shape lifelong beliefs and food preferences, choices, and practices. Community gardens represent a practical approach to change dietary preferences toward fresh fruits and vegetables by fostering social connections among community members and especially the connections between people and food-producing landscapes (Litt, et al., 2011; Kingsley, 2009; Libman, 2007; Alaimo, 2010).

Overall, studies demonstrate that community gardens can significantly improve nutritional quality of dietary intake among urban residents, and increase social bonding and social networking. Community gardens also have the potential to mitigate costs associated with consuming fruits and vegetables, and reduce the need for transportation to grocery stores in urban areas.

*Barriers*

Vacant land and blight such as brownfields can improve community health and become a great social and economic asset if put back into productive use. A former brownfield can provide initially inexpensive land that, with investment, can be transformed into a profitable vital resource as light-industry or commercial business, professional offices, entertainment or recreation space, residential housing, greenspace, or community gardens. Pooling resources from all stakeholders, such as public-private partnerships, and including the surrounding community can help provide necessary resources and reduce investment burden for each stakeholder.

Despite the known benefits of redeveloping brownfields, common obstacles exist that prevent productive reuse of a vacant property. These obstacles center on the uncertainty of cost and finance, project timeframe, liability, legal protections, and stigma (GEPD, 2011; EPA, 2011; Greenstein and Sungu-Eryilmaz, 2004). Other costs may include the loss of a tax write-off of an industrial asset, such as with "Mothballed" properties. Mothballed properties are those in which the cost of keeping the property as a "toxic asset" is far less than the potential future benefit of industrial use and company expansion, and not worth the sale price to unload it (Greenstein and Sungu-Eryilmaz, 2004). “Redfield” properties are another example in which the amount owed on a property far exceeds the property’s real estate value (Greenstein and Sungu-Eryilmaz, 2004).

Brownfields are most often not redeveloped because of costs of the remediation and future maintenance, limited funding available, and liability fears; the social cost of not redeveloping these sites is far greater in terms of the degradation of a community, decrease in property values, tax revenue lost, and the lack of a visual aesthetic (Siikmaki and Wernstedt, 2008).

To assist with the complexities cleaning up brownfields properties, the Small Business Liability Relief and Brownfields Revitalization Act, or Brownfields Act (2002) reduces regulatory barriers and provides compliance standards and funding opportunities through revolving loans and grants specifically for brownfields identification and remediation activities (EPA Brownfields, 2011). The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund) and Superfund Amendments and Re-authorization Act, or SARA, (1996) also allows EPA greater legal authority and funding to track down polluters, known as the primary responsible parties, for the property's contamination, while the Brownfields Act (2002) offers prospective purchasers liability protection from third party lawsuits (EPA Brownfields, 2011).

Competitive grant funding is available from the EPA Brownfields Program to governments, individuals, and non-profit organizations for site assessment and cleanup (EPA, 2011). State brownfields programs provide the necessary regulatory oversight for environmental compliance and contamination clean up (GEPD, 2011). Under the Brownfields Act (2002) state brownfields programs can also offer limitations of liability, providing protection from third party lawsuits. Environmental compliance laws regarding brownfields require that contaminated soils on site must be remediated to soil risk reduction standards that will prevent additional future groundwater contamination above state regulatory standards (GEPD, 2011). As long as the contamination source is removed, then ground water is not required to be remediated (GEPD, 2011).

In addition, properties may have also incurred negative legal judgments, or cloud**,** against the property's title (Greenstein and Sungu-Eryilmaz, 2004). Cloud can include liens, current litigation, compliance violation, or lack of ownership, which may further complicate ownership and development, as well as drive up costs (Greenstein and Sungu-Eryilmaz, 2004). In a study regarding barriers to redevelopment of brownfields into greenspaces conducted by Siikmaki and Wernstedt (2008), the authors found that the greatest barriers to brownfield redevelopment are presence of contamination, liability, the cost of remediation, future maintenance of the site, and lack of ownership; however that the social and public health costs of *not* redeveloping brownfields are far greater.

Federal regulations have also presented barriers to redevelopment of vacant land such as brownfields. The same federal laws that protect the public from toxic chemicals can also hinder brownfield redevelopment. Superfund and state regulations requiring that environmental violations be corrected by the primary responsible party also require that this liability transfers to any new site owner (EPA Brownfield, 2011). To reduce the regulatory barriers and encourage brownfield redevelopment, the Brownfields Act implemented tax incentives and liability protection, recognizing the innocence of eligible prospective purchasers volunteering to correct environmental violations.

Brownfields may not be contaminated but instead may only be perceived as such, or may be contaminated at levels below health concern. Siikmaki and Wernstedt (2008) found that public opposition to redevelopment because of perception of a property as a brownfield can hinder redevelopment or discourage purchasers; however, their results showed that if seen as a partner, state programs can help facilitate the redevelopment of brownfields sites. If developers or community groups do not know about state brownfields programs or the benefits of partnering with state brownfields programs remediation may halt before it can begin.

Community health and vitality can be improved, but only if the brownfield is remediated and reused. Although legislation and government programs are in place at state agencies across the country to alleviate the barriers and encourage purchase and redevelopment of brownfields properties, more is required overcome the barriers and stigma of these properties. Eisen (2007) discusses the issues of developer centered programs and the need to address redevelopment in context of the community in which it is located. Eisen suggests that community context can be used as a measure of a successful and sustainable redevelopment. Community based and grass roots efforts of non-profit organizations and public health agencies at federal, state, and local levels may be able to assist in creating awareness, addressing stigma, and conducting outreach in residential communities.

Public perception of risk and cultural or religious beliefs can be either a benefit or an obstacle. Public perception of the risks of redeveloping a brownfield into a community garden may cause concerns and prevent redevelopment. Communities may desire a change, however, like additional greenspace which is limited because of their urban location (Siikmaki and Wernstedt, 2008), and additionally not have a significant mechanism to obtain it. In this case, the obstacle is not the perception as much as the lack of resources and knowledge.

On the local level, municipal zoning can also be a barrier to redevelopment as a community garden. If local zoning ordinance do not allow, or specifically prohibit, urban agriculture, then a property cannot become a community garden (Greenstein and Sungu-Eryilmaz, 2004). Zoning ordinance has been an obstacle for urban agriculture and community garden redevelopment projects in Detroit and Chicago (Goldstein, 2011; Kastman, 2010; Greenstein and Sungu-Eryilmaz, 2004).

## CHAPTER V: LESSONS LEARNED FROM THIS PROJECT

*Strengths and Successes*

This capstone project offered many successes, challenges, and lessons learned for this process. The project approach was to use tools and literature available online to inform the decision making process and to develop the final product, the handbook template. The approach was very successful with the access to literature and data quickly achieved through the use of online tools and the ease of web access. Environmental records for the property were also easily accessible because records were free and open to the public. The handbook end product was an attractive booklet, readable at the 10$^{th}$ grade level.

With so many online resources, it was more difficult to narrow resources down than to find appropriate resources to conduct the project. However, the success of the approach was also a major flaw. The handbook and site assessment relied heavily on publicly available, web-accessible information, and additional field work conducted for this project was limited. More about this limitation will be discussed in the *Limitations and Challenges* section of this chapter. Despite this limitation, the methods of this approach are easy, time sensitive, and inexpensive to replicate for the public sector, specifically health professionals at local health departments. The methods also relied on tools and information relevant to the community, as well as to the redevelopment project.

Another success for this capstone project is the flexibility for modification and the general applicability state or nation-wide. This project can be relocated in another part of the state with different environmental, political, or social climates and resources. This project can also be applied as a community-based project, actively engaging residents in communities living near these sorts of redevelopment activities.

The project highlighted the need for public-private partnership, agency collaboration, and for a division of responsibilities along the lines of expertise. There is a great opportunity for local (municipal or county level) health department involvement and public health tracking for brownfields redevelopment and community gardens. If involved early on, qualified staff at health departments can assist public officials and regulators with identifying a community's public health needs, and inform planners and developers with suggestions for healthy design.

Readability models returned low readability scores for the handbook (Flesh Kincaid: 46, Dale-Chall: 7), but the grade level was able to be simplified to an average of

10 across the three tests. In the Flesch Kincaid model, passive sentences were at 8%. The low percentage of passive sentences means that the handbook was successful in remaining in the active voice, using plain language, and keeping complex ideas simplified. The simplification of content down to a 9-10 grade level showed success in simplifying some difficult and complex scientific concepts.

In addition to using readability models to test the readability of the handbook, the author sent initial drafts of the handbook to various audiences for review to ensure fewer errors and to test readability, layout, and graphics. Through each phase of the process, edits were considered and comments were addressed. The first draft was sent to friends and family with a varied, non-technical background which reflected a non-science residential perspective. Education backgrounds were varied but included the arts social sciences, psychology, and education. The second draft was sent to public service professionals in public health, environmental protection, and planning to obtain insight from the public service perspective. The final draft was sent to community garden organizers and garden designers.

Other than grammatical errors, the majority of the reviewers found the handbook to be understandable to the layperson. One consistent question was “who is your audience?” with regard to content. The author reviewed the handbook again for content, concepts, and language using readability models.

A suggestion for an additional Georgia specific paragraph was made for the very beginning of the handbook. Otherwise, comments regarding content included some concern about language phrases including the use of “expected to be safe”, site-specific details, “the greatest public health concern”, and additional details about the chemical uptake of metals. Comments were addressed and appropriate changes were made to the handbook. The phrase “expected to be safe” was changed to “considered safe”. The phrase “the greatest public health concern” was changed to “among the public health concerns”. The concern about the description of chemical uptake of metals was regarding a clarification about which metals are taken up and which metals are not, and about adding soil nutrients through fertilizer and compost to reduce chemical uptake. The handbook was revised to reflect all changes.

When asked directly what impact this booklet had on the readers, and whether or not the reviewer would use the handbook, all the above reviewers indicated that the handbook was useful and that they would distribute it. Comments in general included informative, “visually appealing”, “useful”, and “very helpful”.

*Limitations and Challenges*

This capstone project has its limitations, but the author also experienced challenges during the project process. For the site assessment portion of this capstone project, well established methods developed by ATSDR and CDC were used to assess the potential impact on public health of a specific brownfield project being redeveloped into a community garden, however the project did not follow a single strict protocol. The site-specific assessment portion of this capstone project pieced together a protocol using a series of tools relevant to this community and brownfield redevelopment project. No specific protocols were identified that exactly matched the intended project.

Secondly, this capstone is not a proper Health Impact Assessment (HIA); it is an assessment of public health impacts. Although this capstone project is not necessarily a HIA, the methods followed can be adapted into one; however, no HIAs were identified that have been completed specific to a brownfield reuse as a community garden project when researched in known HIA databases[1]. Also, the overall HIA use in the United States is still in its infancy. While this makes HIA a very flexible too l to use, it does not have a strong background for this sort of application in the United States. European countries have been using HIA to inform planning decisions for decades, but its use here is limited.

Further, other HIAs have assessed a variety of garden topics such as: locations best suited to meet a community's nutritional needs, the health benefits of community garden versus some other land use, the loss of a community garden or farmer's market, or health impacts of community gardens zoning barriers; but non have yet weighed in on the reuse of vacant land or the potential for exposure to contaminants on the process of organizing a community garden, and the health impacts to the community.

Instead of looking at these factors, this capstone attempted to explore the topic from a new perspective and hopes that additional follow-up will lay the foundation for future HIA work. For example, many community health indicators are available including years potential life lost, heart health and stroke data, hospitalization data, diabetes and metabolic disorders surveillance, behavioral risk data, and even asthma and indicators of increased outdoor activity. Some indicators offer excellent opportunities for collaborating with residents at the neighborhood scale on community based projects and public health tracking including Body Mass Index, individual metabolism indicators, physical activity trackers such as number of steps walked or jogged, nutrition consumption surveys, and attitude or behavior change surveys. This capstone project did not explore any of these potential indicators or activities.

Additional field work was not conducted for this capstone project. As discussed in the previous paragraph, additional health data was not used to identify or monitor health, nor was additional field work conducted to collect environmental data, such as soil sampling. The project approach limited itself to web-accessible information, and did not integrate environmental sampling in the field.

This capstone project focused on strictly the public health benefit of social capital and did not venture into the community for community involvement activities and

[1] The two main HIA databases tracking all HIA work completed are available through the University of California at Los Angeles (HIA CLIC) and the Health Impact Project organization.

collaboration. This is a significant limitation because public health data is only available at the census tract level and is really not useful on scales smaller than that, or at a scale that most truly represents the surrounding community. The only way to get aggregate health outcome data is through self-reported health outcomes surveys of residents at site-specific projects.

The handbook end product also had a few limitations. The length may prove to work against it, being so long with so much information. In addition, a readability score of sixth to eighth grade on the readability scales was very difficult to achieve. The Flesch Kincaid model returned a readability score of 46, grade level was brought down to 10, and passive sentences was at 8%. The Dale-Chall model returned a grade of 9-10, and the SMOG model returned a grade 10. The higher grade level means that more complex grammar structures, higher syllable words, more technical or academic words often used, and longer sentences were incorporated into the document. Although the grade level was brought down from $12^{th}$ grade to $10^{th}$ grade, this still serves as a limitation for this handbook. This may not be easy to do, however, because readability models do not account for the introduction of technical words, and there are several that are necessary to include that drive the score up simply by the number of syllables alone. In addition, readability models do not account for technical words introduced being defined within the education product. They instead count points against the material for every time the introduced and defined technical word is used. In this way, readability scores, especially SMOG and Flesch Kincaid, work against the reader's competence, and does not account for education and learning from the handbook. Not being able to include important technical words defeats the purpose of the handbook. The Dale Chall score was more appropriate for this handbook, and was much easier to use.

*Other Lessons Learned*

This capstone project demonstrated that there is so much more to think about, follow-up on, or know about when reusing brownfields for community gardens than checking soil chemistry and how to grow a seed. This capstone project highlighted the many facets, and the need to understand that a garden as a business or project model that requires a larger vision and greater depth in planning.

Through this capstone project, the author learned the various descriptors for idle vacant properties (in addition to brownfields there are also “mothballed” properties, “redfields”, property lien complications, tax clouds, etc.), the many reasons why a property may remain vacant (ownership, tax laws, “toxic assets”, etc.), and how these reasons can inhibit a vacant property’s reuse. Often the owners of vacant properties cannot be located to discuss purchase or transfer of ownership. Some vacant properties may be owned by an industrial corporation and considered a better investment to keep on the books rather than selling the property because of the potential for future industrial use or expansion. As a result, the company would rather claim the tax write-off rather than sell it at the current market value. Others are in default with the banking lender and have too many liabilities (liens, mortgage due, chemical contamination that requires regulatory remediation) to be economical to redevelop. Community gardens offer an economical, flexible, and lower-cost alternative to these sites remaining vacant; however gaining permission and access to the site when the public record is tied up in red tape may prove to be too complicated to be reasonable or feasible. Also, in the real world, meeting assistance program eligibility can be just as tricky.

Additional lessons about the complexity of starting a community garden were also identified through this capstone project; a community garden is an investment. This capstone project's focus was on the impacts to health of reusing a brownfield as a community garden, but part of that consideration is the necessary business and agriculture savvy required to get a garden started to begin with. A great deal of knowledge about gardening, agriculture, soil chemistry, and farming needs is necessary to get a garden to thrive. Also a basic knowledge of business and a business plan are essential to running a community garden. A community garden must be thought of in terms of labor, assets, funding, economic return, investment, and resources to be able to get started or be sustained. Although there may be a great benefit to the community, starting a community garden also an investment and an organization. It is an appreciable commitment to make for any individual, and may require a larger network than the community itself can support. Through the capstone project, the author realized that the garden isn't just a simple community project, but an effort at a new neighborhood asset- and for some, a new way of life.

Developing the handbook identified that reusing a brownfield for a community garden requires much more than a few soil samples and some plant seeds. Other needs realized through this capstone project include investment and intellectual capital necessary to supply farming/gardening equipment, access the water supply, property maintenance capability (if necessary), insurance, garden design contractors, organization and network building needs, communication needs, and possibly legal forms or other paperwork necessary to identify the garden organization as a legal entity (either non-profit, not-for-profit, limited liability corp., etc.). Grant funding opportunities were included in the handbook to assist with some of the start-up monetary capital needs, as well as discussion about funding for brownfield site assessment and clean-up available through the EPA. Free technical assistance and expertise resources were also given in the handbook to give the reader a more complete idea of the array of technical knowledge necessary, as well as to assist with grant proposal writing. The relative breadth and depth of expertise in addition to the environmental expertise needed to get a garden started and sustainably running is much more than originally anticipated.

Further research, projects, or follow-up should focus on conducting a full economic cost-benefit analysis of the reuse of a brownfield for urban agriculture, designed for municipalities and local governments. The analysis would need to convert externalities such as monetary loss from a vacant property, or neighborhood property value lost, or the value of green space or quality of life, into a value in dollars. Being able to show the money saved (for example on reduced hospitalizations and chronic disease treatment from volunteer gardening exercise and through daily consumption of fruits and vegetables, or cost of transportation with and without the garden reuse), and the expected or potential profits made from the garden. Other projects could further explore policy analysis of zoning and local policies that support urban agriculture use of brownfields, and why they are successful.

## CHAPTER VI: CONCLUSIONS

Community gardens promote healthy communities and provide nutrition resources, especially in disadvantaged communities. They improve community aesthetic, increase property value, add to the green space network, and provide sustainable reuse of a formerly vacant and/or contaminated property. Community gardens strengthen social cohesion (community bonds or social capital), create recreational and therapeutic opportunities for a community, and provide community education. This capstone sought to respond to the question of what hazards there are when planting a food garden for local residents' consumption on a contaminated brownfield site. It did so through reviewing current and relevant literature, and by assessing one case study site from along the Atlanta BeltLine.

Of the public health concerns presented – potential exposure to chemicals, health disparities, nutrition related chronic diseases, and other social health factors – the greatest concern is a brownfield laying idle and unused. Based on literature reviewed and research conducted, most vegetables and fruits do not take-up chemicals into the edible portions as easily as anticipated; however, leafy greens, roots or tubers, and squash vegetables are more likely to take up chemicals, especially metals, and care should be taken. Therefore gardens must be conscientiously designed in order to be most protective, including soil testing and clean-up, and protective garden design features.

Gardens grown on brownfields require a balance between remediation and garden design. Remediating soil is protective and reduces the potential for chemical uptake, however some soils may not be easy to remediate to protective levels. Based on phytoremediation, chemical uptake, and garden design literature, remediating soils to background level may not be necessary. Although growing plants in the soil for those gardens may not be the best option, gardens can still be safely grown on brownfields sites that are difficult to clean up. Some property features can help protect gardeners and others. For example, Georgia state hazardous waste laws may require a concrete slab to create a barrier between contaminants and human contact. Also, specific design features utilizing containers, raised beds, or hydroponics to remove the plants from contaminants in soil, are all options for using a more difficult brownfield.

In general, although the initial investment may be high, the long-term benefits outweigh the costs. Guidance, assistance, funding sources, public support, and in many places the political support necessary is often intact. Although it may be difficult to get the initial investment and resident interest, the effort will match or exceed the costs reflected in better dietary habits, longer life, reduced prevalence for obesity and diabetes, fewer incidents of heart disease or stroke, physical activity, healthier outlook on life, and quality of life. If one were to add up all the money spent for:

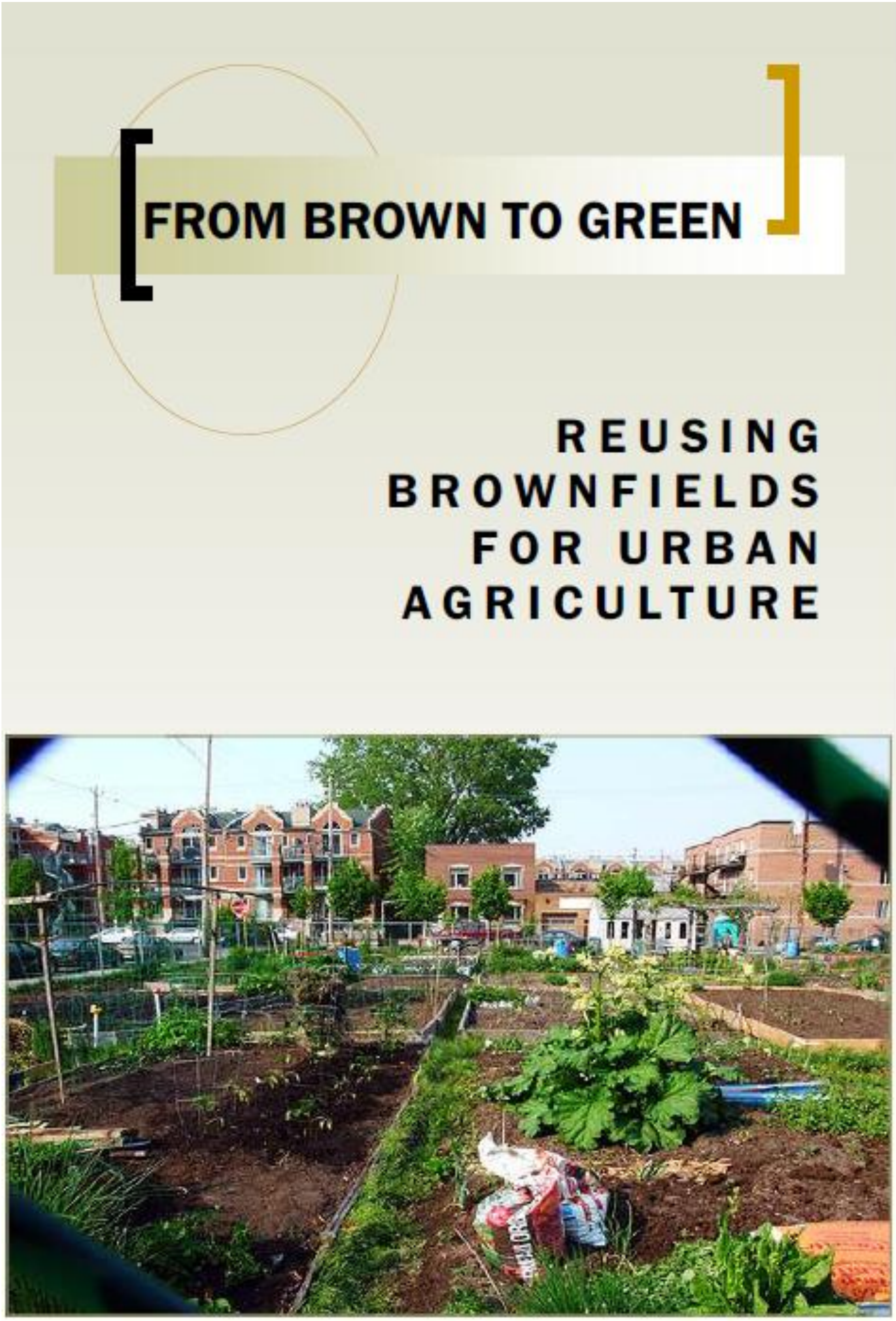
- treatment of these serious diseases multiplied by each individual,
- money saved increasing by physical activity,
- money saved by growing food locally and sustainability,
- profit through food sales from that productive property,
- property value increase for each home,
- community value increase,
- money saved in the community from decreased crime,
- money saved over each child's lifetime from having learned good nutrition and healthy habits from an early age.

The community benefits far outweigh the costs, even at an investment of millions of dollars. Monetary cost barriers can be overcome by community leaders dedicated to the project and public-private partnerships; time and liability costs can be alleviated through state environmental regulatory programs; potential exposures can be avoided through intelligent and purposeful garden design; and even garden start-up costs can be reduced by taking advantage of local government amenities such as free mulch and compost.

Reducing health disparities, and improving the nutrition and health habits of children who may not otherwise have access or encouragement is well worth the cost in the long run. Therefore, this handbook has been designed for the general public to address common concerns, to answer frequently asked questions, and to assist with community involvement and buy-in of these kinds of projects. The handbook supports the efforts while providing assurance and resource links to be able to make informed decisions for safety throughout the redevelopment process.

**APPENDICES**

**Appendix 1: "From Brown to Green: Brownfields Reuse as a Community Garden**




**PREFACE**

This handbook was prepared as a Master's of Public Health capstone project at Georgia State University in Atlanta, Georgia, USA. The project explored the public health benefits and considerations of using a brown-field site for gardening. For this project, I tried to think from the gardener's perspective. Questions like:

(1) *Is it safe to reuse brownfields sites for community gardens?*

(2) *Should I test my soil? What do the results mean? What about human health concerns?*

(3) *What are best practices to follow and best strategies to reduce exposure?*

The handbook attempts to explain that contaminated sites that remain idle (brownfields) can be reused for gardening if the site is cleaned up to federal and state standards, and if gardens carefully planned. The public health benefits outweigh the potential costs if done properly.

- Julia Campbell, MPH Candidate
Georgia State University

Photo Sources

Back cover:
Penn State University
www.e-education.psu.edu/geog030/node/362

Front cover:
Wayne State University, Warrior Demonstration Garden 2009
Article found at: www.celsias.com/article/urban-agriculture-career-path

## About this Handbook

This handbook was created to answer general questions about brownfields reuse for urban agriculture in Georgia, and to supplement the U.S. Environmental Protection Agency's (EPA) *Brownfields and Urban Agriculture: Interim Guidelines for Safe Urban Gardening*. The purpose of this handbook is to:

- raise the level of community awareness about using brownfields for urban gardens;
- clarify potential misconceptions about contaminated property;
- discuss common public health concerns and benefits of brownfield reuse as an urban vegetable garden;
- identify sources of funding for these projects;
- provide contact names and other sources of useful information; and
- encourage community members to explore redevelopment opportunities to be found on brownfield sites, including an urban community garden.

EPA's handbook and additional information about brownfields and urban agriculture can be found on EPA's website: *www.epa.gov/brownfields/urbanag.*

## Table of Contents

## URBAN AGRICULTURE

About 30% of America's food is grown in urban places whether in backyards, on rooftops, or in community gardens. More communities are using urban agriculture to improve their neighborhoods. Urban agriculture is defined as growing food for yourself, for education, or for sale using the infrastructure in a city.

Urban agriculture popularity has come and gone throughout history. In fact, one example is the Victory Gardens started during World War I. Urban agriculture can come in different forms, such as community gardens, commercial gardens or urban farms, community supported agriculture, farmers' markets, and personal gardens. Community gardens of various designs are a popular form of urban agriculture. They can also put vacant land to good use creating green space, increasing neighborhood value, and improving the look and feel of an area. Georgia has about 52 community gardens statewide.

In Georgia, gardening has been a part of the culture since the 1700's. Georgia's agricultural and industrial activities from gardening, farming, international trade, railroads, and manufacturing were shaped as a result of the industrial revolution and the civil war. Despite many changes, gardening has remained a way of life for Georgia's families. Today, Georgia enjoys more than 50 community gardens statewide.

Vacant sites can be a former industrial complex over whole neighborhoods or an individual lot in commercial and residential areas. These sites can be considered as potential places to grow food. Using farming as either a short term use of less than five years, or as long-term use can improve the environment, neighborhood features, and have direct benefits to people's ability to get healthy foods.



## URBAN AGRICULTURE, continued...

When thinking about what to do with a former industrial sites like brownfields, one option may be to reuse it for urban agriculture. Several cities have already started urban agriculture activities on or near former industrial sites to improve those communities. The use of urban agriculture has grown in response to community decline, and is seen as a sign of neighborhood resilience. Cities such as Cleveland, Ohio; Detroit, Michigan; and Buffalo, New York all have nurtured community gardens and established local infrastructure to support them.

In Georgia, several cities have started urban gardens including in Metro Atlanta and Savannah. Atlanta was recently named as one of the top cities in the nation for its efforts to help people start and manage community gardens in the 2011 Emory Turner Law Institute Urban Agriculture Report, including making small changes to it's zoning laws to allow activities beyond community gardens.

## VACANT PROPERTIES AND BROWNFIELDS

Vacant properties are often sites with an industrial or commercial past. Their presence often lowers property values in a community. Putting these sites back to good use can not only increase property values, but may also provide jobs, foster green space, or help neighbors to get to know one another better, which is called social cohesion. Vacant sites might potentially have hazardous chemicals in the soil and groundwater from their former uses. These kinds of sites are known as brownfields sites.

The U.S. Environmental Protection Agency (EPA) defines a brownfield as a property where there might be chemicals in the ground from previous uses, known or perceived. Specifically, EPA defines a brownfield as "a property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." EPA states that "cleaning up and reinvesting in these properties protects the environment, reduces blight, and takes development pressures off greenspaces and working lands."

In Georgia, a brownfield is an idle or vacant property with known contamination. Georgia has more than 350 brownfields sites, equivalent to 500 acres in properties throughout the state. Because of known contamination, these properties are regulated by the Georgia Environmental Protection Division (GEPD) under federal and state hazardous waste laws, and the Georgia Hazardous Site Redevelopment and Reuse Act, or the Georgia Brownfields Act, from 2003.





Brownfields can drain community resources and lower the value of surrounding properties, but they also have public health impacts. The greatest public health concern about brownfields is the tendency for a brownfield site to remain contaminated and unused. The longer that a brownfield site remains unused, the more likely that an exposure to toxic chemicals or other hazards can occur.

**Brownfields can pose health hazards** like exposure to chemicals in soil, groundwater, surface water, or indoor air. They can cause injuries, or harbor pests from dumped waste. Brownfields also influence health factors related to socioeconomic status like cohesiveness among neighbors, health disparities, stress and anxiety, and crime.

**Cleaning up (remediating) and reusing these sites can promote and improve health in the community.**

Liability concerns and bad stigma often prevent a brownfield from being cleaned up and reused. To reduce liability concerns and encourage brownfields reuse, EPA developed specific laws and created federal assistance programs. Brownfields compliance programs have been adopted in many states.

Federal and state brownfields laws require that brownfields be cleaned up before they are reused. These laws also provide regulatory oversight, legal protection, and soil clean-up standards that are determined by the planned reuse of a site. Brownfields sites in Georgia may be eligible for limitation of liability, tax incentives, technical assistance, and EPA funding.

Each brownfield is unique, just as the needs of each community are unique. If planned carefully, a brownfield put back into productive use as a community garden can meet community needs, and provide productive temporary or permanent reuse of a brownfield. Community gardens can make an almost immediate improvement in the community. For more information, or to determine if a property is a brownfield, contact EPA and GEPD.

## BROWNFIELDS USED FOR URBAN AGRICULTURE

In Georgia, brownfields must be cleaned up enough for residential use if they are to be converted into community gardens. The benefits to the community of reusing brownfields as community gardens are increases in property value, sense of community, recreational and cultural resources, and access to nutritional sources.

The community can also enjoy environmental benefits such as better soil quality, added soil nutrients with good compost, better water infiltration into soil, and better localized air quality.

The greatest public health concern about using a brownfield for a community garden is the issue of exposure to chemicals in soil through digging activities, or by eating garden herbs, fruits, or vegetables. Because brownfields must be cleaned up to residential standards before they are reused, health hazards from exposure to chemicals in soil is already reduced.

If you don't know whether a property has been cleaned up, check the property history, test the soil, and check out protective garden designs. Also, gardeners may wish to:

- wear gardening gloves while gardening
- wear easily cleaned gardening shoes
- wash hands and face thoroughly after gardening

To reduce tracking contaminated soils into the home, gardeners should:

- remove shoes before entering the home
- leave gardening shoes outside or at the door
- remove clothes and wash them after gardening

There is still much to be learned about exposure to chemicals through eating garden produce. For example, some chemicals can be taken up by plants while others, like lead, typically are not. Some plants are also better at absorbing chemicals and storing them in their roots, shoots, fruits, or leaves.



## BROWNFIELDS FOR URBAN AGRICULTURE, Continued...

Certain plants like wild mustard plants, gourds or squashes, herbs, weeds, and grasses can extract metals or solvent chemicals from the soil and store these chemicals in the roots, shoots, and leaves of the plants. In fact, mustard plants, trees, and grasses are frequently used to clean up contaminated soil through a process called *phytoremediation*.

Most garden fruits and vegetables do not easily absorb chemicals. For vegetables to take up heavy metals depends on soil pH, concentration of chemicals in the soil, soil type. It also depends on organic matter in the soil, nutrients like calcium, plant type, and plant growth stage. Some type of vegetables such as tubers and root vegetables are more likely to absorb chemicals into the edible portions, but most do not absorb chemicals into the fruits or leaves of the plant. An increase in soil nutrients such as compost and calcium fortification reduces the uptake of metals in plants.

| Exposure Source | Vegetable/ Edible Part | Potential for Exposure |
|---|---|---|
| Soil | N/A | High |
| Root or Tuber | Root | Moderate |
| Leafy Green | Leaf | Moderate |
| Herbs | Stem/Leaf | Moderate to Low |
| Fruit | Fruit | Low |

Although more needs to be learned about plant uptake of chemicals, gardening in soils cleaned up to residential standards is considered safe. Additionally, vegetables and fruits grown on cleaned up properties still provide valuable nutritional benefit. As a best practice safety measure when preparing fresh foods grown in any urban garden, **wash or peel all fruits and vegetables before eating**. Gardeners are encouraged to wear gloves to protect them against sharp objects found in the soil.

## GARDEN DESIGNS

Different garden types or designs can further reduce the potential for exposure to chemicals. Garden designs including raised beds and mulched walking paths can protect food quality and gardeners. Garden types such as greenhouse gardens, container gardens, and vertical gardens can provide protective barriers to chemicals in soil for edible plants. Drawings and design plans can help prepare for garden safety.

Photo source: Daniel Blaustein-Rejto, *www.inhabitat.com*

For gardens that may have contamination problems that can be easily solved, raised bed gardens and vertical gardens can help ensure healthy soils and healthy plants. Raised bed gardens are large container gardens usually two to three feet deep. Lining the bottoms and sides can provide further protection.

Photo source: George Irwin, *www.agreenroof.com*

Vertical gardens are garden designs that allow plants to grow in limited spaces. Also known as living walls and living wall farms, they can be ornamental or edible.

These garden designs can also help to reduce garden pests without using pesticide chemicals.

*Remember: washing fruits and veggies reduces the potential for exposure to harmful bacteria or chemicals in the soil.

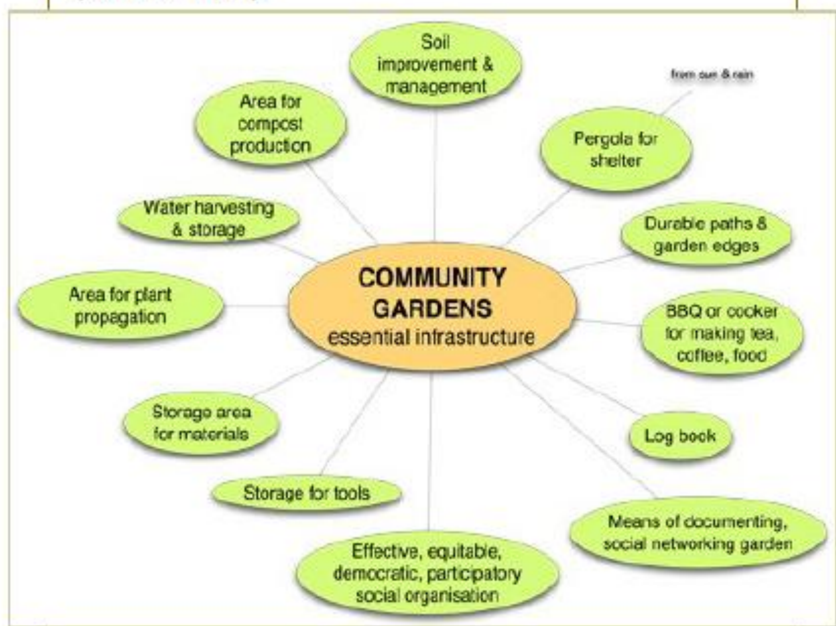


## OTHER CONSIDERATIONS

There is more to think about beyond the "who" and "where" when preparing to start a community garden. A community garden must have a business plan that outlines resources and identifies needs. Needs include equipment, time and volunteers, plot sizes and rental considerations, storage, compost and water usage/costs, documentation, and so on.

Garden design depends on hours of sunlight, shade, access to water, location, types of crops, security and lighting, and accessibility. If contamination remains deeper in the soil, growing plants with shallow root systems may be necessary or more clean soil may need to be added safe for growing (raised beds).

The chart below provides a general outline for things that are essential to start a garden. Assistance preparing urban garden business plans are available from the EPA urban gardens website, community garden organization websites, and at your local library.



## HEALTH BENEFITS OF COMMUNITY GARDENS

Community gardens can improve community health. They can make it easier for people to get healthier foods like fruits and vegetables. Research shows that volunteering with community gardens increases a person's likelihood to eat more fruits and vegetables. Children and youth who have access to a community garden, or who garden themselves, are more likely to enjoy eating fresh fruits and vegetables as snacks.

Often, people want to eat fruits and vegetables, but are limited by how they can get them. Community gardens can help people get healthier foods. Community gardens may also improve fruit and vegetable quality, selection, cost, and distribution. They have the potential to lower the cost of fruits and vegetables and the need for transportation to grocery stores in urban areas.

Community gardens are great places for neighbors and others to bond, and to create a strong social network. They offer a place for neighbors to get together, exercise, or work toward a common goal. Networking with your neighbors can increase resources needed in your neighborhood. If a garden is used as an education tool, it can set up healthier lifelong habits, especially for children and teens.

Volunteering with community gardens can help to reduce stress for individuals and the greater community. Gardening activity lowers stress for the volunteers, and can be a spiritual sanctuary for some. Gardens also reduce stress for an entire community by improving the community's look and feel.

Improving the look and feel of a community increases a person's sense of wellbeing, and promotes healthy behaviors (such as walking). It also promotes a sense of belonging. A neighborhood's cleanliness, design, and beauty play a significant role in a community's health and feelings of wellbeing. This is known as a community or neighborhood's





"aesthetics". A community garden can improve the look and feel of a neighborhood, and this can influence health behaviors such as people's walking habits. In fact, a good impression of a community or of a garden can also increase the amount of fruit or vegetables we eat.

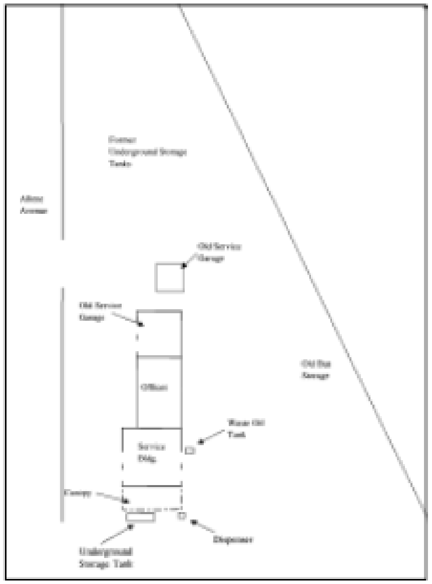
Community members' sense of belonging is also shaped by aesthetics. Good design, cleanliness, and beauty can promote neighborhood stability and involvement. Feeling good about your neighborhood can help everybody be more comfortable, healthy, and happy.

A person's social, psychological, and environmental setting shapes their beliefs about food for life. Community gardens are a practical way to reconnect people with their food. The connections made through gardening can improve people's attitudes about fresh fruits and vegetables. By nurturing these connections, community gardens can make a positive change in lifelong eating habits.

Community gardens improve both the physical and social health of communities. They help people to get nutritional foods, often in areas with very few options. They offer a place for neighbors to socialize, exercise, or work toward a common goal. Gardening can lower stress for volunteers, and also lower stress throughout the community by improving the community's aesthetic. Improving the community aesthetic increases a person's sense of wellbeing. It promotes healthy eating and exercise, and increases a community's sense of identity and pride.

## In Your Community: Allene Avenue Community Garden

### Site History




The Allene Avenue Community Garden is located in a mixed-use zone of Oakland City neighborhood, southwest Atlanta. The property is a former vehicle charter and maintenance site bordered by Allene Avenue to the west, abandoned rail line and houses from northwest to southeast, and by office buildings to the south.

In the past, the property has been used for automobile services: a gas station (1945-1955), a truck leasing service (1955-1981), and bus/limo charter and maintenance business (from 1981). The property had office buildings, fuel storage tanks, and garage buildings onsite. Several other industrial or commercial properties are located within 1/8mile of the site, and the nearest residents are adjacent to the east boundary along the railroad track.

Four underground fuel storage tanks (USTs) were located on the property: a 10,000 gallon diesel UST at the south end of the site; 4,000 gallon and 2,000 gallon gasoline tanks, and a 1,000 gallon kerosene tank (onsite locations are shown on the diagram above). The three smaller USTs were removed in 1998. Several unlabeled 55 gallon storage drums were observed on the property, however all storage tanks and drums have been removed and properly disposed. Contaminated soils were remediated. Solid waste was found improperly disposed of on the property. The waste was removed and properly disposed.



## In Your Community, continued...

### Environmental Data Review

At the Allene Avenue property, soil is mostly clay up to approximately 100 feet deep. Bedrock is made up of fractured rock and granite. Diesel gasoline and petroleum byproducts were found in the soil below federal and state clean-up levels.

Groundwater at the site is from 16 feet to 31 feet deep, and flows to the northeast. The property slopes gently to the south.

Petroleum breakdown products such as benzene were detected in groundwater underneath the property, but below federal drinking water standards set by EPA. Petroleum breakdown products are part of a chemical group called volatile organic chemicals, or VOCs. VOCs are chemicals that evaporate easily and break down with sunshine and rain.

Other VOCs were detected in groundwater from nearby sites moving the direction of the property more than 15 feet below ground surface.

Contamination in groundwater onsite or from nearby sites is too deep to affect vegetables grown onsite. Soil contamination is not likely affect health because the soil has been previously cleaned-up to federal and state clean-up standards.

Surface water runoff may contribute to soil contamination over time, and exposure to contaminants in soil may occur through touching or breathing or accidently swallowing chemicals in soil; however, harm to health from exposure is unlikely.

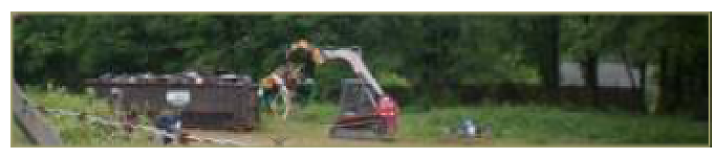


Photo source: Julia Campbell, *Allene Avenue Community Garden*

## In Your Community, continued…

*The success or failure of any government in the final analysis must be measured by the well-being of its citizens. Nothing can be more important to a state than its public health; the state's paramount concern should be the health of its people.*

~ Franklin Delano Roosevelt

The Allene Avenue property is located in 2010 Census Tract 65, within Atlanta neighborhood planning unit (NPU)-S along the boundary with NPU-V. These NPUs have a population of 14,896 and 14,711 respectively. The population of census tract 65 is 3,678. Elementary and high schools in the community include Ragsdale School, Capitol View School, Adair School, Brown High School, and Sylvan Hills High School.

| Table 2: Demographics for all Census Tracts | |
|---|---|
| African-American | 91% |
| White | 7% |
| Mixed | 2% |
| Hispanic | 2% |
| Percent Who Rent | 58% (range: 34-81%) |

The Food Desert Map by the U.S. Department of Agriculture and Environmental Systems Research Institute used population information and grocery store type to identify urban areas with very few healthy food options. The map identified the community around the Allene Avenue garden as a nutritionally underserved population.

Health in the community is similar to the nation with higher rates of diabetes, obesity, and heart disease than other areas of Atlanta. Statistically, African-Americans have 40% higher risk of death from heart disease.

From this perspective, a garden will be very helpful to this and nearby communities. Thousands of people will be able to get healthier foods more easily and meet with neighbors. People will also be able to enjoy low impact exercise, or being out in nature. Allowing younger children and teens to participate in gardening, education programs, and giving garden tours will allow them to share pride in their community and encourage them to eat healthy foods.



## In Your Community, continued…

Soil on the property has been cleaned up to state and federal standards under GEPD oversight. Additional design features might include:

- **Mulch**—Mulch to cover bare soil that is not being used for planting.
- **Buffer**—Allow a 5 ft buffer distance between the road and the planted vegetables to reduce chemicals deposited on soil and plants from car exhaust.
- **Include sidewalks in street design**—Sidewalks along the street allow friends and neighbors to enjoy the garden while providing a buffer from the road.
- **Community Compost**— on-site composting with donations of compostable waste like yard clippings from neighbors can supplement soil nutrients.
- **Rain Barrels**—rain barrel collection systems can provide affordable, local garden care.

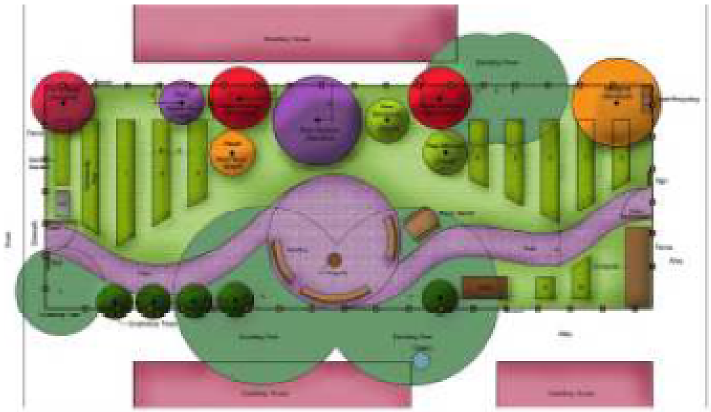


**Photo Source: IndyTilth, *www.indytilth.org***

## HOW TO START YOUR OWN COMMUNITY GARDEN in GEORGIA

1. Form a garden planning committee
2. Identify all resources
3. Approach potential sponsors
4. Choose a site
5. Prepare and develop the site:
   a. Research property history
   b. Take soil samples (contact UGA Cooperative Extension Labs)
   c. Determine site clean-up and design needs
   d. Plan the garden design for children, other sensitive groups, or others with special needs
6. Organize the garden, decide on membership, identify management, roles, and responsibilities
7. Prepare volunteer crews and gather needed materials and equipment
8. Write garden rules and bylaws
9. Determine insurance needs
10. Establish communication network for members

**For more information and guidance go to:**

*www.epa.gov/brownfields/urbanag/steps.htm*

*www.urbanharvest.org/cgardens/startguide.html*

*http://communitygarden.org/learn/starting-a-community-garden.php*



## INFORMATION and TECHNICAL ASSISTANCE RESOURCES

**UGA Cooperative Extension Service**
University of Georgia, Athens, Georgia
*http://extension.uga.edu/*
(800) ASK-UGA1

**UGA Extension Soil Testing Lab**
University of Georgia, Athens, Georgia
*www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7440*
*http://aesl.ces.uga.edu/*
(706) 542-5350

**USDA Alternative Farming Systems Information Center**
*http://afsic.nal.usda.gov*
(301) 504-6559

**EPA Brownfields and Urban Agriculture**
*www.epa.gov/brownfields*
*www.epa.gov/brownfields/urbanag*

**GEPD Brownfields Program**
*www.gaepd.org/brownfields*
(404) 656-2833

**American Community Garden Association**
*info@communitygarden.org*
*www.communitygarden.org*
*(877)*ASK-ACGA

**Community Food Security Coalition**
*www.foodsecurity.org*
*(310) 822-5410*

**Agency for Toxic Substances and Disease Registry**
*www.atsdr.cdc.gov/sites/brownfields/overview.html*
(800) 232-4636

## FUNDING SOURCES

**EPA Brownfields Program**
Brownfields Phase 1 and 2 Assessment Grants, Cleanup Grants, and Green Jobs Grants
*www.epa.gov/brownfields*

**USDA Community Food Grants**
*www.csrees.usda.gov/fo/communityfoodprojects.cfm*

**Georgia Department of Community Affairs**
Community Development Block Grants
*www.dca.state.ga.us/communities/cdbg*

**Community Foundation Grants**

**Foundation Center**
*http://foundationcenter.org/*

**John S. and James L. Knight Foundation**
*www.knightfoundation.org/what-we-fund/*
*(Columbus, Macon, and Milledgeville)*

**Suntrust Bank Foundation**
*www.suntrust.com/Microsites/foundation/funds.htm*

**United Parcel Service Foundation**
*www.community.ups.com/UPS+Foundation*



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Georgia Environmental Protection Division
*www.gaepd.org*

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Agency for Toxic Substances and Disease Registry
*www.atsdr.cdc.gov/sites/brownfields/overview.html*

Department of Agriculture, Alternative Farming Systems Information Center
*http://afsic.nal.usda.gov/*

U.S. Environmental Protection Agency, The Path to Brownfields Assessment, Cleanup, and Sustainable Redevelopment
*www.epa.gov/landrevitalization*

Centers for Disease Control and Prevention, NIOSH Pocket Guide to Chemical Hazards
*www.cdc.gov/niosh/npg*

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*www.census.gov*

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*http://oasis.state.ga.us*

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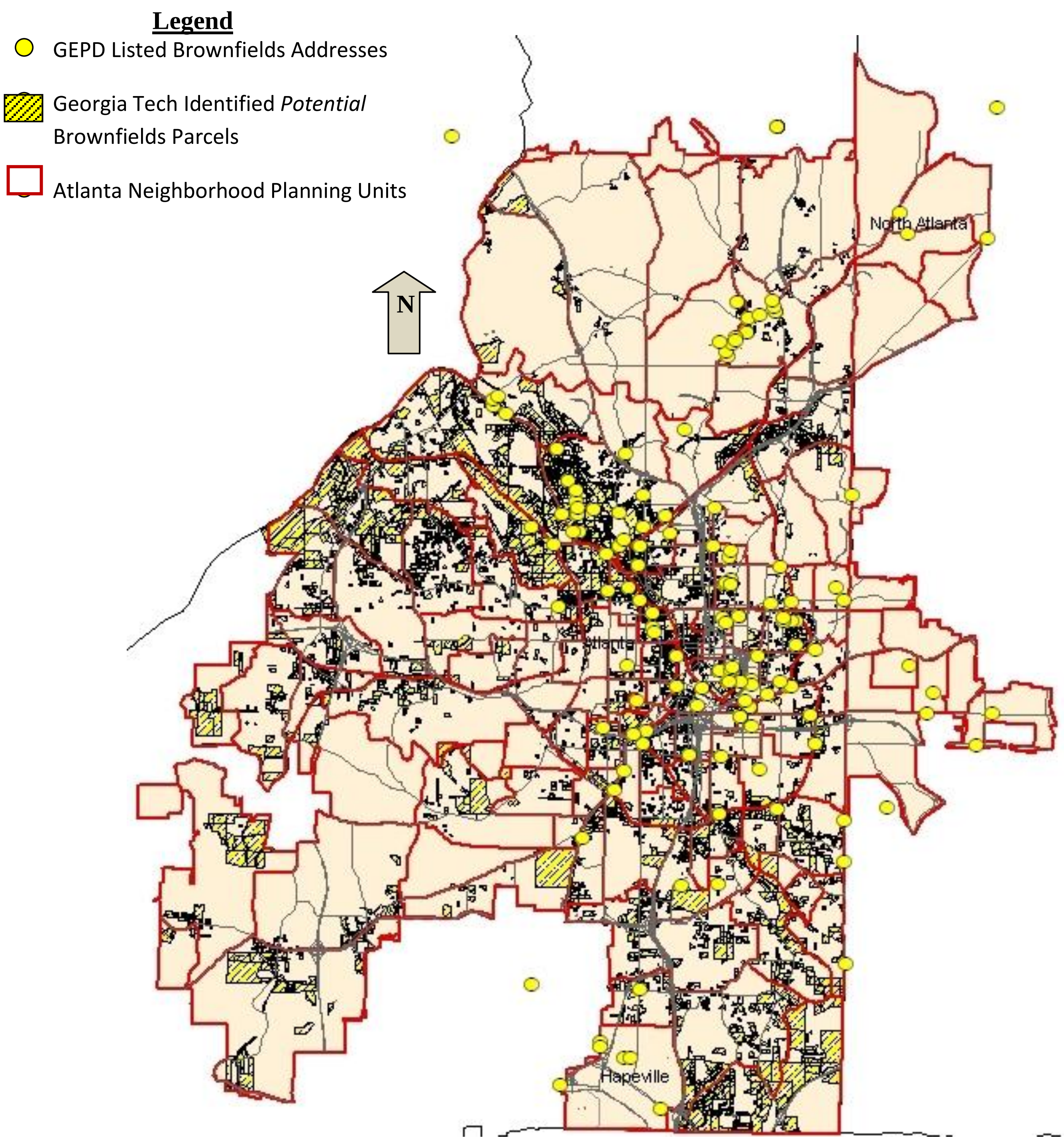
**Appendix 2: Brownfields Sites in the City of Atlanta, Georgia**

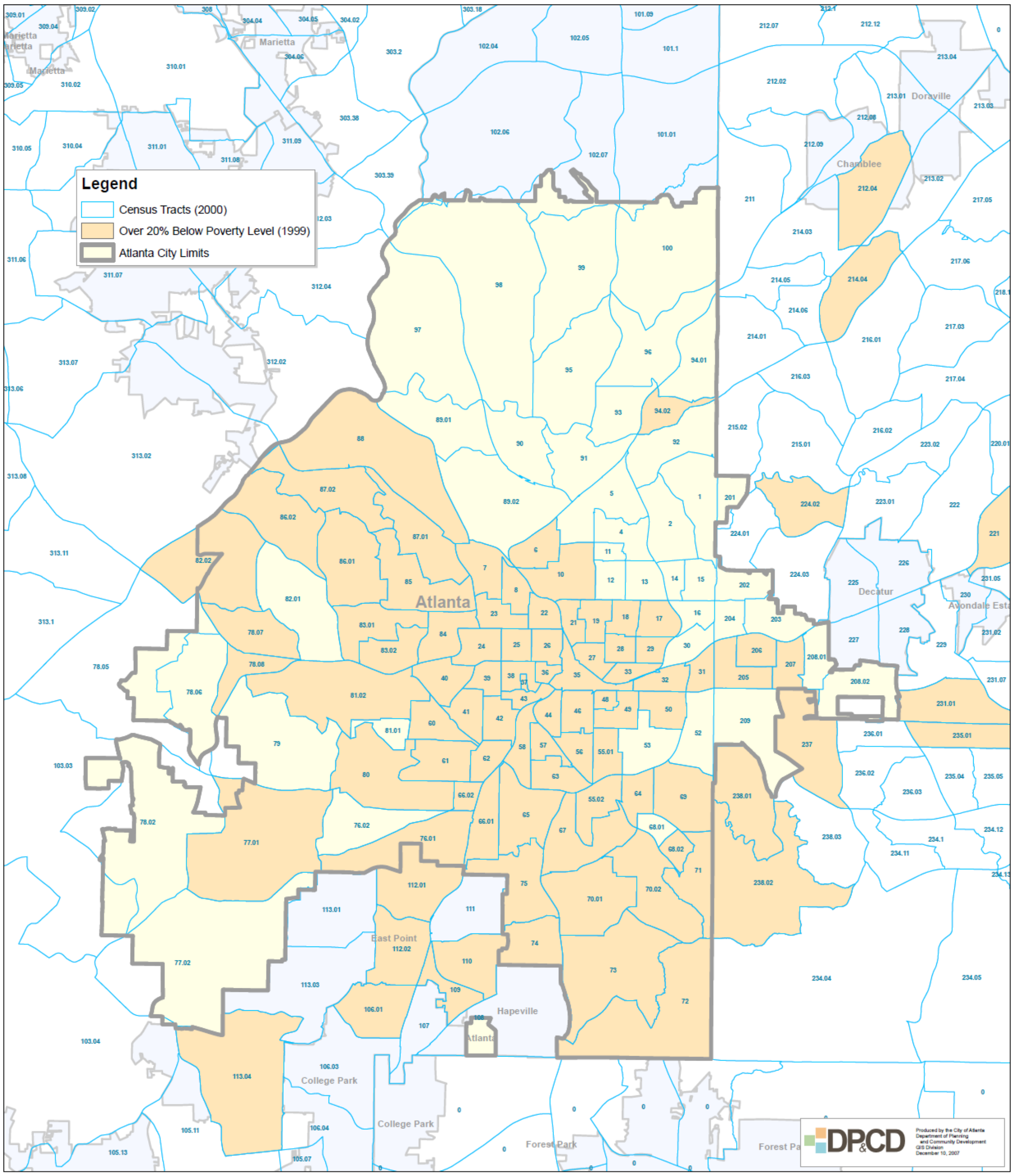



**Map source:** Georgia Department of Public Health, (2012), Atlanta, Georgia
**Address locations source**: GEPD (2010), Atlanta, Georgia
**Potential parcels source**: Georgia Tech GIS (2008), Atlanta, Georgia

## Appendix 3: Census Tracts in Poverty in the City of Atlanta

City of Atlanta

Census Tracts with over 20% of Population Below Poverty Level



**Appendix 4: Site Assessment for the Allene Avenue Community Garden**

The Allene Avenue Community Garden is located in a mixed-use zone of Oakland City neighborhood, southwest Atlanta. The property is a former vehicle charter and maintenance site bordered by Allene Avenue to the west, abandoned rail line and houses from northwest to southeast, and by office buildings to the south. Neighborhood schools include Brown High School, Sylvan Hills High School, Ragsdale School, Capitol View School, and Adair School.

Historically the property has been used for automobile services: a gas station (1945-1955), a truck leasing service (1955-1981), and bus/limo charter and maintenance business (from 1981). The property had office buildings, fuel storage tanks, and garage buildings onsite. Several other industrial or commercial properties are located within 1/8mile of the site, and the nearest residents are adjacent to the east boundary along the railroad track.

Four underground fuel storage tanks (USTs) were located on the property: a 10,000 gallon diesel UST at the south end of the site; 4,000 gallon and 2,000 gallon gasoline tanks, and a 1,000 gallon kerosene tank (onsite locations are shown on the diagram in Figure 1). The three smaller USTs were removed in 1998. Several unlabeled 55gallon storage drums were observed on the property, however all storage tanks and drums have been removed and properly disposed.

Solid waste was found improperly disposed of on the property. Contamination was not detected in the soil on the property above state and federal regulatory levels for residential use.

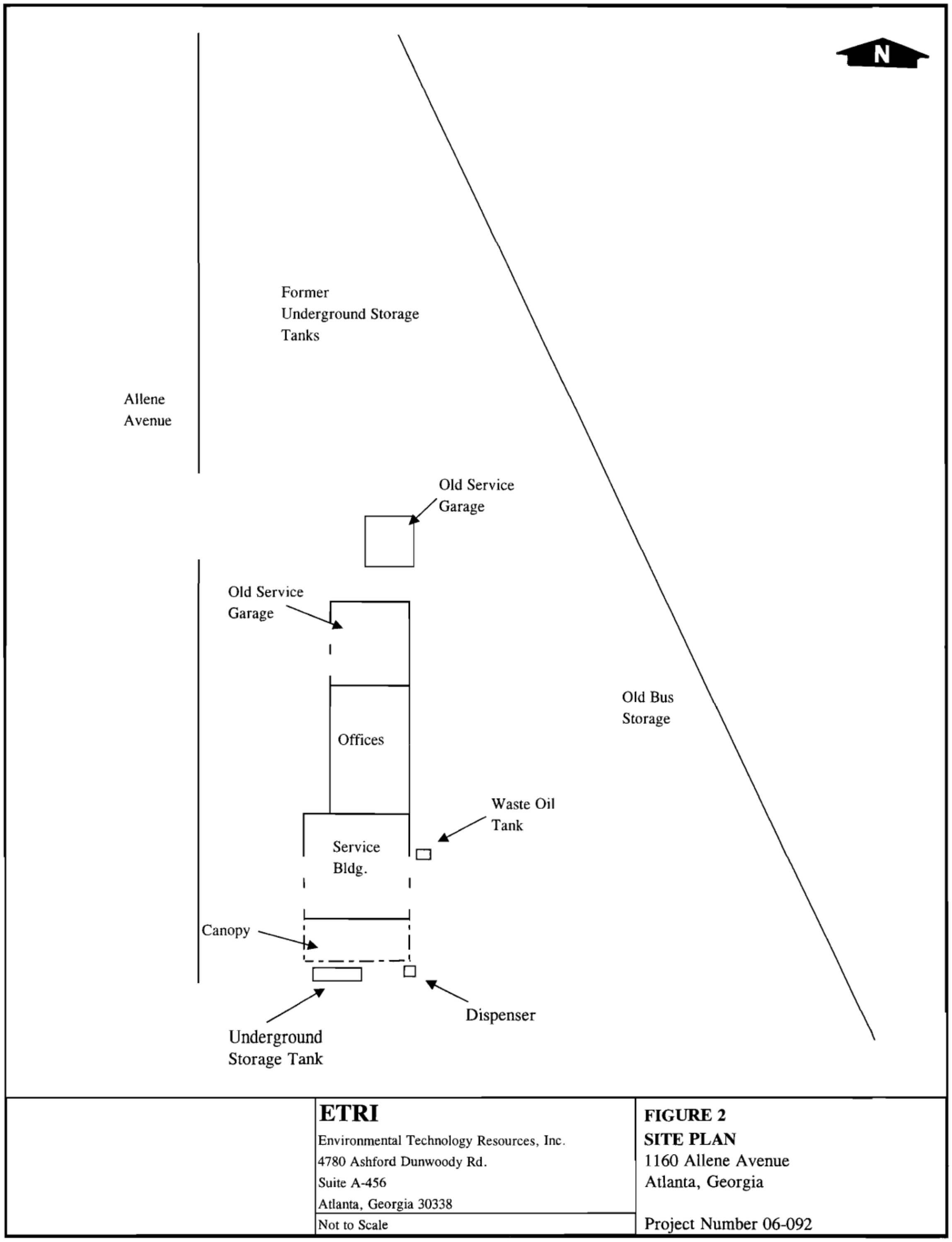
At the Allene Avenue property, soil is mostly clay up to approximately 100 feet deep, and bedrock is made up of fractured rock and granite. Groundwater at the site is from 16 feet to 31 feet deep, and flows to the northeast. The property slopes gently to the south. Other industrial sites within 1/8-mile have contributed to groundwater contamination in the direction of flow onto the property which may impact groundwater underneath the property.

Diesel gasoline and petroleum byproducts were found in the soil below regulatory levels. To protect environmental health and safety, the top three feet of soil on the property has been removed.

Petroleum breakdown products such as benzene were detected in groundwater underneath the property, but below federal drinking water standards set by EPA. Other volatile organic compounds (VOCs) were detected in groundwater from adjacent sites moving the direction of the property more than 15 feet below ground surface. VOCs are industrial chemicals that evaporate easily and break down with sunshine and rain.

Contamination in groundwater onsite or from adjacent sites is too deep to effect roots of vegetables grown onsite. Contamination in onsite soil was not detected above state or federal regulatory levels for residential use. Surface water runoff may contribute to soil contamination over time, and exposure to contaminants in soil may occur through touching or breathing or accidently swallowing chemicals in soil, however exposure is unlikely to result in adverse health effects and plants do not absorb petroleum byproducts products easily.

**Figure 1: Site Diagram for 1160 Allene Avenue Prior to Remediation**



The Allene Avenue property is located in 2010 Census Tract 65, within Atlanta neighborhood planning unit (NPU)-S along the boundary with NPU-V. These NPUs have a population of 14,896 and 14,711 respectively. Adjacent Census Tracts include census tracts 42, 58, 62, 63, 66.01, 67, and 75. The total population of all census tracts surrounding the property is 13,970, however the population of census tract 65 is 3,678. Interstates 75/85 and 20 divide the area to the east. Neighborhood schools include Brown High School, Sylvan Hills High School, Ragsdale School, Capitol View School, and Adair School. Demographics of these census tracts show that this area is primarily African-American (91%), with some residents who are White (7%), mixed (2%), and Hispanic (2%). Approximately 42% are homeowners, with renters ranging from 34-81%.

The Food Desert Map by the USDA and ESRI used population and grocery store information to identify urban areas with limited healthy food options. This map has identified the area around the Allene Avenue Community Garden as a nutritionally underserved population (http://megacity.esri.com/fooddeserts). The Street Smart Walkability Score for the neighborhood is 35 out of 100 (www.walkscore.com) and identifies the area as "car-dependent" (www.walkscore.com/report/1160-allene-avenue-atlanta-ga). Although grocery stores and parks are located approximately a half of a mile from homes in the Oakland City neighborhood, large city blocks and fewer intersections make the area less pedestrian friendly.

Health status in the community is similar to that of the health status our nation with higher rates of diabetes, obesity, and heart disease. Statistically, African-Americans have 40% higher risk of mortality from heart disease, nationally. In Census Tract 65, Fulton County, African-Americans have among the highest years of potential life lost before age 75 than other census tracts in Atlanta.

The Allene Avenue Community Garden will provide a great benefit to thousands of people, offering easier access to nutritious foods, chances to congregate with neighbors, and opportunities for low impact physical activity and communing with nature. Allowing younger children and teens to participate in gardening, education programs, and giving garden tours will also help to encourage them to eat more raw fruits and vegetables.

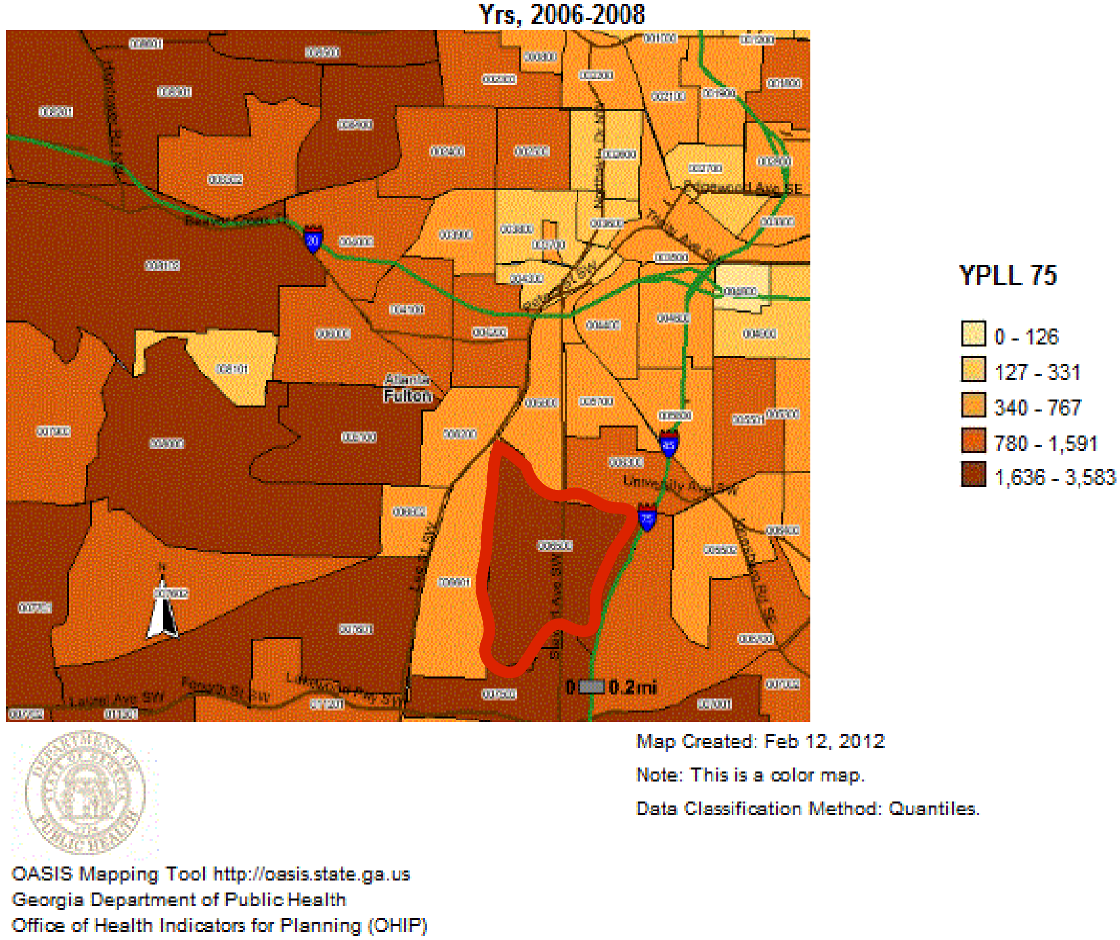
Contaminated soil on the property has been removed and fresh soil added under EPD regulatory oversight. Soil has been cleaned up to state and federal regulatory levels, and is expected to be safe for all ages, however, given the history of the site, special design features could be considered to ensure protection and safety for all ages. Design considerations could include:

- **Mulch**—Mulch to cover bare soil that is not being used for planting,
- **Buffer**—Allow a 5 ft buffer distance between the road and the planted vegetables to reduce chemicals deposited on soil and plants from car exhaust.

- **Include sidewalks in street design**—Sidewalks along the street al.low friends and neighbors to enjoy the garden while providing a buffer from the road.
- **Community Compost—** on-site composting with food donations from neighbors can supplement soil nutrients,
- **Rain Barrels**—rain barrel collection systems can provide affordable, local garden care.

**Appendix 5: Years Potential Life Lost at Age 75 by Census Tract near 1160 Allene Avenue, Atlanta**

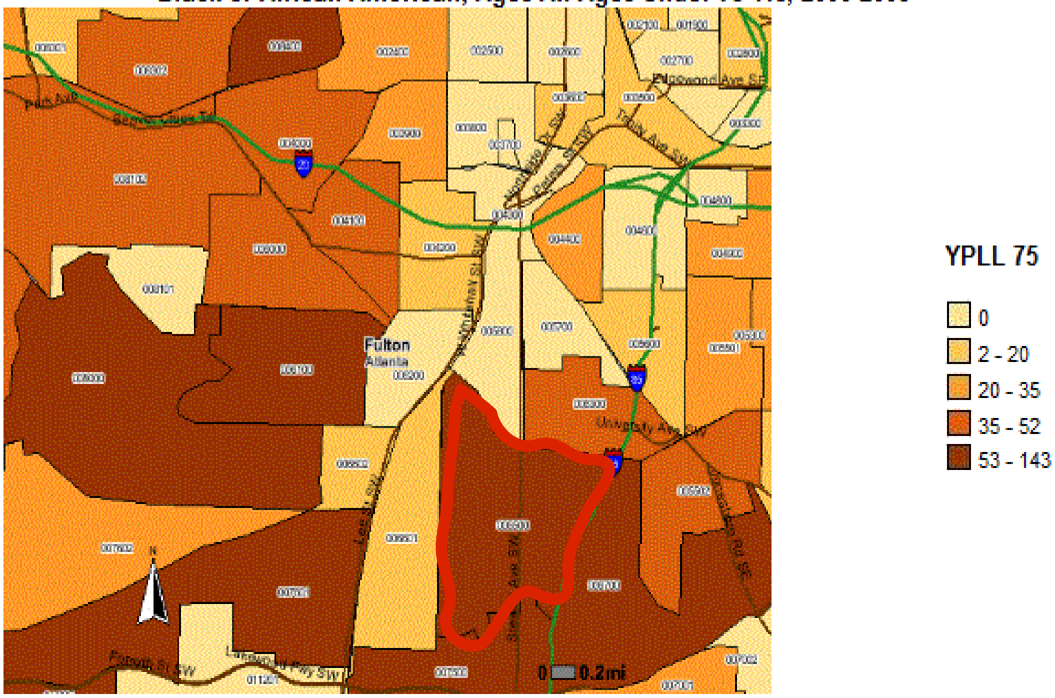
YPLL 75 by Census Tract, Fulton County, Black or African-American, Ages All Ages Under 75 Yrs, 2006-2008



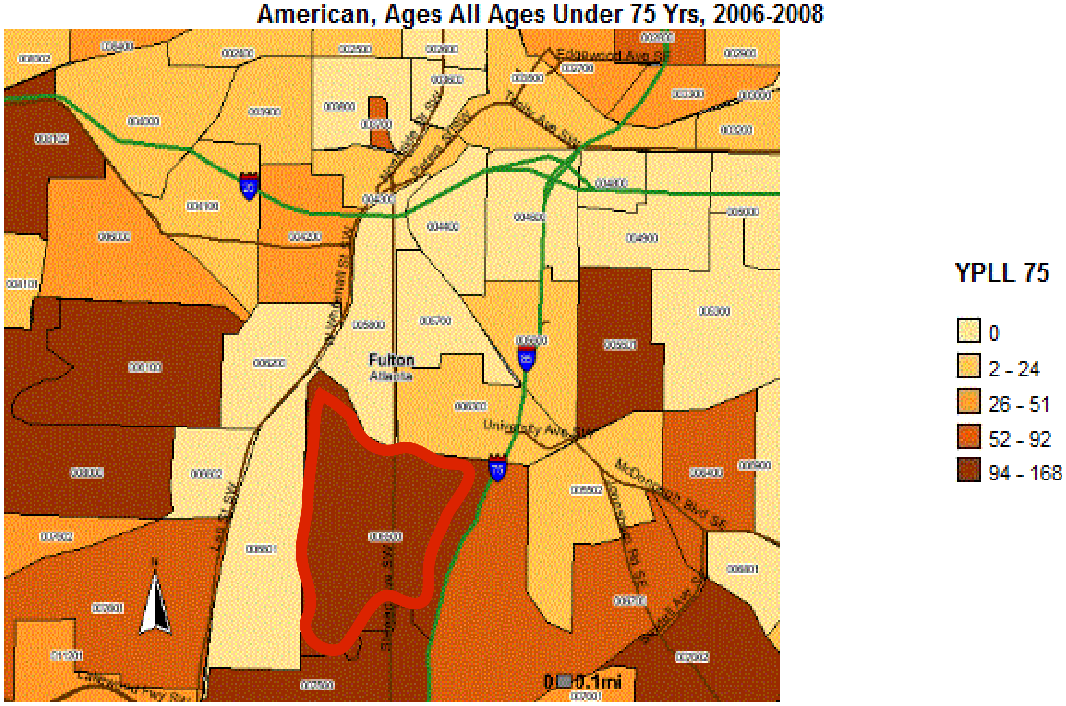

Years Potential Life Lost (YPLL) data was reviewed to identify premature mortality of all causes, diabetes/metabolic diseases, digestive disorders, heart diseases, and stroke prior to age 75 for the population living near the Allene Avenue Community Garden. While YPLL represents a mortality rate, the fact that the mortality is occurring prematurely signifies that it is preventable. All YPLL-75 data reviewed were for diseases known to have an impact from fruit and vegetable consumption. All YPLL-75 data was accessed from the Georgia Department of Public Health Online Analytical Statistical Information System mapping tool.

In Atlanta, census tract 65 has among the highest rates of premature mortality for African-American residents 75 years and under when compared with surrounding census tracts. The southwestern quadrant of Atlanta has considerably higher rates than census tracts throughout the rest of Atlanta.

**YPLL 75, All Endocrine/Nutritional/Metabolic Diseases by Census Tract, Fulton County, Black or African-American, Ages All Ages Under 75 Yrs, 2006-2008**



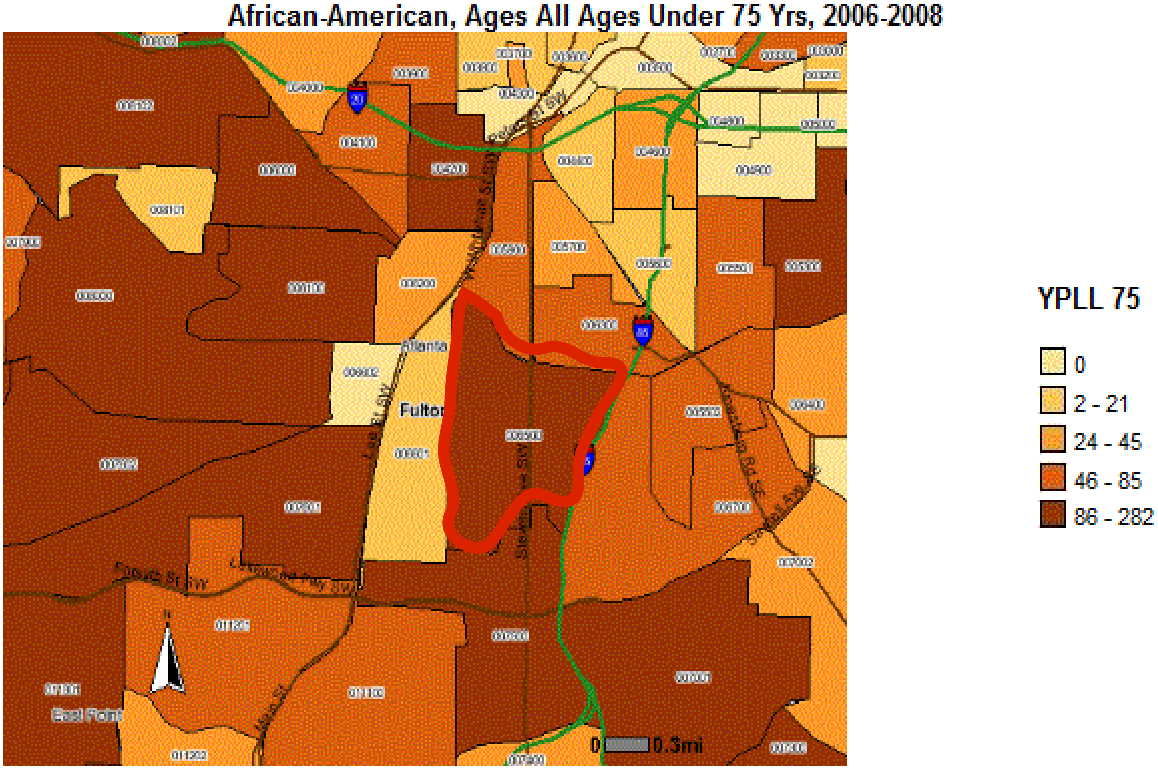

**YPLL 75, All Digestive System Diseases by Census Tract, Fulton County, Black or African-American, Ages All Ages Under 75 Yrs, 2006-2008**



Census tract 65 has significantly higher rates of premature mortality from metabolic disease than surrounding census tracts to the north, although similar to other census tracts to the east and west. The data show that death from metabolic diseases such as diabetes, thyroid disorders, or malnutrition is from 2 to 50 times more likely and more frequently to occur prior to age 75 among residents living in census tracts with high YPLL-75 rates than surrounding census tracts with low YPLL-75 rates. However, proper nutrition and access to fruits and vegetables (if consumed) will improve these rates in current and future generations.

Census tract 65 has slightly higher rates of premature mortality from hypertension than surrounding census tracts to the north, although similar to other census tracts to the east and west. The data show that death from hypertension is only 2 times more likely and more frequently to occur prior to age 75 among residents living in surrounding census tracts. Census tract 75, immediately south and adjacent to tract 65 has the highest rate 2 times more likely than tract 65, but are 3 to 4 times more likely than other tracts.

**YPLL 75, Obstructive Heart Diseases (Heart Attack) by Census Tract, Fulton County, Black or African-American, Ages All Ages Under 75 Yrs, 2006-2008**



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