RECLAIMING A BROWNFIELD SITE BY THE COMBINATION OF

LANDSCAPE DESIGN AND REMEDIATION STRATEGIES

(NEWTOWN NEIGHBORHOOD, GAINESVILLE, GA)

by

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(Under the Direction of Sungkyung Lee)

ABSTRACT

This thesis aims to explore an effective solution to reclaim the brownfield near the Newtown neighborhood in Gainesville, GA, reduce the impact from industrial activities and turn the site into a park that serves the surrounding neighborhoods. Newtown residents have suffered from pollution of soil, noise and dust for decades because the neighborhood is located near an industrial district. The final design proposal is achieved by the combination of remediation technologies and landscape design and the combination of a community park and greenway. It not only helps Newtown residents eliminate health risks, but also revitalizes the site by taking industrial history, the need for greenway connection and surrounding land development into consideration.

INDEX WORDS: Brownfield, Landscape Architecture, Remediation, Newtown, Gainesville, Industrial, Residential

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CHAPTER 1

INTRODUCTION

Introduction

Through various stages of economic boom, activities intended for city development, while resulting in some positive changes, also bring about unfortunate side effects. Frequently, policy-makers set on realizing immediate economic growth may ignore or sacrifice the future. For example, Industrial Revolution promoted economic development largely from the 18th to 19th centuries. But when industry is not the main support of economic growth, the number of waste or contaminated lands increases dramatically because of the changes in land usage. In recent decades, with increasing tragedies of environment pollution, like "The Love Canal Tragedy" and "Minamata disease", the risk posed to human health because of the increase in contaminated lands, as well as the potential to reuse these wastelands, has attracted scientists' attention. With further urban developments, infrastructures and growing numbers of abandoned buildings, the formation of waste or contaminated lands will be ongoing. Thus, an effective solution is needed urgently to reclaim these lands for both environmental and economic benefit.

In a 2010 report by Ashley Fielding entitled "Newtown foresees more green space for a better community" (Gainesville, GA, Figure 1.1), Newtown resident Rose Johnson Mackey expresses her good wishes and love for her community with words that touch me.

Figure 1.1: Newtown's Location within the State of Georgia

"Imagine that you're driving into Newtown, whether you're driving in from the Martin Luther King side or the Athens Street side, and when you drive into the community up to Mill Street, you'll see a sign that says — a beautiful sign that says — 'Newtown: a proud community, a nice place to live.'"

For Newtown residents, calling home "a nice place to live" is still a dream of the imagination. As a result of poor city planning and land use change, they live in neighborhoods next to heavy industrial sites without any buffer and have complained about noise and air pollution for years (Fielding 2010). They also face the risk of contaminates in the ground from the surrounding industrial activities. Fortunately, the land next to Newtown, which currently belongs to Blaze Recycling & Metals, is planned to be turned into a green space in the Gainesville Future Development Map (Figure 1.2) and has the potential to be a buffer or a barrier for Newtown residents. For these reasons Newtown serves as the perfect research site for this thesis, and it is my hope that its conclusions will provide an effective solution to increase Newtown residents' quality of life.

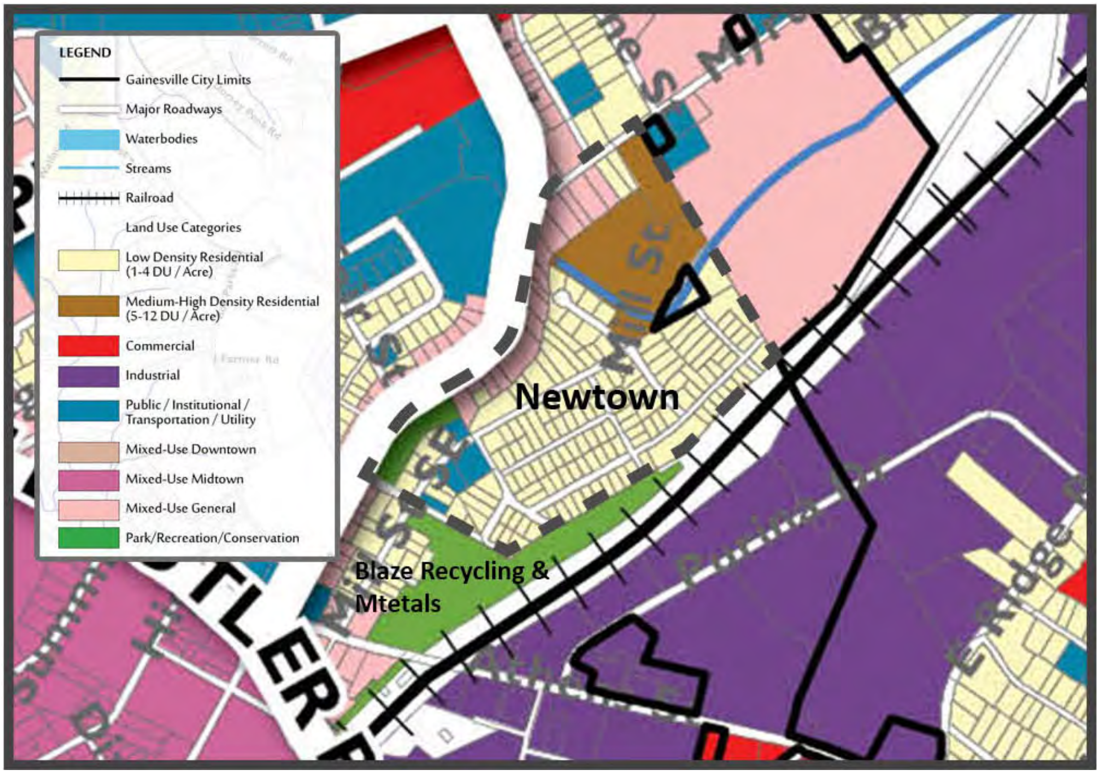


Figure 1.2: Future Development Map around Newtown
(The Official Site of Gainesville, Georgia 2012)

<u>The Problem</u>

1. Introduction of Newtown

Newtown is a community with over 150 homes and apartments in Gainesville, GA (Land Use Clinic 2008). Gainesville was hit by a tornado on April 6, 1936 that caused a fatal disaster, in which more than 200 people were killed and nearly 1600 people were injured (Land Use Clinic 2008). New buildings, including Newtown, were constructed for the purpose of housing displaced families, as part of the tornado recovery program (Land Use Clinic 2008). However, as a result of racial segregation, Newtown, which was called "New Town," was designated for the displaced black families and was separated from the white population (Land Use Clinic 2008). Newtown's first homes were built on the former landfill just south of downtown Gainesville in 1937 (Land Use Clinic 2008).

2. The problem

Since the 1950s many factories have set up shop in the community, even next to Newtown homes, in order to take advantage of railroad access. These factories include both heavy and light industries, such as Purina Mills for animal feed, Guiliford Mills for paper products and Pine Wood Products Inc (Figure 1.3). Even though this industrial

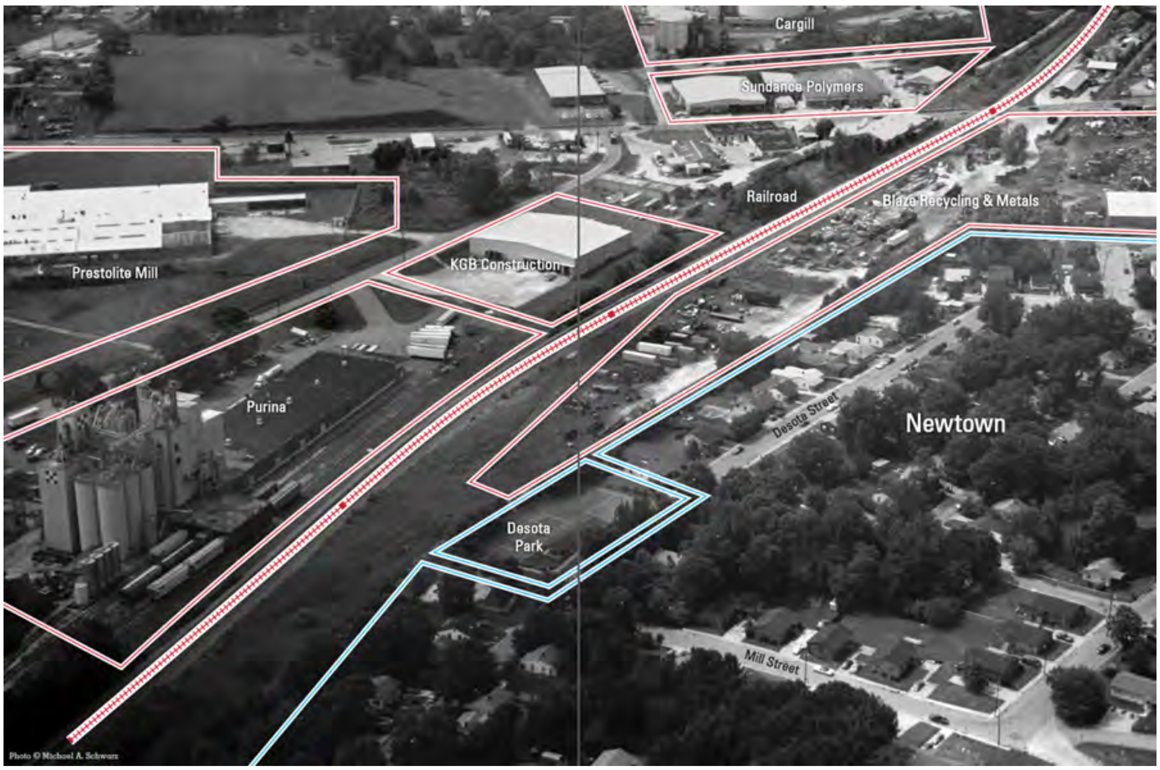


Figure 1.3: An Aerial View of Newtown and Surrounding Factories
(Land Use Clinic 2008)

growth, especially agribusiness, became a primary economic support of the city (Urban Collage Inc. 2011), it brought negative effects such as soil contamination, air pollution and noise to the people living there. The Norfolk Southern/CSX railroad, which is still active today, borders Newtown and is the major source of noise pollution for the community (Land Use Clinic 2008). Though some of the factory buildings have changed hands, many of the above industries, like Purina Mills and Pine Wood Products Inc., are still there. According to Land Use Clinic's report in 2008, both the noise level and dust particles in the air near these existing factories exceed generally accepted standards, thus adversely impacting residents' quality of life and health (Land Use Clinic 2008).

The Newtown Florist Club, which was formed by women in the 1950's, has fought for environmental justice for more than 20 years. Even though the club members' initial duty is caring for the sick and buying flowers for community funerals, they often act as leaders of civil rights and community improvement (Spears 1998). In 1990, the club found that one kind of cancer and lupus was the major cause of local deaths. Since then, many investigations have been done to try to prove that pollutions from the aforementioned industries contribute to this cancer (Land Use Clinic 2008). Desiring to protect Newtown residents, the club asked disease researchers of several institutions, such as the Rollins School of Public Health of Emory University and the University of Georgia, to conduct studies and issue advice, like proposed changes to ordinances. However, their advice has had little practical effect, for when I visited the Newtown Florist Club, they told me residents are still suffering from noise and air pollution.

Even though in the future a factory may be removed, the abandoned land cannot be utilized directly if there is risk of contamination. For example, soils near metal recycling factories tend to be contaminated with heavy metals such as chromium (Cr), nickel (Ni), copper (Cu), zinc (Zn), cadmium (Cd) and lead (Pb) (Yang et al. 2013), which may pose a substantial health risk to the population (Raun et al. 2013). Therefore, before adapting the land of Blaze Recycling & Metals as a buffer to mitigate the effects of noise and air pollution, the soil should be tested to ensure it will not negatively impact the environment.

Because the site is surrounded by a residential zone, an industrial zone and will be possibly connected to a greenway, an interdisciplinary landscape architecture approach, which considers the city, its people and its nature (Liu 2013), is preferable to that of an engineering approach for discovering ideal solutions for Newtown.

Research Question

How can a brownfield site adjacent to Newtown be reclaimed by the combination of remediation technologies and landscape design as an environmentally and socially beneficial landscape? In this question, "environmentally" refers to ecological balance and aesthetic promotion, while "socially" refers to economic development and people's living standards.

Based on the current situation, this thesis aims to relieve the problems of Newtown by reclaiming and designing the site that currently belongs to Blaze Recycling & Metals with landscape architecture approaches. To prepare the site for re-use, this thesis presents solutions to the problem of contaminated soil using some remediation technologies, such as chemical stabilizers and phytoremediation. It will also address concerns of air and noise pollution in its design process.

Design Process

This is a design thesis that solves problems and draws conclusions mainly through design. It also takes remediation into account.

The author created the design process diagram (Figure 1.4) based on the General Approach Process for Brownfield Remediation by Reddy and Hollander. After selecting

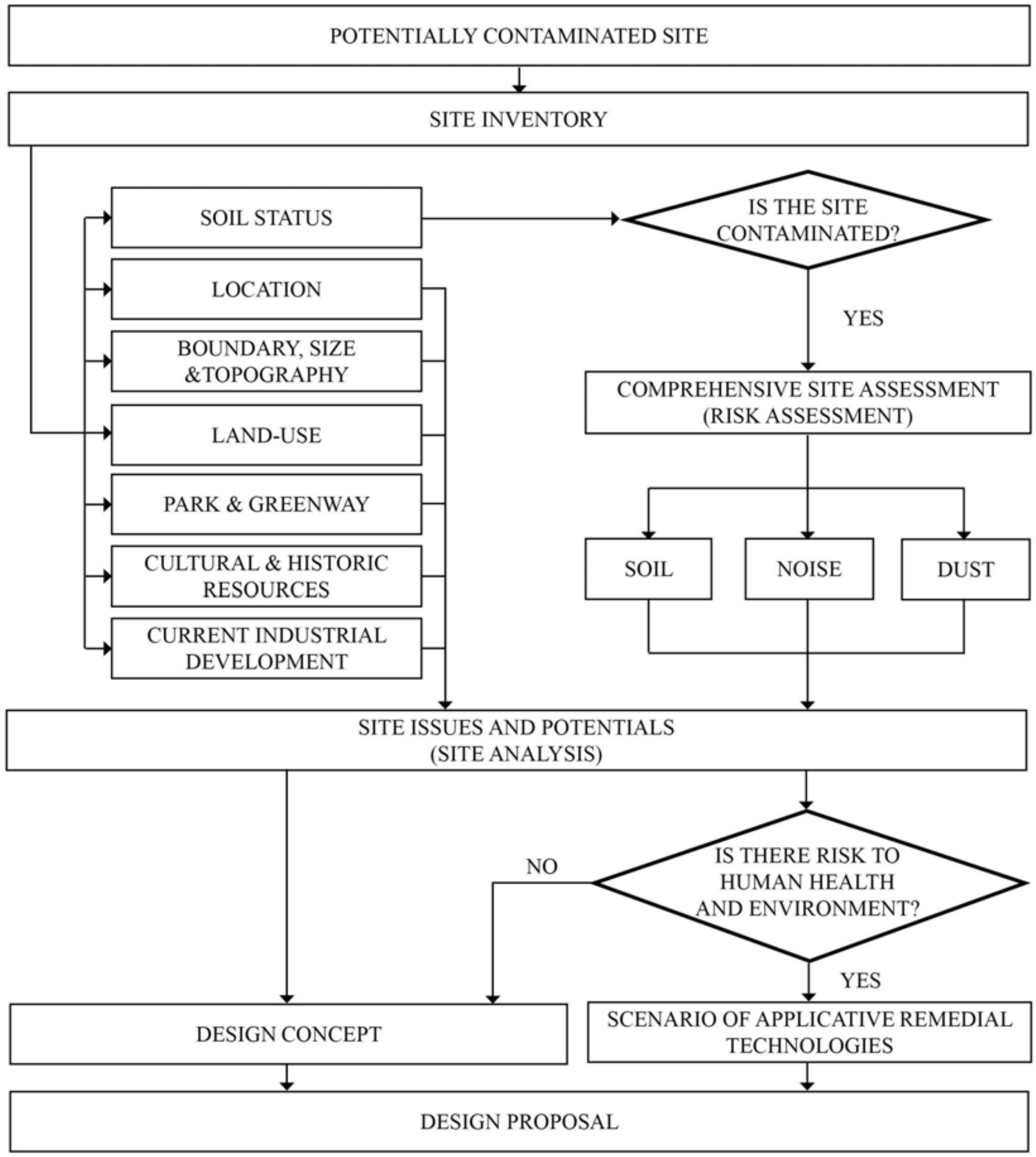


Figure 1.4: Design Process (Author 2015; Reddy 1999; Hollander 2010)

the site of Blaze Metal & Recycling and considering its potential contamination, the site inventory includes the information of soil status, site location, boundary, size, topography, land-use and surrounding resources. In order to know about contamination level, the soil status will be assessed on actual test and data from other reports, like Newtown Health Impacts Report. If the site is contaminated, a risk assessment is required to evaluate whether the pollution of soil, noise and dust will become issues on site. Site analysis, which is based on site inventory, is a vital step to determine site issues and potentials that contribute to the formation of a design concept. Whether to use remedial technologies depends on whether contaminants bring risks to human health and environment. Only when the answer is "Yes" should the scenario of applicative remedial technologies be considered. After the design concept is formed and remedial technologies are selected, a detailed design plan is presented at the end of design proposal.

Purpose and Significance

The purpose of this thesis is to minimize the impact of industrial pollution on Newtown residents and reclaim a brownfield by design-oriented landscape approaches. In so doing, it will consider the ability of landscape architecture based solutions to provide social and economic benefits, such as residents' quality of life and future surrounding development.

It is my hope that this thesis can increase awareness about the need to solve problems in underserved neighborhoods near industrial sites and other post-industrial brownfields in urban areas while also providing a potential solution for such cases. Though it must be said that each site has its own characteristics and conditions, and the approaches in this thesis cannot be directly applied on sites, I believe and hope that the principles proposed in it can be widely applied.

Thesis Structure

Chapter 2 starts with a comprehensive review of the literature on the brownfield, and then focuses on how contaminated soil and abandoned sites can be reclaimed. It describes the general process followed in brownfield projects; specific approaches and techniques commonly used to clean soils, such as excavation and incineration; and other means to help remove contaminants, such as phytoremediation, which is the planting of specific plants to absorb contaminants.

Chapter 3 analyzes the case of The Steel Yard in Providence, RI that may provide applicable methods for the Newtown site because of its similar history of soil contamination and its positive effect on surrounding neighborhoods after its reclamation. The viability and effectiveness of the methods used are addressed and evaluated by analyzing design considerations and current status of site utilization. The insights learned from the case study assist the development of the design in Chapter 5.

Chapter 4 provides the site inventory for the research site, including location, site boundary, size, topography, land-use, parks, greenways and cultural and historic resources. It especially explores the current development of surrounding industries and soil status. Then, based on that inventory, the risk of pollution on human health is assessed and site potentials are concluded.

Chapter 5 begins with design principles based on the findings from the preceding chapters, and is followed by a description of the design concept. The chapter culminates in a master plan and other elements, such as site details and sections showing soil remediation.

Chapter 6 reviews the entire project and proposes further required research. It also concludes this thesis' contribution to the site as well as landscape architecture.

CHAPTER 2

BROWNFIELD, GENERAL STRATEGIES AND TECHNOLOGIES

Discourse for Brownfields

There seems to be confusion as to how to classify the increasing number of abandoned American waste sites. Scientists named such sites based on their understanding from different perspectives. Making clear the definition of each term will help to understand what the site near Newtown exactly is and find more efficient ways to solve the problems. Even though individuals or groups from different fields give a variety of appellations to such sites, they all put forward ideas about waste sites' further development.

The most well known word that is used to describe such a site is "brownfield". At a U.S. congressional field hearing hosted by the Northeast Midwest Congressional Coalition in 1992, this term was first used to express the challenges and opportunities from such sites (Hula 2012). The U.S. Environmental Protection Agency defines a "brownfield" as "real property", "the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" (U.S. EPA 2012). This term generally suggests the land has potential for economic redevelopment (Kirkwood 2001).

Niall Kirkwood, a Professor of Landscape Architecture and Technology at the Harvard Graduate School of Design, called brownfields "manufactured sites" in his book, "Manufactured Sites". The meanings of this term refer to three aspects: sites, technologies and approaches. The first definition emphasized the sites that were formerly under industrial and manufacturing processes (Kirkwood 2001). Additionally, the second definition points out the processes of using techniques to clean up the sites and reshaping the materials of the site (Kirkwood 2001). The third one signifies an interdisciplinary approach to regenerating the contaminated sites that were used for industrial activities (Kirkwood 2001).

"Drosscape" is a term created by Alan Berger, professor of urban design at MIT, to focus on "the productive integration and reuse of waste landscapes throughout an urban world" (Berger 2006). It is used in design pedagogy relevant to waste landscapes since it not only is a simply description of waste landscapes but also reflects Berger's idea about the role of designers, who should reinvest vast waste lands with new programs or new sets of values (Berger 2006). "Drosscape" can also be used as a verb to describe this design process.

All these terms express the same features, such as being no longer used, contaminated and in an urban area, which also belong to the site next to Newtown.

The remainder of this thesis will use "Brownfield" to refer to such sites because of its widespread use and accurate description of the features of the site next to Newtown.

1. The Causes of Brownfield Formation

The cause of brownfield formation explains the reason that the large numbers of such sites widely exist.

Nowadays, the number of brownfields may be startling—there are nearly half a million brownfields across the U.S. and nearly the same amount in Asia and Europe

(Hollander 2010). No one knows the exact data since brownfields continuously arise and change.

Figure 2.1: The Steel Yard, Providence, Rhode Island (KMDG 2011)

As seen above, The Steel Yard in Providence, Rhode Island, is a brownfield redevelopment project. It was built on the site that belonged to Providence Steel and Iron Company, which was established in 1882 and was forced to close like other steel manufactures in 2001 because of decreasing demand for steel and iron (Wener 2013). It is no surprise that soils were contaminated and the steel building was left. Luckily, the site has been cleaned up and is now used as an industrial arts educational center (Hollander 2010).

However, The Steel Yard is just one of those few brownfields that has a chance to be reclaimed. Thousands of untreated brownfields are still distributed over post-industrial zones, which is formed after the Industrial Revolution in the U.S. in the nineteenth and twentieth century (Hollander 2010). As the service industry became the mainstay of the U.S. economy, many factories were closed and their sites were abandoned. This is the main cause of brownfields' formation, but may not apply to all waste landscapes.

Alan Berger has more general and abstract understanding of such landscapes' formation. "Dross will always accompany growth" (Berger 2006). Just as he said, it is hard to avoid the emergence of dross or waste. According to the relationships between waste landscape and urbanization, he divides waste landscapes into six types: waste landscapes of dwelling, of transition, of infrastructure, of obsolescence, of exchange and of contamination (Berger 2006). We can easily tell the various factors that lead to waste landscapes' formation from this category. Industrial revolution is just one process of urban development. Brownfields mentioned above are more of waste landscapes of contamination.

2. The impact of Contaminated Urban Soil

The soil in brownfield is one type of urban soil. Human's better understanding of urban soil will help reduce the impact of contaminated urban soil by preventing contaminants from polluting soils. With growing public concern about environmental health risks, and more respect to brownfield redevelopments, urban soils has been the study of greater scientific research in the last twenty years (Hooker 2005). Unlike agricultural and forest soils, urban soils, a neglected part of soil study for decades, have no definite criterion, classification and research approaches, which results in various understanding on the scope of urban soils (De Kimpe 2000). Based on Bullock and

Gregory's (1991) definition, soils in parks and gardens are excluded from urban soils. But in this thesis, the author will refer to urban soils as defined by Craul (1992): "A soil material having a non-agricultural, manmade surface layer more than 50 cm thick that has been produced by mixing, filling, or by contamination of land surfaces in urban and suburban areas."

The structure of urban soil is quite different from that of natural soil, reflecting the accumulation processes of human activities and environmental changes (De kimpe 2000). Each layer of urban soil is not parallel to the ground surface (Figure 2.2). Heterogeneity is an accurate word to describe the characteristic of urban soil, with rubble, gravel, debris and other wastes mixed unevenly throughout it (De Kimpe 2000). These compositions of urban soil came from nearby human activities and mixed with each other year by year (De Kimpe 2000).

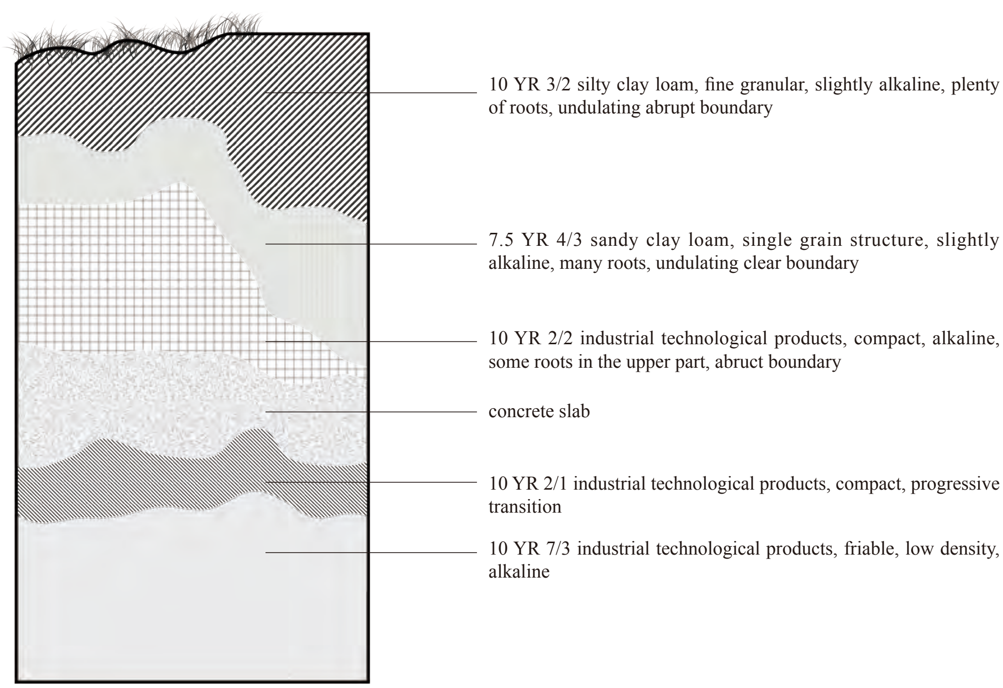


Figure 2.2: Schematic Description of An Industrial Site profile (De kimpe 2000)

It is much needed to set criteria and classification of urban soil's suitability and pollution level to help developers improve and make use of soil. One of the serious problems that urban land developers face is the heavy metal contamination of wasteland soil. The most common pollutants are lead, cadmium, mercury and polycyclic aromatic hydrocarbons (PAHs) (Hooker 2005). Humans can be exposed to excessive amounts of these poisons by direct contact, water and foods. According to the U.S. Centers for Disease Control and Prevention (CDC), lead poisoning is considered the most common and serious environmental disease in young children and children contact lead easily from soil exposure (Ryan 2004). Thus it can be seen how dangerous living near contaminated grounds is, especially for children.

3. The Benefit of reclaiming brownfields

Consequently, the first benefit of reclaiming brownfields is to reduce contamination and minimize threats to public health. At the global and social level, reclaiming brownfields will prevent the exploitation of virgin greenfields and encourage balanced land uses so that consumption of natural resources will be reduced (Hollander 2010). Making use of brownfield sites in existing urban areas can minimize total costs compared to building new facilities in suburban areas and reduce vehicle mileage from about 32 to 57 percent, by which pollution emissions will also reduce (U.S. EPA 2014).

The reclamation of brownfields may help reduce crime, beautify the environment and improve property values in neighborhoods (Bartsch and Collaton 1997). It should be pointed out that brownfield redevelopment brings benefits not only to residents, but also to the owners of properties (Hollander 2010). Some owners may hide the brownfields to avoid penalties and other difficulties from legal and environmental responsibilities. But many cases have shown that reclaiming brownfields will improve, not harm, the interests of those owners (Greenberg 2003; U.S. EPA 2014). For example, the High Line was a railway for metro that was disused for decades. But when it was reclaimed and became a hot spot of New York City, tourist-clogged paths and soaring land prices in surrounding areas show the benefits of reclaiming brownfields (Moss 2012).

Strategies for Designing with Brownfields

The best strategy to eliminate risks from brownfield and reclaim it is landscape architecture. Landscape architecture is a profession that shapes outdoor space to define people's activities by designing and shows respect to nature and culture by including natural and cultural elements (Foster 2010). Generally, we value a system if it is robust and open (Corner 2004). The resilience, self-organization, and hierarchy of a system ensure how well it will work (Meadows 2009). Similarly, a good strategy is a highly organized but also flexible plan, which is able to adapt itself to changing circumstances (Corner 2004). In a similar way, a "fitness landscape" means that its "specific forms of organization, arrangements, configurations and relational structures" can adapt to the complicated environment (Corner 2004). Thus, a "fitness landscape" that is both physically fit and synthetically symbiotic (Corner 2004), is one of the best choices to dispose and adapt to certain conditions, such as brownfields.

Landscape architecture's "Interdisciplinary" nature makes it adaptable to certain conditions. It reflects landscape strategy's multi-dimensional and process-based structure, for which reasons landscape strategy is considered to be most powerful and effective

(Erdem and Yildirim 2014). Designers usually come up first with a traditional and classical method, such as removing everything on site and putting forms first. However, just like Peter Latz said, “The scale of these (environmental) problems has become so large and so complex that I can't apply approaches like that any more” (Weilacher 2008). As designers find that traditional method cannot solve problems effectively, inter-discipline is more valued now.

Alan Berger (2006) also mentioned inter-discipline, when he talked about strategies for drosscape: “None of the work will require a single disciplinary design approach nor will the sites operate under univalent environmental conditions” (Berger 2006). When dealing with a contaminated site, removing contaminants is just the first step of redevelopment. Social, cultural and environmental benefits (Berger 2006) should also be taken into consideration. To handle a project, designers, whose roles are more of collaborator and negotiator now, not only expert (Berger 2006), may work with ecologists, engineers, botanists, sociologists, etc. Therefore, it is beneficial to have these natural and social scientists sharing their understandings (Lach 2014).

It is not recommended to start a brownfield project without fully understanding what is planned to be built on the site (Hollander 2010). Before starting the project, these factors should be made clear: involved persons, a community outreach plan, relevant resources and support services (Hollander 2010). Learning experience from other people and other projects is helpful to get access to new technologies and serviceable advice (Hollander 2010). Only by finishing these steps can we step forward to the next stage – brownfield remediation.

Approaches and Technologies for Brownfield Remediation

Even though each brownfield site is unique, a systematic approach is needed to best determine which remediation technique or strategy to apply for a specific brownfield, in order to promote projects and avoid unexpected results and waste of time and money (Reddy 1999). According to Reddy (1999) and Hollander's (2010) summary, Figure 2.3 diagrams this systematic approach. First, when a site with potential contaminants is

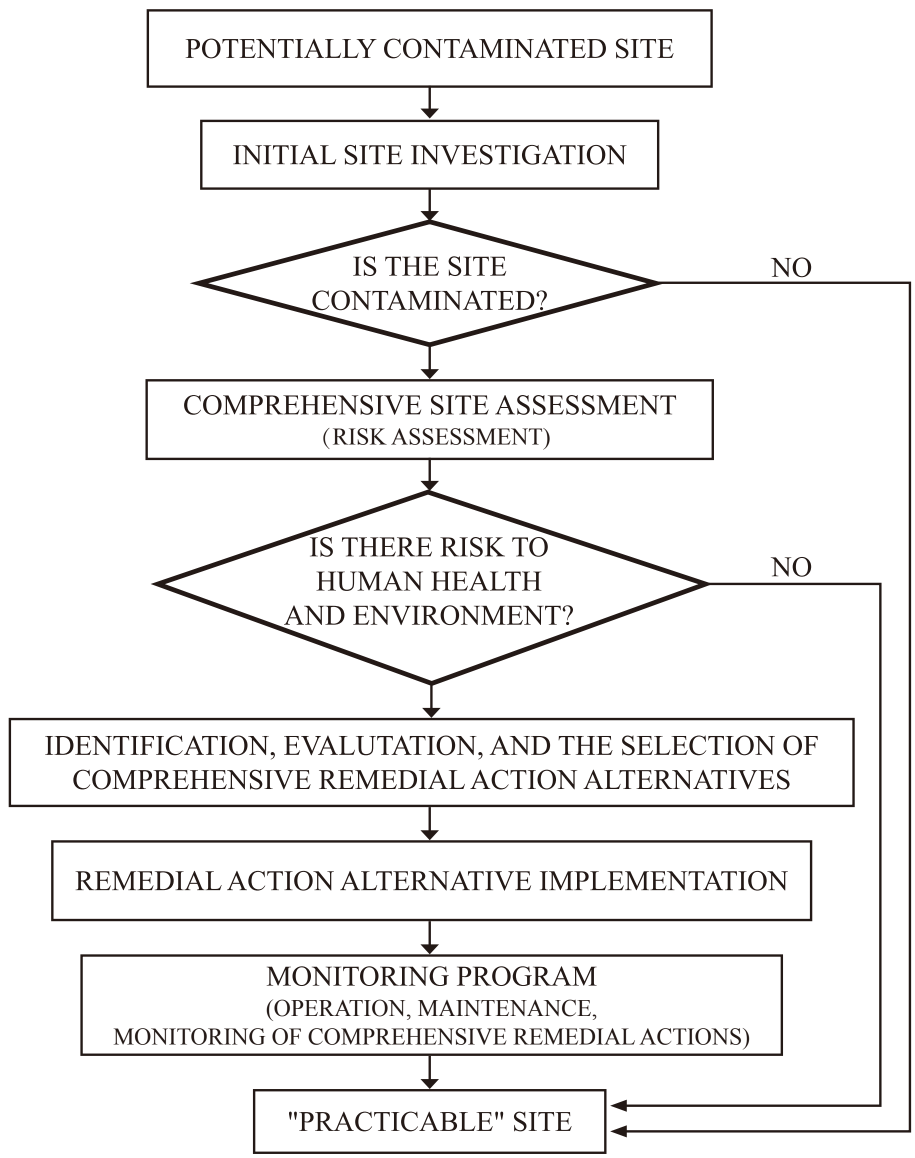


Figure 2.3: General Approach Process for Brownfield Remediation (Reddy 1999; Hollander 2010)

selected and considered for reclamation, a preliminary assessment gathers the characteristics of the site, including location, background information and – most importantly – its contamination profile (Reddy 1999). A detailed plan about how to have samples tested will help save time and estimate a budget during this step. Second, a risk assessment, including identification of hazards, evaluation of pollution level and selection of remedial action alternatives, plays an important role in determining whether remedial measures should be taken. Probable hazards are potassium, calcium, magnesium, sodium, lead and mercury in a soil sample, but not all the elements are harmful to human health and environment until there are certain high amounts of them. Generally, lead and mercury should be of greatest concern for their high risk. Then, the harmfulness of these elements is evaluated in the "evaluation" step by comparing test results with the criterion and regulatory limits for heavy metals and hazards in soil. If those elements in soil won't damage human health and environment, the "remediation" step can be skipped. Otherwise, remedial strategies need to be selected and compared based on their efficiency, compatibility, flexibility, cost and regulatory from U.S. EPA (Reddy 1999). Only after hazard cleanup can the site be deemed usable for new land use.

So what kind of remedial action can be applied on site? Summarily, there are five general approaches to remediation, which are: full cleanup, partial (off-site) cleanup, partial (in place) cleanup, full concealment, and nonintrusive cleanup (Hollander 2010).

The conditions of the brownfield, including the level, the size of the site, location, extent of contamination, etc., decide which approach should be selected (Hollander 2010). The advantages and disadvantages of each approach are represented in the following table (Table 1).

Table 1: Five General Remediation Approaches (Hollander 2010)

Approaches	Features	Advantages	Disadvantages	Notes
Full Cleanup	Complete soil excavation	Completely clear the site	High costs	
Partial Cleanup- Off-site	Remove contaminated soil to another site to remediate in sequential batches	·Economies of scale ·A specialized labor force ·The efficient use of equipment	·Extra costs for transportation ·Soil removals and deliveries need precise timing	The soil can be reused after being cleaned off site.
Partial Cleanup- In-place	Use technologies and remediation equipment on site	No spread of further contamination	·Limited working space ·Restrictions to other engineering activities on site	Technologies: soil vapor extraction, soil flushing, bioremediation, etc.
Full Concealment	Replace the soil at top and seal the contamination in place in the ground	Low cost	·The continued presence of the contamination ·Safety	
Nonintrusive Cleanup	Use natural or friendly remedial technologies	More benign and sustainable	Many of these technologies are still in the emerging technology phase	

In the past, full cleanup, commonly referred to as the “dig and dump” approach, was frequently used (Batty and Anslow 2008). In this approach, contaminated soil is removed and hauled to a hazardous waste landfill or buried in place with an asphalt or concrete cap (Kirkwood 2001). However, this approach doesn’t solve the problem fundamentally. According to the legislation changes, the approach has become gradually unviable in Europe (Batty and Anslow 2008). Nowadays, trends are shifting towards partial (in place) cleanup, which may be combined with other approaches.

For each approach, a wide range of remedial technologies are available for cleaning up pollutants, such as air sparging, bioremediation, bioventing, incineration, phytoremediation, soil washing, and thermal desorption (Hollander et al. 2010). According to scientific rationale, remedial technologies can be divided into three categories:

- Established treatment technologies

This kind of technology has many precedents, so it is easy to find similar cases and estimate cost and performance. These technologies include bioventing, encapsulation, excavation, incineration, soil vapor extraction and stabilization (Hollander et al. 2010).

- Innovative alternative-treatment technologies

Relative to established treatment technologies, innovative alternative-treatment technologies are limited in application because data about cost and performance is not enough. ioremediation, natural attenuation, soil washing, and thermal desorption, have less cost and performance data so they are limited in application (Hollander et al. 2010).

- Emerging alternative-treatment technologies

These technologies, like Landfarming and Phytoremediation, are still largely confined to the laboratory so there are not enough practical examples to show its effectiveness, which still has to be established (Hollander et al. 2010).

How to select one or more technologies depends on the type of contamination, effectiveness, cost, the ability to be implemented and so on. For a visual comparison, a table assessing each technology is shown in Table 2.

In the last three decades, there have been some noticeable shifts in the selection of alternative technologies. The United States Environmental Protection Agency (U.S. EPA) records from 1985 to 1995 show that encapsulation, stabilization and incineration were the most used technologies, but the frequency of use decreased. In contrast, the use of bioremediation and thermal desorption increased in those ten years (Sellers 1999). Based on the Proceedings of the International Conference of Soil Remediation in 2000, 2004 and 2008, remediation with physical and chemical technologies tends to be replaced by phytoremediation, biological technologies and other natural technologies. More and more soil treatments with facilities off site are switching to treatments with mobile facilities on site (Luo 2009). Also, there is a trend of combining two remediation technologies (Luo 2009). For example, it has been proven in laboratory that the combination of soil flushing and electrokinectics is a promising method, with soil flushing's ability of removing soluble and easily extractable radionuclides and electrokinetics's ability of removing residual radionuclides (Velzen 2015). Other combinations, like the combination of phytoremediation and stabilization, are also worth consideration.

Table 2: Comparative Assessment of Remedial Technologies (Reddy 1999; Hollander 2010; U.S. EPA 2000)

Approaches	Categories	Technology	Applicability	Advantages	Limitations	Cost Range
Full Cleanup	Established treatment technologies	Excavation	All contaminants	Required by some ex-situ treatment, easy	Noisy, risk of safety	$270-$460/ton
Partial Cleanup (off site)	Established treatment technologies	Incineration	Organic compounds (chlorinated hydrocarbons, PCBs, and dioxins)	Useful for various contaminants	High cost	$500-$1500/ton
		Stabilization /Solidification	Heavy metals; depends on different stabilizers	Immobilizes contaminants; Neutralizes soil	Possible leaking out of volatile or other contaminants	$100/ton
	Innovative alternative-treatment technologies	Thermal Desorption	VOCs (Volatile Organic Compounds)	Low cost	Not suitable for soil with high organic content; Require air emissions control probably	$100-$200/ton
		Soil Washing	Organic compounds, metals	Volume reduction, short/medium-term	Require additional treatment probably	$100-$300/ton
Partial Cleanup (in place)	Established treatment technologies	Soil Vapor Extraction	VOCs	Minimal equipment	Not effective in the saturated zone	<$100/ton
		Stabilization /Solidification	Heavy metals; depends on different stabilizers	Immobilizes contaminants	Effectiveness varies depend upon chemical composition of wastes	$40-$60/cy in shallow applications
	Innovative alternative-treatment technologies	Electrokinetics	Heavy metals, anions, and polar organics	Most applicable in low permeability soils	Not effective in dry soils	$90-$130/ton
		Thermal Desorption	VOCs	Removes contaminants on site; Adapt to wide range of soil types	Utility costs may be high	$120-$300/cy
Full Concealment	Established treatment technologies	Encapsulation	All contaminants	Quick installation; Low cost	Contains wastes; contaminant still exists; Operation and maintenance required	$45,000-$170,000/ac
Nonintrusive Cleanup	Established treatment technologies	Bioventing	Organic constituents	Easy, minimal disturbance, short term	Only in unsaturated zone	$45-140/ton
	Innovative alternative-treatment technologies	Bioremediation	Organic compounds	Low cost; Contaminant turns into nonhazardous substance	Slow at low temperatures, long term (6 months to 5 years)	$27-$310/ton
	Emerging alternative-treatment technologies	Phytoremediation	Organic compounds, metals, radionuclides	Less secondary waste	Shallow soils; Seasonal; Better for low concentrations of contamination; In the lab stage	<$100/ton
		Landfarming	Petroleum hydrocarbons	Easy to design and implement	Medium/long term; Need large amount of space	$25000-$50000 for laboratory studies, <$100000 for pilot tests, <$75 per cubic yard for prepared bed

CHAPTER 3

LESSONS FROM THE STEEL YARD BY KMDG

Table 3: Basic Information of The Steel Yard

<u>Basic Information</u>

Project name: The Steel Yard
Address: 27 Sims Avenue, Providence, RI
Construction completed: 2009
Cost: $1.2 Million
Size: 3.5 Acres
Owner: Woonasquatucket Valley Community Build
Client: The Steel Yard
Designer: Klopfer Martin Design Group (KMDG)
Civil Engineer: Morris Beacon Design
Structural Engineer: Structures Workshop Inc.
Contractor: Catalano Construction
Volunteer Planting Day: Groundwork Providence + Trees 2020 Program
Former Use: Steel Fabrication Facility
Current Use: Industrial arts educational center
Contaminants: Lead
Remediation Features: Contamination over 10,000ppm removed from site, between 4,000 and 10,000ppm treated/retained

Case study is an effective way to learn from other brownfield projects, showing the process of how contaminants are cleaned up, what difficulties projects face and overcome and how the sites are reclaimed with new functions. After study of dozens of brownfield projects throughout the world, this author highlight The Steel Yard as the optimal case for the research site near Newtown, because of its example in remediation strategies, nearby residences, similar industrial history and proposed development. This project's mission is “reducing soil disturbance,” “reconciling grade displacement,” and “reintroducing ‘Urban Wild’ vegetation and habitat” (ASLA 2011).

Project Background

The Steel Yard, which was once home to the Providence Steel and Iron Company (PS&I), was changed into a community-based, non-profit educational center that focuses on fabrication arts, offering arts and technical training programs (Landezine 2015). It is located on a brownfield in the Olneyville neighborhood of Providence, Rhode Island, a part of Providence’s Industrial Valley district (U.S. EPA 2011). The surroundings of this site were also occupied with industry, but some of them have been reclaimed as commercial and residential properties.

Nick Bauta, a Rhode Island School of Design graduate, and Clay Rockefeller, a Brown University student, purchased the site of Providence Steel and Iron Company in the name of their new organization, The Steel Yard, after the close of company in 2001. They saw the potential of the site to be a meaningful and flexible space for the local art community (Hollander 2010). They aimed to develop community and revitalize this urban area by celebrating the site’s history and embracing the arts (Hollander 2010).

Site History

In 1902, the Providence Steel and Iron Company was founded in a two-story brick building at 27 Sims Avenue in Providence, Rhode Island (Hollander, 2010). Over the next 40 years, due to the factory’s expansion, they built another brick building and a network of overhead gantry cranes (U.S. EPA 2011). However, during this period, excessive levels of lead infiltrated the soil because of the overspray of lead-based paint on steel beams (U.S. EPA 2011).

The steel and iron industry left its heyday, and PS&I closed in 2001. Unlike other industrial facilities being torn down after closing, facilities on PS&I site were kept and redeveloped according to the owners' plan. But before realizing the plans, the site had to be cleaned up according to the guidelines of the U.S. EPA and other professional organizations.

The specific points of the project process are summarized in the following timeline (Figure 3.1).

Remediation

Due to the excessive level of lead, regulations required the soil to be treated under the supervision of the Rhode Island Department of Environmental Management was required (RIDEM). As mentioned in Chapter 2, remedial approaches can be taken on site and off site, but The Steel Yard and its founders preferred to treat soils on site as much as they could because they thought that transferring contamination problems to elsewhere was unethical (Wener 2013). Also, treating soils on site would cost relatively less than cleaning up off site. Thus, in their remediation plan, soils on the site were sorted into two pollution levels, with treatments specified for each. Soil with lead over 10000ppm was completely excavated and carried out to a licensed landfill, while soil with lead between 4000ppm and 10000ppm was retained and stabilized on site (Hollander 2010). With such heavy pollution, preventing storm water from carrying contaminants to the neighboring river and bay is a major concern. After a careful screening, a new approach called FESI-

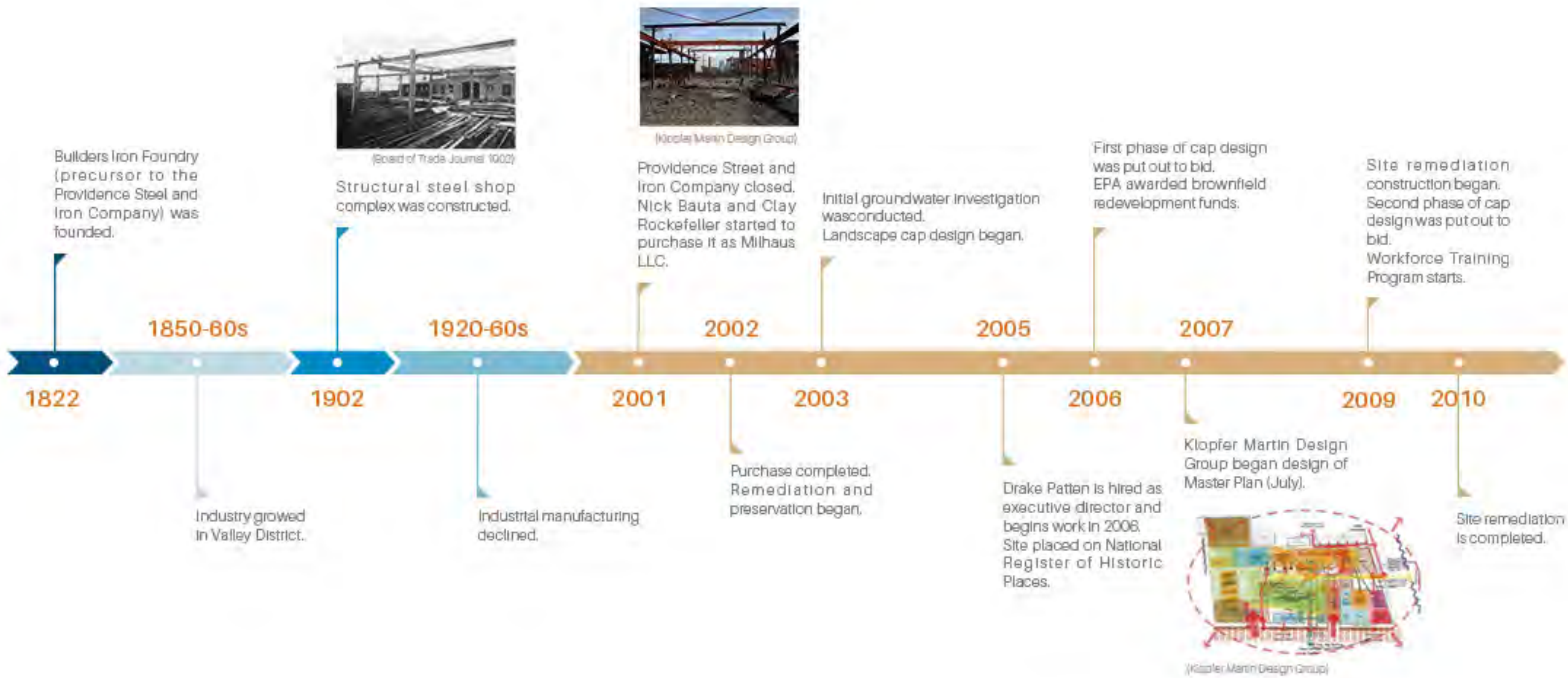


Figure 3.1: Project Process from 1822 to 2010 (Based on Wener, 2013)

BOND was proposed to solve this problem (Wener 2013). FESI-BOND is a blast-abrasive additive that can be used as chemical stabilizer, which keeps lead from leaking out of the soil by converting lead to insoluble minerals (Easter 2013). In addition to lead, FESI-BOND is also able to control As, Cu, Hg, Cd, Cr, Zn, Se, and other RCRA and non-RCRA (The Resource Conservation and Recovery Act) metals (Forrester Environmental Services, Inc. 2015). It is also worth pointing out that, as a food-grade stabilizer, FESI-BOND is not hazardous to the workers or the environment.

Three categories of environmental "caps" were applied on site to avoid exposure of contaminated soil (Wener 2013). The first was "hard" paving, such as concrete and bituminous asphalt (Wener 2013). Second, porous paving materials (Figure 3.2) were also laid, such as permeable concrete, concrete pavers, grasscrete and crushed stone (Wener 2013). The last "cap" is landscaped areas, like bio swales and lawns (Wener 2013). Since parts of the contaminated soils were removed, clean soils were added over the surface. Replacement of soils resulted in changes in topography, which transformed into an 11800 square feet center landform in the center of the site (Hollander 2010).

Figure 3.2: Porous Pavement (KMDG 2011)

Figure 3.3 and Figure 3.4 clearly illustrate the sections of capping structures. The vehicular entrance, basketball and parking pad caps are all one "hard" paving – bituminous concrete – while the "Movie Room" and "Carpet" areas are capped with permeable paving. The sections of the central landform and the "Movie Room" landform

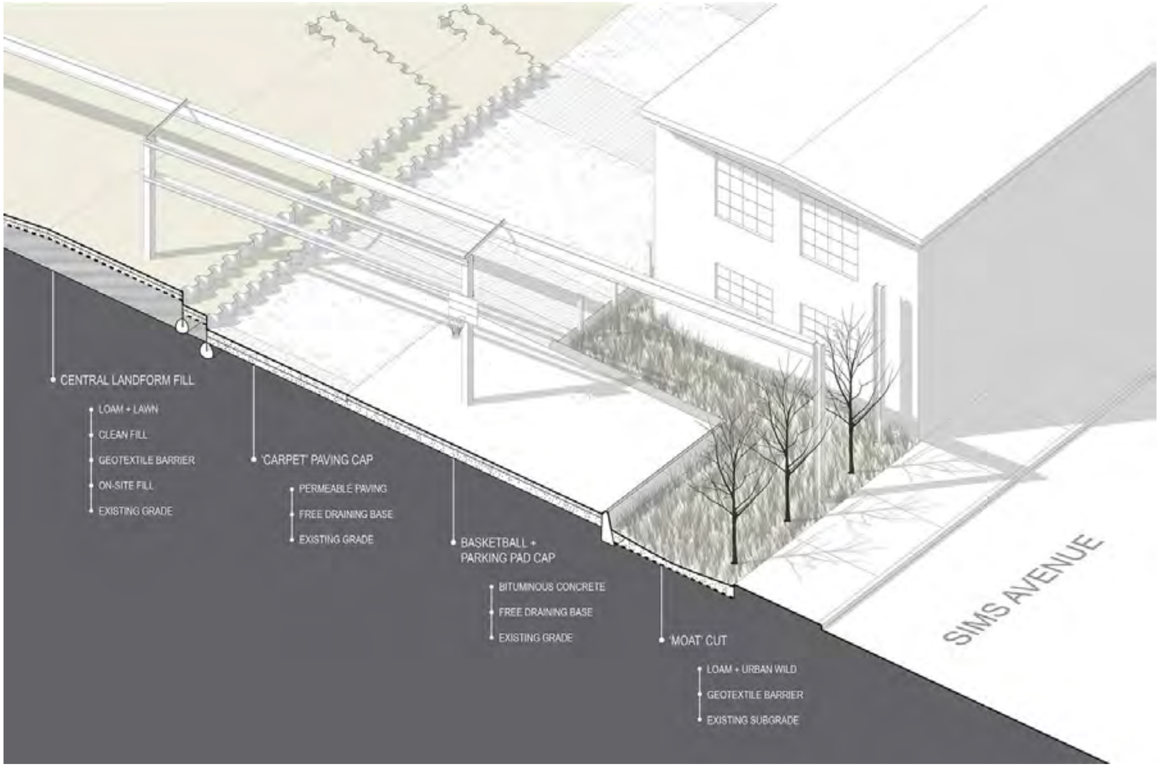


Figure 3.3: Cap Section 1 (KMDG 2011)

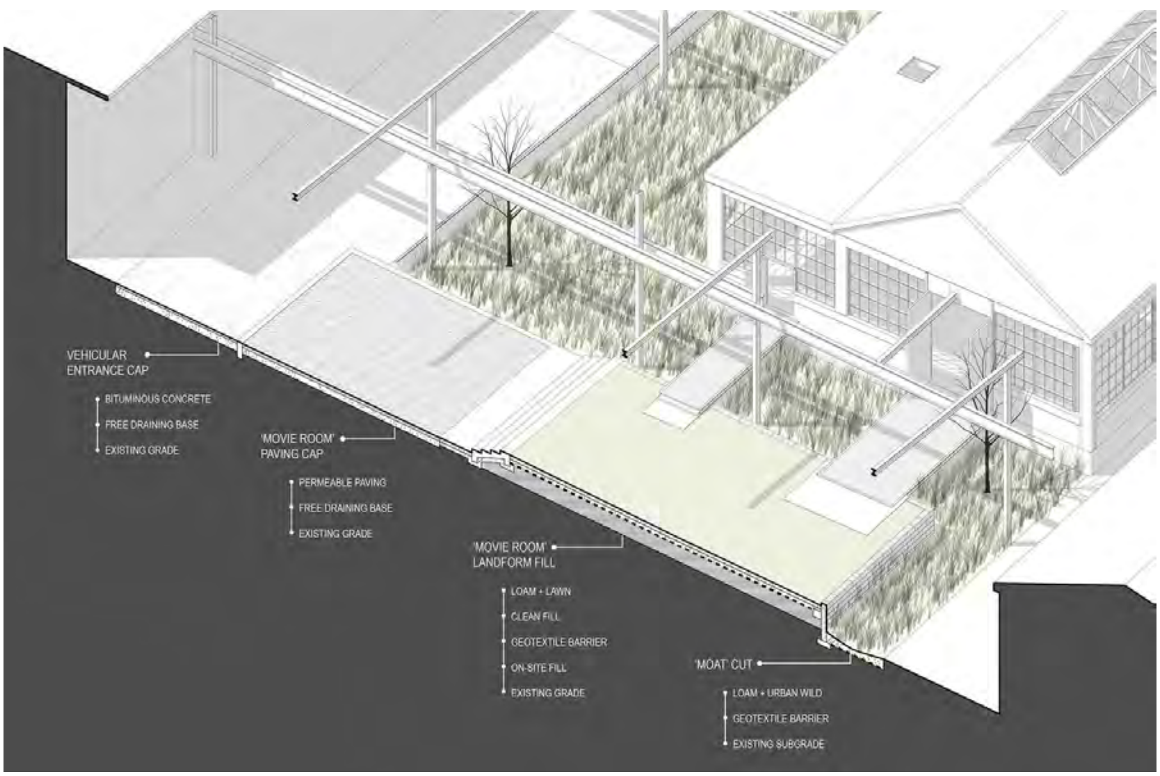


Figure 3.4: Cap Section 2 (KMDG 2011)

show how the remedial approach applies to soil. Geotextile barrier is used to isolate clean soil and on-site soil. Loam is added as the top layer to guarantee nutrition for the grass.

<u>Design Considerations</u>

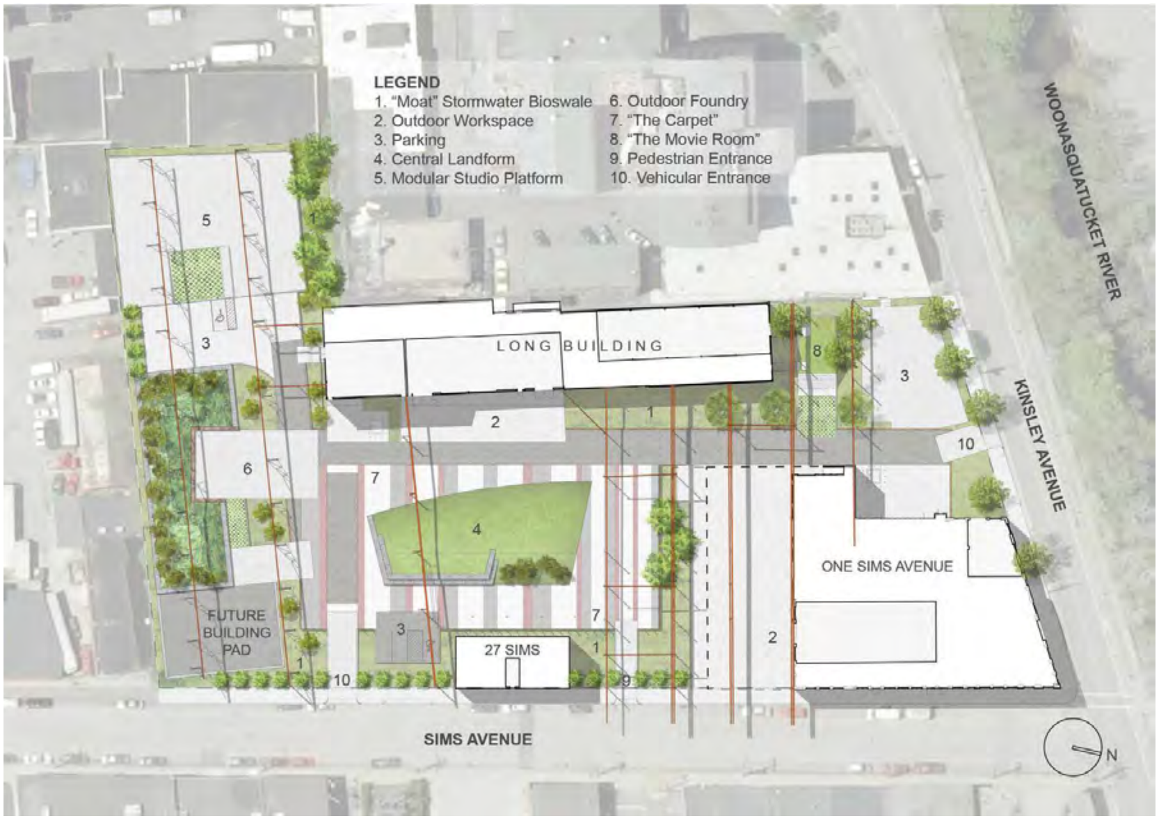


Figure 3.5: Master Plan (KMDG 2011)

1. Plants

One of the project's missions is "re-introducing 'Urban Wild' vegetation and habitat" (ASLA 2011). 'Urban Wild' is defined as the characteristic of the site before remediation. People who love the chaotic and wild atmosphere there are afraid that it will disappear after a series of remedial actions (Wener 2013). To retain this characteristic, plants are introduced according to different areas' functions (Figure 3.5), such as turf for central landform as "cushion," sumac and tall grasses for the southern landform as screen, and some native pioneer and volunteer species for remaining sites as re-colonists (ASLA 2011).

Figure 3.6: Turf and Tall Grasses Used for Different Programs (KMDG 2011)

2. Storm Water

The greatest challenge in design is how to treat the storm water on site. RIDEM wanted to keep storm water from discharging into the sewer system as much as possible to protect the Narragansett Bay watershed. They set seventy-five percent as the minimum requirement of storm water to be kept on site (Wener 2013). To meet this requirement and to adapt to changed grade, the design uses moats to separate buildings and paved areas (Wener 2013). The moats play an important role in directing storm water into rain gardens, phytoremediation sites, bio swales and permeable surfaces to collect and filter

90% of annual rainfall (ASLA 2011). They also are one of the main supports for plant growth.

3.Buildings and Structures

KMDG and The Steel Yard kept and remodeled two brick buildings and overhead gantry cranes rather than demolishing them. Activities were relocated in existing buildings and new structures, which were improved by reinstalling missing windows, adding new roof and galvanizing metal façade (Wener 2013).

4.Programs

KMDG also took activities and programs into consideration in their master plan (Figure 3.5). They separated vehicles and pedestrians by setting two vehicular entrances and one pedestrian entrance facing a main road. Each vehicular entrance has a parking lot. Considering the terrain generated by soil remediation, designers designed the central landform together with "The Carpet," a striped pattern plaza, as a public space, purposed for art exhibition, farmer's markets and performance (Hollander 2010). "The movie room," an outdoor gathering space for movies, also makes use of the terrain to build a landform. Additionally, there are several outdoor spaces including an outdoor workspace, modular studio platform and outdoor foundry that are used for different studio programs, such as foundry, metalworking, ceramics and blacksmithing. The outdoor workspace is close to buildings to help users make use of indoor resources conveniently.

Public Involvement By Educational Programs

This project mainly serves artists and nearby residents. After the site opened as an educational center, The Steel Yard attracted artists and nearby residents with a series of classroom, studio, and workshop programs (Wener 2013). These programs are outlined as follows:

- Camp Metalhead

    Camp Metalhead introduces creative metal fabrication to youth about 14 to 18 years old by a two-week program (The Steel Yard, 2015). It was launched in 2005 and has offered programs each summer since then (Wener 2013).

Figure 3.7: Students in Camp Metalhead (The Steel Yard, 2015)

- Public Projects

    Public Projects is a program begun in 2004, in which The Steel Yard collaborates with local artists, vendors and industries to produce unique urban furniture for the city of Province, neighborhoods and nonprofit (Wener 2013). It aims to earn income by selling urban furniture, to support courses and youth programs (The Steel Yard, 2015).

- Weld to Work

    Weld to Work is a paid program that aims to help low-income adults from age 18 to 24 learn about metalworking in order to increase their job opportunities

(The Steel Yard, 2015). Its courses are taught in small groups and last three weeks (Wener, 2013).

- Classes

The Steel Yard provides classes for iron casting, blacksmithing, welding, jewelry making and ceramics (The Steel Yard, 2015). People from Providence, Rhode Island, Connecticut and Massachusetts are all welcomed to participate in these weekend workshops. They also offer 25 sessions to youth for free (Wener, 2013).

Figure 3.8: Cruise Night (The Steel Yard, 2015)

- Events

In addition to occasional movie nights, The Steel Yard holds four events on site, including a performance, "Halloween Iron Pour," a competition, "Iron Chef," a "Wooly Festival" and a "Cruise Night" (Wener, 2013).

- Rentals

Rentals make up the major revenue for the organization. Studios can be rented both short and long term, while some spaces in the office can be leased to businesses (The Steel Yard, 2015). Private event rentals also contribute to the income (The Steel Yard, 2015).

As of today, hundreds of people have participated in and benefited from these programs.

Current State

It has been four years since the completion of the remediation of the site. The Steel Yard has acted as a catalyst in industrial arts and creative works. With classes and education programs growing steadily, maintaining and increasing the financial sustainability is the main task in the next stage (Wener, 2013). With the focus of small business incubation (Wener, 2013), some programs, including Weld to Work and Public Projects, have been considered or carried out. They plan to expand Weld to Work to train more work forces and rent the site to a dance company for performances (Wener, 2013). The organization continues to seek new methods to make better use of the site.

Assessment And Lessons Learned

1. Assessment

The Steel Yard models a successful reclamation of an abandoned industrial site into an educational center for brownfield redevelopment. The Steel Yard not only remedied the site with a relatively inexpensive technology (stabilization on site), but also retained its industrial history. By cleverly using existing buildings and structures to carry out a variety of projects, The Steel Yard provides education opportunities for locals to help them find more job opportunities.

The whole project took ten years from start to finish. Even though the organization works well now, its process was far from smooth. The project team, with only five full-time staff members, had no experience with brownfield remediation (Hollander 2010). In order to have reclamation approaches approved level-by-level, they had to reconcile conflicts and negotiate with contractors and each department, like Rhode Island

Department of Environmental Management and U.S. EPA (Hollander 2010). A lot of time was wasted in this process because their extended timeline led to brain drain so that new employees had to be acquainted with the projects from start (Hollander 2010). Fortunately the project team overcame those limitations and gained a respectable achievement in the end.

2. Points in Common (The Steel Yard Site V.S. Newtown Site)

- Contaminants: Lead
- Site classification: Brownfield
- Location: Close to communities living below average level
- Cultural considerations: Industrial history

3. Lessons

Because the site near Newtown shares so many commonalities with The Steel Yard, many of its ideologies and methods are worth imitation.

First, The Steel Yard offered several advisable remediation approaches. I tend to agree with the founders' idea, that transferring contamination problems to elsewhere is unethical. It would be better to retain as much soil as possible and remedy them on site, which will also help save project budgets. FESI-BOND is an optional technology that can restrict the leak of lead, and phytoremediation is also a helpful way to clean up the site. Additionally, cap and moats tactfully retain storm water on site but isolate people from contaminants.

Second, the project team took public involvement into consideration, not only because the local public knew a lot about the site, but because the public is also the ultimate beneficiary. They believed Newtown residents have the right to know what kind of benefits the redevelopment would bring. Correspondingly, the designer will learn more about residents' needs.

Third, when the team thought about the function of the site, they thought of artists, who had been attracted by the post-industrial site before the project started and could be a potential resource in future development. Art became the core in program organization. Choosing the appropriate target users will help sites be better used and also save effort spent on attracting customers in the future.

Last but not least, a thorough but flexible plan and an experienced director played important roles in running the project. Many unexpected things will happen in practice and will slow down the process, so choosing people who can handle it will minimize the impact of unnecessary contingency. Since this thesis is a proposal, practical experience is not covered in this thesis.

CHAPTER 4

SITE INVENTORY AND ANALYSIS

Inventory

Site inventory gives the first impression of its current and future states. The inventory list includes location, site boundary, size, topology, land use and surrounding resources. The inventory will also provide important information to summarize the issues and identify site potentials for redevelopment.

1. Location

Figure 4.1: Proposed Site and Surroundings

The site of Blaze Recycling & Metal is located in southern Gainesville, Georgia, between Newtown and Norfolk Southern/CSX railroad. Many factories stand along the other side of the railroad. The residential lands to the northwest of the railroad are called the Fair Street Area (Figure 4.1). Athens Street lies on the southwest boundary of the site, crossing the railroad. Athens Highway is also not far away from the site, as the above diagram shows.

2. Site Boundary, Size and Topology

The site boundary is on the south border of Newtown and along CSX railroad, as Figure 4.1 shows. Area 1 (as Figure 4.2 shows below) is 7.54 acres, while the Area 2 is 6.74 acres. The total area of the proposed site is 14.28 acres.

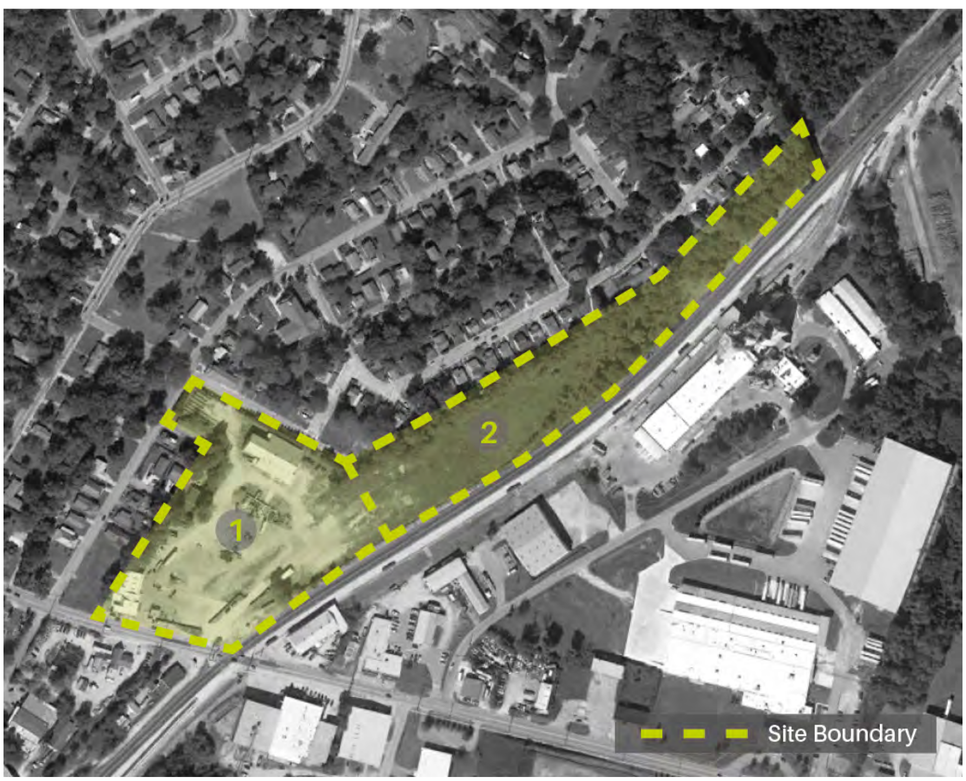


Figure 4.2: Site Boundary

The topography suggests storm water will flow from southwest to northeast, so the best location of the rain garden and bio-retention would be at lower area.

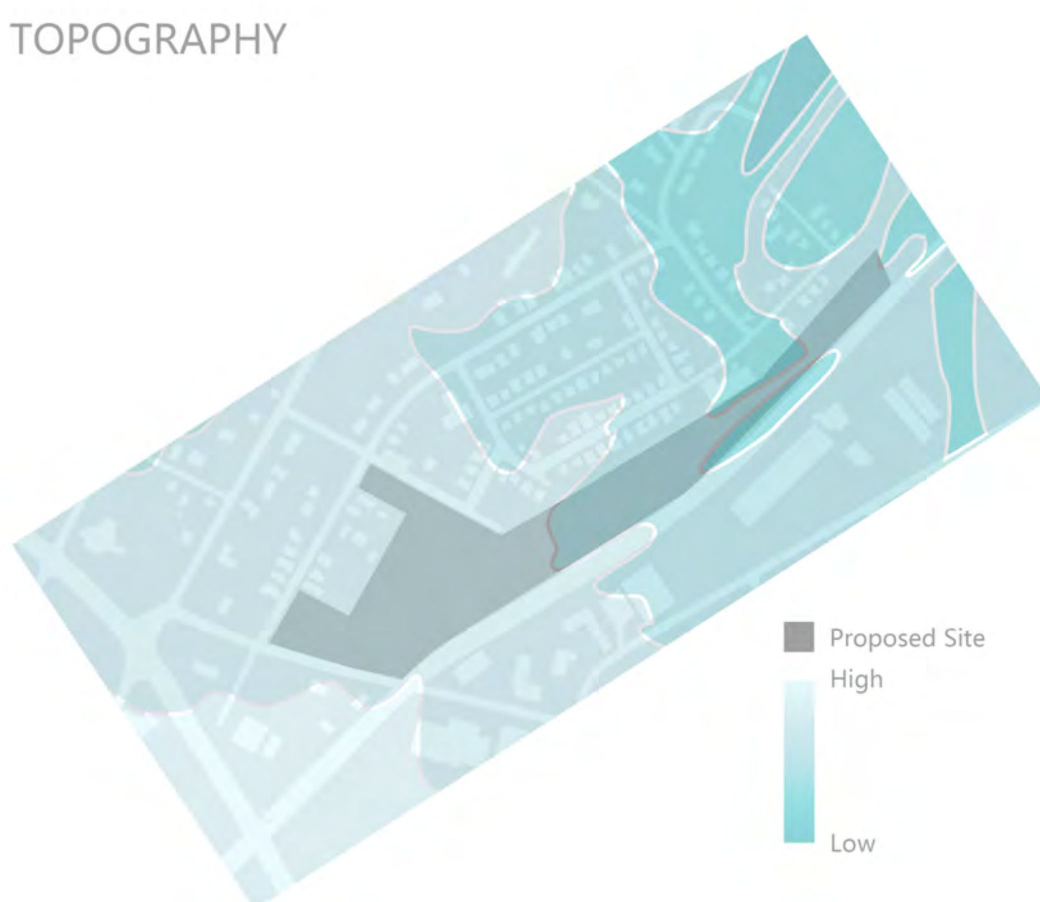


Figure 4.3: Site Topography

3. Land Use

Currently, the site is not entirely utilized. Most of Part 1 (as Figure 4.2 shows above) belongs to Blaze Recycling & Metals. According to the satelite map on Google Earth (Figure 4.4) , the ground surface was mainly soil in 1993. In the following years, most of the soils became barren because of land degradation. Now however, the land is partly covered by impermeable concrete for vehicle use.

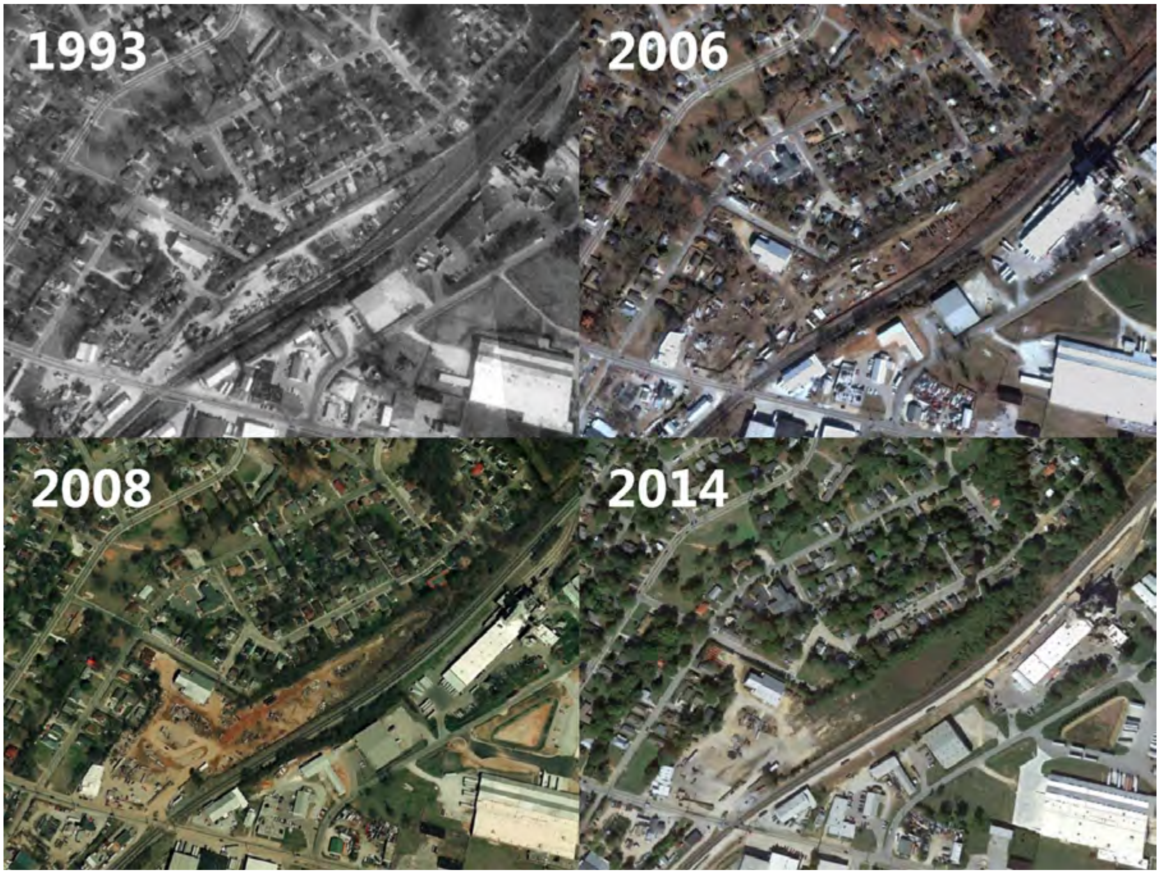


Figure 4.4: Historical Satellite Maps of Blaze Recycling & Metals (GOOGLE 2015)

Part 2 is a wasteland with wild plant growth. These plants may reduce the noise from railroad, but they make it difficult for people to walk the property. Also, the boundary of the property is littered with partially buried trash (Figure 4.5).

Figure 4.5: Trash Found on Site

According to the existing land use map (Figure 4.6) revised in March 15, 2011, the proposed site is designated for industrial development. Most of the lands northwest of the site are residential and institutional, while those on the other side of the CSX railroad are industrial and commercial.

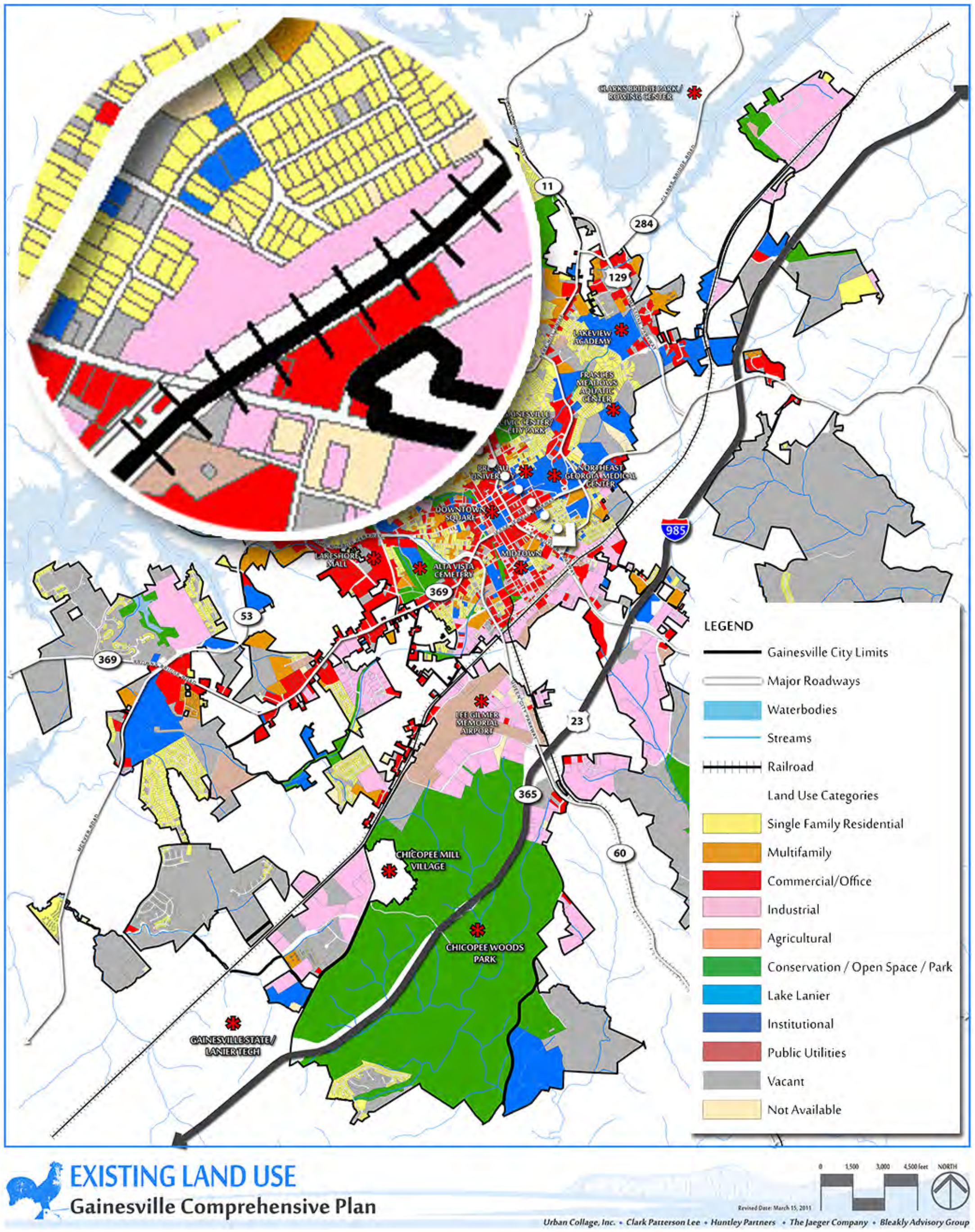


Figure 4.6: Existing Land Use Map (The Official Site of Gainesville, Georgia 2015)

However, the proposed site will be turned into park/recreation land based on future development map (Figure 4.7) for 2030 Comprehensive Plan of Gainesville, Georgia. Apparently, this plan will somewhat insulate the neighborhood from industrial neighbors and centralize a park/recreation land for the Fair Street neighborhood area.

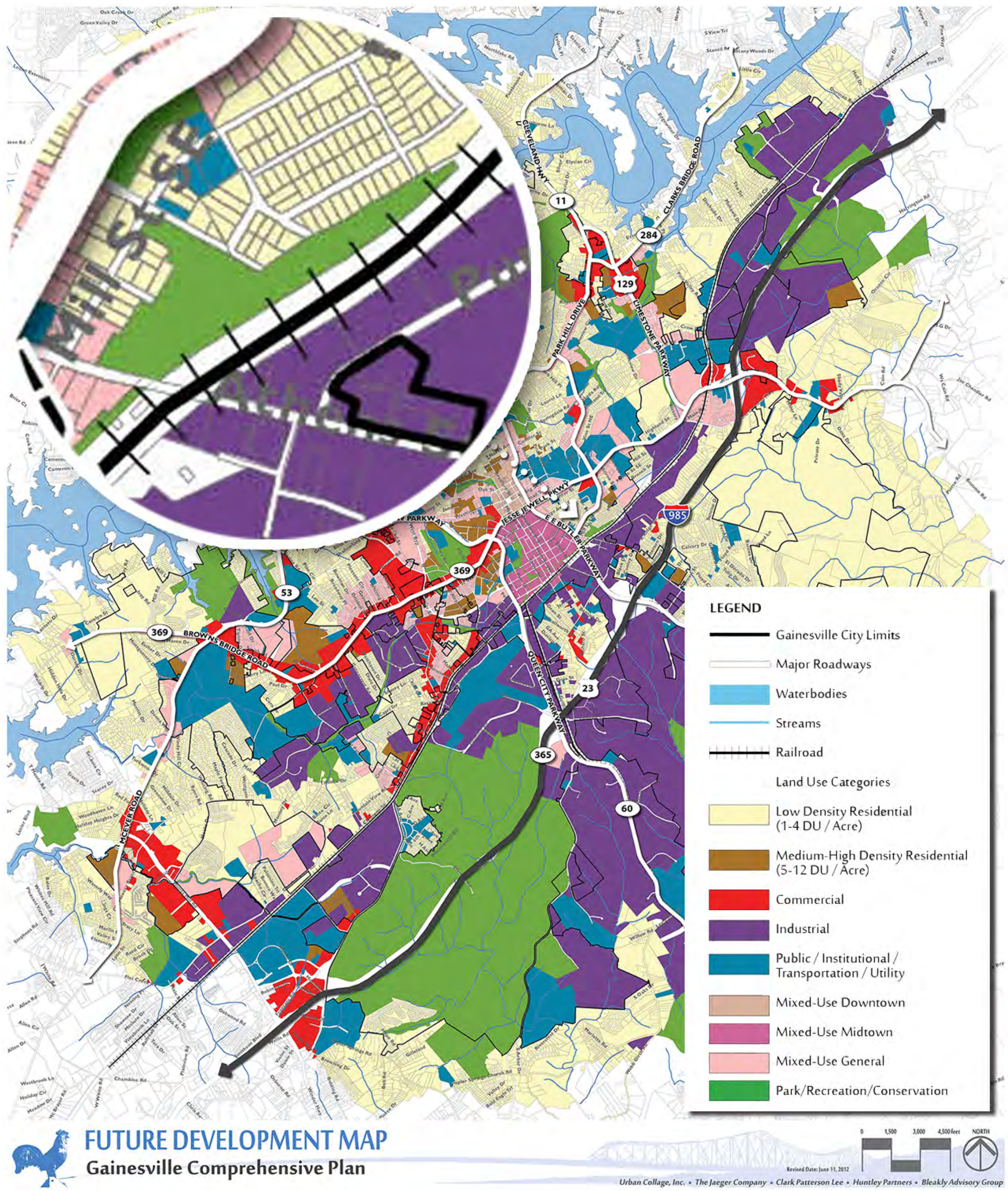


Figure 4.7: Future Development Map (The Official Site of Gainesville, Georgia 2015)

4. Demographics and Housing

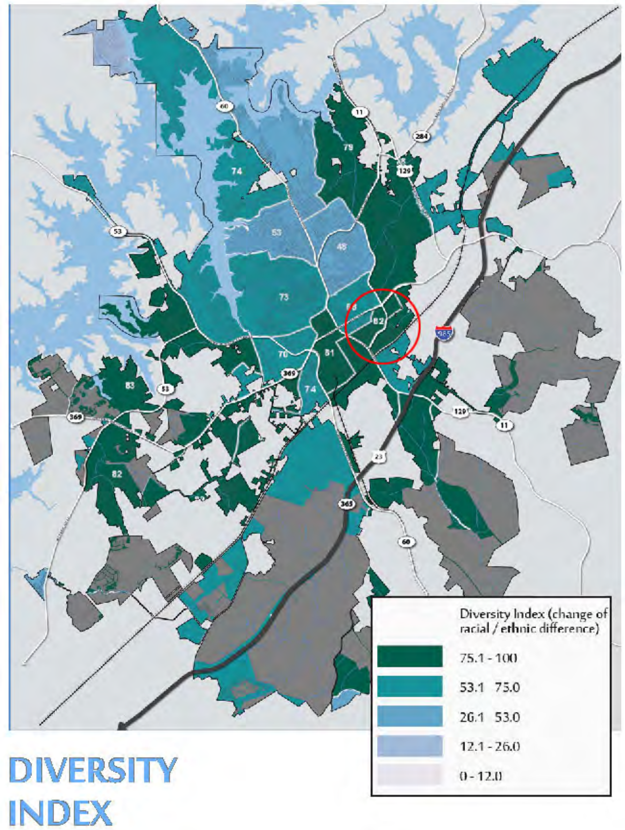
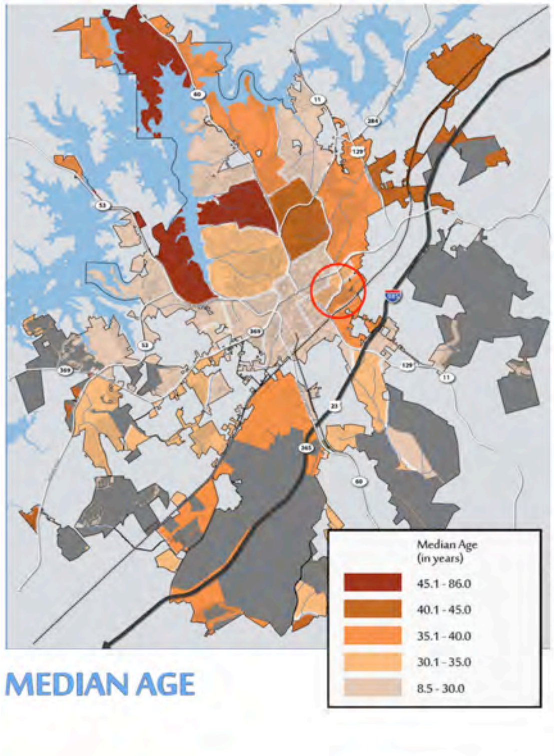


Figure 4.8: Gainesville Diversity Index (Urban Collage Inc. 2011)

In 2010, Gainesville had a population of 33409 (Urban Collage Inc. 2011). It increased about 23% from 2000 (Urban Collage Inc. 2011). Based on the data in 2010, white people account for 54.2% of the total, while the percentage of Africa-American people was only 15.2% (Urban Collage Inc. 2011). The domain ethnicity in Newtown and Fair Street Area can be deduced from the Ethnicity Diversity Index (Figure 4.8). Most of residents in Newtown and even Fair Street Area are Africa-American people, because Newtown houses Africa-American families and the ethnicity diversity is single in the surrounding area. The median age of these residents is between 30-40 years old (Figure 4.9) and the average household income of Fair Street Area is below the average level of the city (Figure 4.10).

The number of housing units in Gainesville is about 12000 in 2010 (Urban Collage Inc. 2011). The number is estimated to increase to 15234 in 2021 (Urban Collage Inc. 2011). Among these housing units, the number of multiple-family houses is increasing (Urban Collage Inc. 2011). But for now, most of houses in Fair Street Area are still single-family.



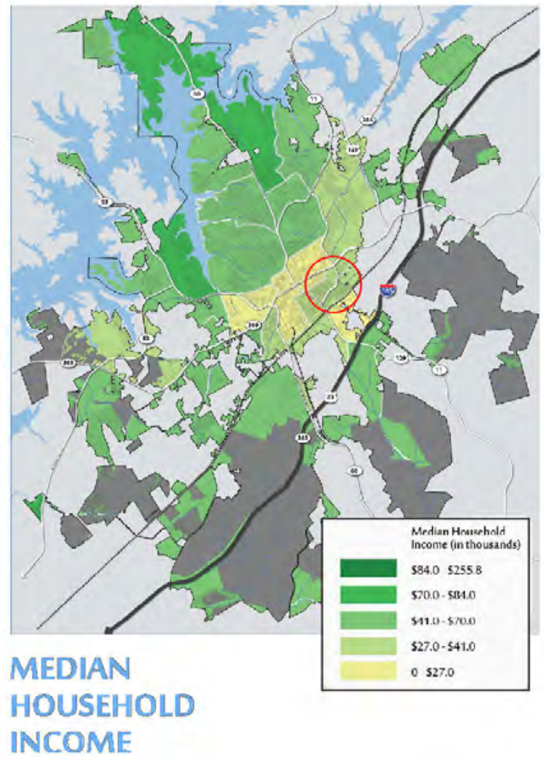


Figure 4.9: Gainesville Median Age (Urban Collage Inc. 2011)

Figure 4.10: Gainesville Median Household Income (Urban Collage Inc. 2011)

5. Park/Recreation and Greenway

Generally, the most acceptable distance for going out by walking is 0.25 mile (5-minute) (Figure 4.11) (Yang 2012), and for longer distance people will prefer to go out by driving or stay indoors. Even though Fair Street Area is a large, concentrated neighborhood area, there is little recreational green space to be found within a ten-minute (0.5 mile) walking distance.

DeSota Park is the only one park located within a 0.5-mile radius with a tennis court, basketball goals and picnic pavilion with a grill inside. It is more of an amenities-only park serviced for Newtown residents. Next to DeSota Park is Mrs. Ruby Wilkins Community Garden, which was established by Newtown Florist Club in 2010. This community garden is the place where Newtown residents can grow their own produce.

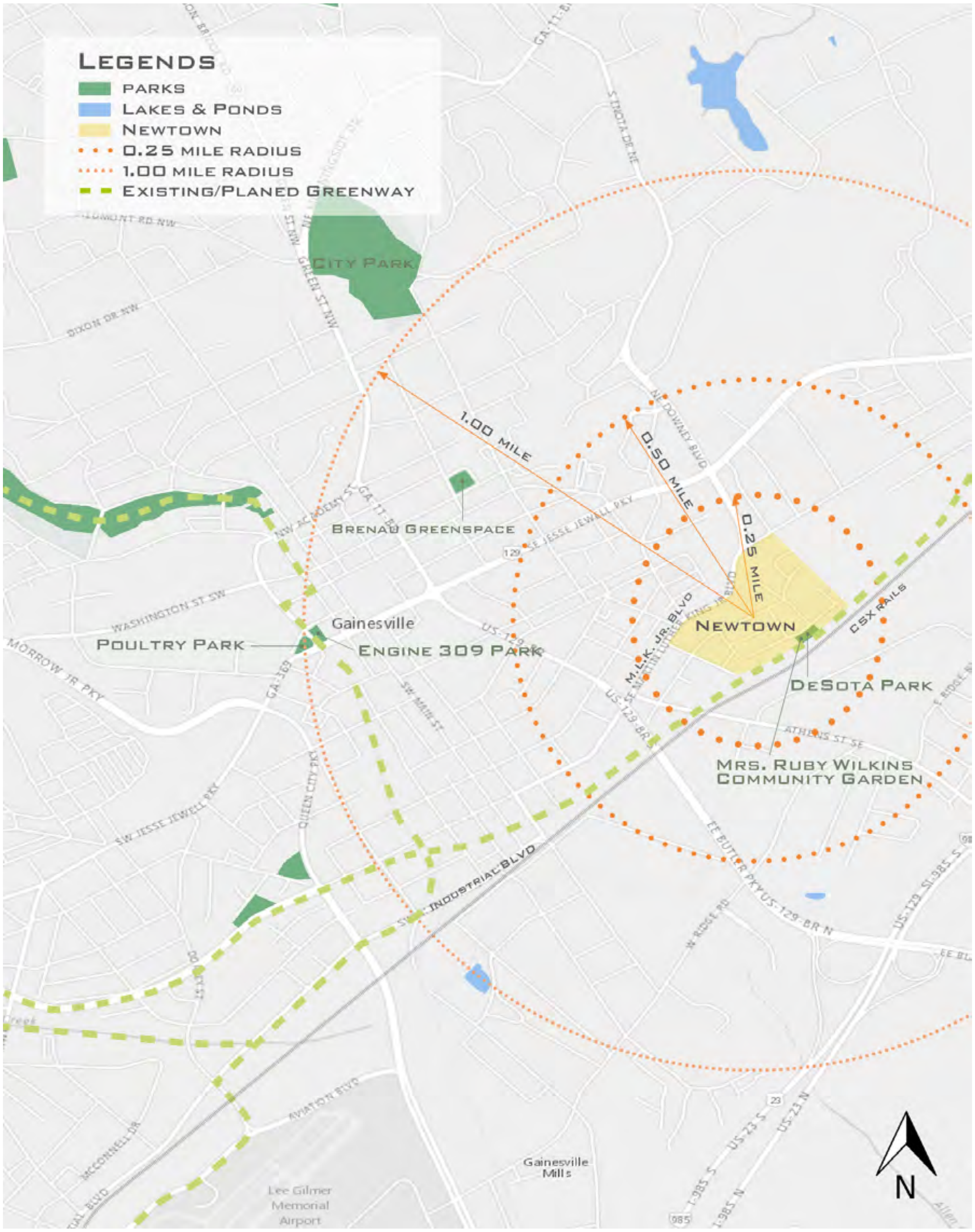


Figure 4.11: Park and Greenway Map

Furthermore, Figure 4.11 also illustrates existing and future greenways connecting each park. The greenway that will extend to Newtown is called Midtown Greenway; Phase I of which was completed and opened in April 2012 (National Brownfields Conference 2013). As this project envisions, it will be lengthened south to Industrial Boulevard and then extended northeast towards Newtown along the road between M.L.K. Jr. Blvd and CSX rails (National Brownfields Conference 2013).

6. Cultural & Historic Resources

The Fair Street Area epitomizes the booming African-American business community from the Gainesville Urban Renewal starting in 1970s (Crist, 2010). To encourage the historic homes preservation in city development, the Harper-Smith House, a red brick house, was designated as a historic home (Crist, 2010). It belonged to William Harper, an outstanding black community member, who helped black students get educated in college (Crist, 2010). Members of the Bethel African Methodist Episcopal Church would like to take use of the house to provide educational programming for at-risk youth and families, such as mentoring, job assistance and the arts (Silavent 2015).

Figure 4.12: Harper-Smith House

7. Current Industrial Development

Gainesville is called the "Poultry Capital of the World," because of its increasing number of poultry processing and related industries since World War II (Urban Collage Inc. 2011). Now, agricultural business is the mainstay of the city's economy and the dominant user of the railroad corridor, instead of past industries, such as textile mills, foundries and wood-processing (Urban Collage Inc., 2011). Two of the biggest food processing factories (Cargill and Purina) are located opposite the proposed site, along the CSX rail.

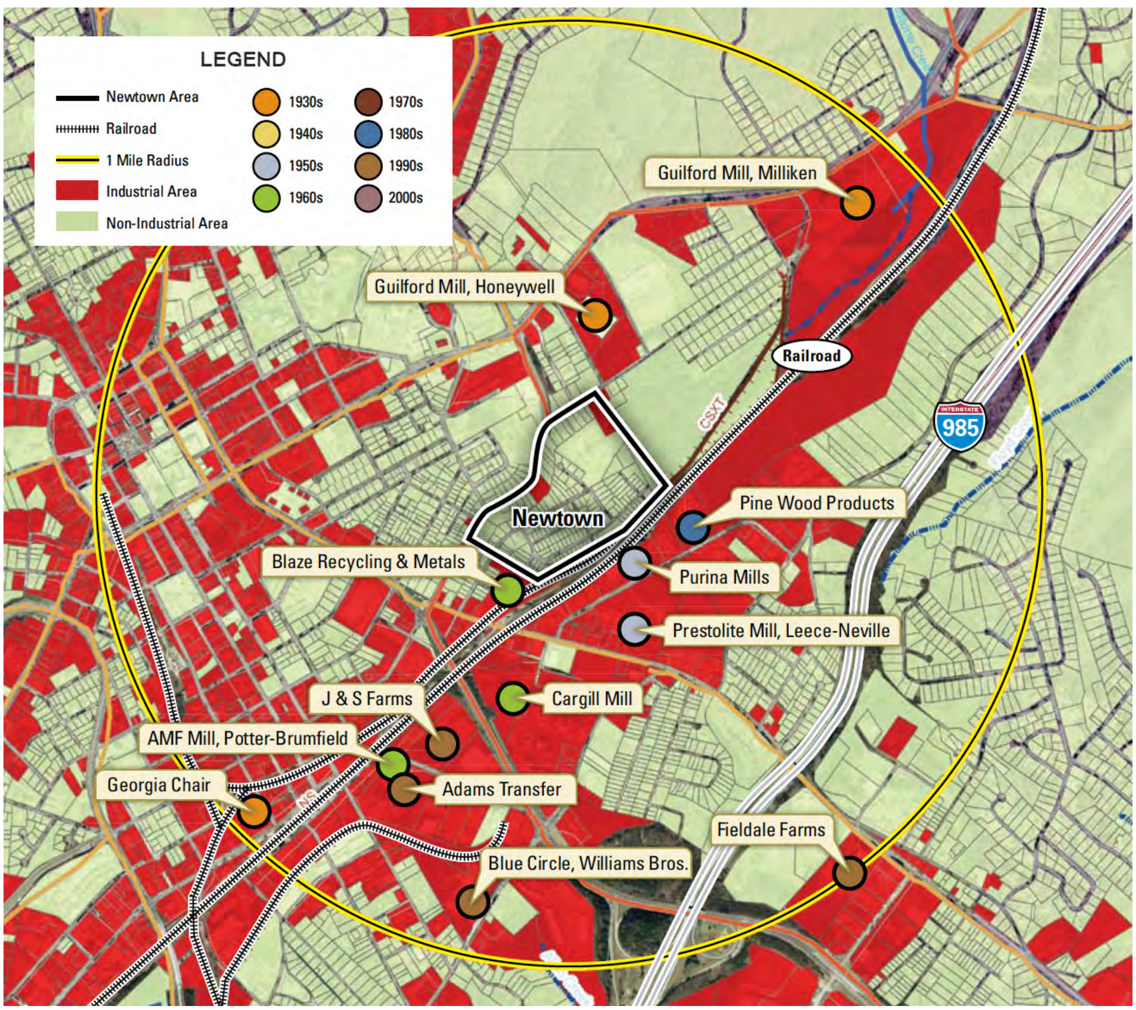


Figure 4.13: 1930s - 2000 Industrial Development
(Land Use Clinic, 2008)

Figure 4.13 is a diagram from the Newtown Health Impacts Report from 2008. The colored dots signify major factories established since the 1930s within a three-mile radius of Newtown. Most of these factories, like Cargill, Purina and Pine Wood Products, are still in use. Specific classification and details are listed in Table 4.

Table 4: Current Industrial Plants

Classification	Name	Business	Construction Date	Remarks
Light Industry	Purina Mills Inc	Animal Feeds	1950s	N/A
	Cargill Mill	Vegetable Oil	1966	N/A
	Potter & Brumfield Inc.	Manufacturer of Electronic relays	1966	N/A
	Guilford Mills	Paper	1930s	Changed into clinic
	Pilgrim's Pride Corporation	Poultry	N/A	N/A
	Fieldale Farm Corporation	Poultry	1990s	N/A
	Georgia Chair	Chair	1930s	N/A
Heavy Industry	Pine Wood Products Inc.	Manufacturer of Wood	1985	N/A
	Blaze Recycling & Metals	Metal Recycling	2000s	N/A

8.Soil Status

In order to study the influence of local industry on the soil of the proposed site, I had soil samples analyzed at the University of Georgia Agricultural and Environmental Services Laboratories. As aforementioned, the proposed site is divided into two parts based on its current properties. At present, the soil status of Part 1 cannot be analyzed because of the restriction of private property. Its contamination status can only be speculated by analyzing similar cases. For this reason, only the soil sample from Part 2 was tested.

Figure 4.14: Location of Soil Sample Cores

Using the guidelines prescribed in the Soil Test Handbook for Georgia, I took ten random samples from part 2, as Figure 4.14 shows. Due to the limited availability of tools, the sampling depth is about 4 to 6 inches. I then combined and mixed these samples in a plastic bucket, from which I took a pint of the mixed soil and enclosed it in a UGA soil sample bag and sent it to the lab. Two tests were then run: a Routine Test and Total Elemental Analysis. The content of each test is defined as follows:

- ROUTINE TEST:

  Soil pH, Lime Requirement, Extractable Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Manganese (Mn), and Zinc (Zn) by the Mehlich I extract (Kissel, 2008).

- TOTAL ELEMENTAL ANALYSIS:

  Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulfur (S), Manganese (Mn), Iron (Fe), Aluminum (Al), Boron (B), Copper (Cu), Zinc (Zn), Sodium (Na), Lead (Pb), Nickel (Ni), Chromium (Cr), Cadmium (Cd), Molybdenum (Mo), Arsenic (As), Selenium (Se), Mercury (Hg) (Kissel, 2008)

According to the Soil Test Report (Appendix A), the PH of soil is 5.4, which is a little lower than suggestive value 5.5 – 6.0. Adding 105 pounds limestone per 1000 square feet will help raise PH.

In order to know if the soil is contaminated by heavy metal, I compared the result of the Total Element Analysis (Appendix B) with the regulatory limits on heavy metals applied to soils (U.S. EPA 1993) in Table 5. Thus it can be seen that the soil in part 2 is not contaminated. The regulatory limit set by the U.S. Environmental Protection Agency on lead is 400 ppm for a play area and 1200 ppm for a non-play area (U.S. EPA 2001), but it may be lower based on different state legislations; for example, Minnesota permits 100ppm for a play area (Rosen, 2010). Even though lead content in the soil of part 2 is less than 100 ppm, it is higher than 50ppm (Agency for Toxic Substances and Disease Registry, 2010), which is the maximum for general lead concentration in uncontaminated soil. Therefore, the soil does not require treatment for lead content at this level, however taking simple steps, like raising soil PH to reduce lead mobilization would minimize potential risks. However, the contamination status of deep soil is unclear based on this soil test.

Table 5: Heavy Metal Contamination Analysis

Samples	Abbr.	PPM	Limit ppm	Contaminated or Not
Cadmium	Cd	1.510	85	NO
Chromium	Cr	13.59	3000	NO
Copper	Cu	25.51	4300	NO
Molybdenum	Mo	<1	57	NO
Nickel	Ni	9.288	75	NO
Lead	Pb	69.52	400	NO, but slight excess of 50ppm, the general lead concentrations in uncontaminated soil
Zinc	Zn	166.3	7500	NO

Risk Assessment

Site inventory reflects that residents in Newtown and even Fair Street Area are facing a series of issues and risks. One of the issues is they don't have enough green space to enjoy outdoor activities in walking distance. However the biggest problem is that the residents are living in an environment that may cause health risks. The risks come from two sources: soil contamination and industrial activities. Considering the restrictions of current site conditions and detection tools, some potential risks can only be deduced by some similar cases, literature and data, to provide information for future design.

1. Soil

The soils in part 1 is more likely contaminated by heavy metal than those in part 2 because of long-term activity by Blaze Metal & Recycling. Heavy metal may accumulate in soils by storm water infiltrating through permeable surfaces. Blaze Metal & Recycling recycles most metals and electronic scrap into a variety of materials, including ferrous, non-ferrous, stainless, electronic, vehicular and industrial manufactures. Although there is no data about soil quality at the site, other similar metal recycling facilities tend to be contaminated with heavy metals, which may pose a substantial human health risk (Raun et al. 2013). An evaluation of heavy metals (Cr, Ni, Cu, Zn, Cd, Pb) in the soils of a factory for electronic equipment recycling showed that concentrations were higher than the value of general content (Yang et al. 2013). A soil test of an abandoned e-scrap recycling site in Longtang, China, also displayed excesses of Cadmium (Cd) and Copper (Cu) (Wu 2015). Additionally, field studies on two scrap iron and metal recycling facilities showed very high content of lead (Pb), copper (Cu) and zinc (Zn); high concentrations of cadmium (Cd), chromium (Cr) and nickel (Ni), especially in the area for car-battery salvage and cable burning (Jensen 2000). Those metals are even found at 80cm depth. Besides, the pH of the soil is as low as 3.5, which may be due to acids leak from car batteries (Jensen 2000). All of these potential risks should be taken into consideration in later analysis.

2. Impact of Industrial Activities

Industrial activities also bring potential risks to human health. Their impact can be divided into two categories: noise and air pollution.

2.1 Noise

Any unwanted sound can be called noise. (Singal 2005) It's always expressed in decibel (dB). Figure 4.15 is a sound scale that shows different levels of sound produced in various activities in both indoor and outdoor environments.

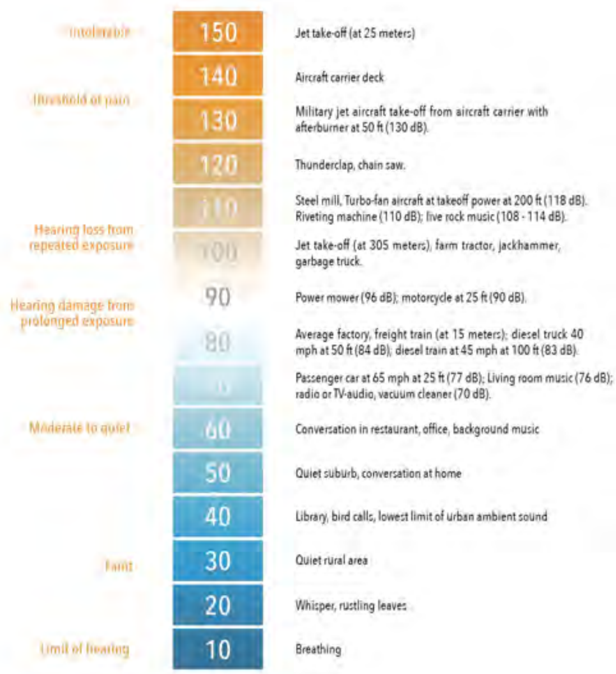


Figure 4.15: Sound Level (Decibels)
(Federal Interagency Committee on Noise 1992)

The first source of noise that most disrupts Newtown residents is from passing trains. Most of these trains are freight trains that service surrounding industries. The noise from a freight train (15 meters away) passing is at least

80 dB (Federal Interagency Committee on Noise 1992), but sometimes it may be up to 110 dB. Sound over 70 dB will annoy people, while prolonged exposure to sound over 80 dB will possibly cause hearing damage (Federal Interagency Committee on Noise 1992).

Figure 4.16: Sound Level near Newtown (Land Use Clinic 1992)

The other source of noise for Newtown comes from industrial plant activity. In 2008, the Land Use Clinic from the University of Georgia took noise tests at two spots: Desota Park and 857 Norwood Street (near Blaze Metal & Recycling) (Figure 4.16). Noise level at Desota Park was between 54 – 58 dB (14 -18 dB higher than normal levels in neighborhoods) (Land Use Clinic 2008). Purina Mill, the nearest plant of Desota Park, was responsible for it, as the noise related to its daily operations, diesel truck and rail car shipments (Land Use Clinic 2008). Also, since the early 2000s, more and more residents have complained about increasing activities on Blaze Metal & Recycling, as they generate noise up to seven days a week (Land Use Clinic 2008). The onsite noise level was measured between 55 – 93 dB (15 – 53 dB higher than normal level in neighborhood) (Land Use Clinic 2008), a level that may cause hearing loss.

2.2 Air pollution

Air pollution is another severe effect of industry. In the 1990s, three chemical releases occurred in the Newtown area, including two sulfuric acid spills in 1990 and 1992 from Cargill Mill and one hexane air release in 1995 from a disputed source (Land Use Clinic 2008). The hexane release in 1995 even leaded the evacuation of Newtown residents (Land Use Clinic 2008). Dust and smoke are also common forms of air pollution. The Land Use Clinic also conducted visual dust observations south of Newtown in 2008. Purina Mill, Cargill Mill and Blaze Metal & Recycling were accused of releasing fugitive dusts and Blaze Metal & Recycling was even warned by the Department of Natural Resources in August and October of 1999 (Land Use Clinic 2008). But the good news is that Purina agreed to address multiple air quality violations by signing a consent order in 2007 (Land Use Clinic 2008), but dust is still a significant problem.

Site Potentials

Soil Inventory not only reflects the issues, but also shows site's potentials that will improve the living environment of surrounding residents. These potentials provide opportunities and directions for the site's reclaim.

- Land-use changes

Based on Future Development Map (Figure 4.7), this site is proposed to be turned into green space. So this land has potential to be a community park serving the Fair Street

Area. The site is within a 0.25-mile radius of Newtown (Figure 4.17), which is convenient for nearby residents, especially Newtown residents.

Figure 4.17: Surrounding Context of The Proposed Site

As parts of industrial areas are planned to change to mixed-use lands and Blaze Metal & Recycling will be removed, industrial areas will no longer directly abut the Newtown neighborhood. Thus, the proposed site between Newtown and industrial areas can work as a barrier potentially to reduce impacts from industrial activities across the railroad as much as possible.

- Greenway Connection

Since the greenway will be extended along the railroad and extend in two directions, as shown in the Future Development Map (Figure 4.7) and the Park and Greenway Map

(Figure 4.11) in The Greenspace Initiative of Gainesville, there is a potential to extend the greenway across the site and connect to the land to the northeast of Newtown, which may turn into recreational area in future. The northeast of Newtown is currently an unutilized green land, but it will be utilized as mixed-use land in future. Extending the greenway to mixed-use land will also help the mixed-use land's development by attracting more visitors to this area.

Figure 4.18: Green Connection of The Proposed Site

- Space for a barrier

As the Future Development Map shows, Blaze Metal & Recycling will be replaced by green space so it will no longer be a source of noise and dust. The major source of noise and dust is, therefore, the surrounding industrial area. According to the location of Newtown, the proposed site and industrial land, the most effective method to block noise and dust is by building a barrier on the proposed site.

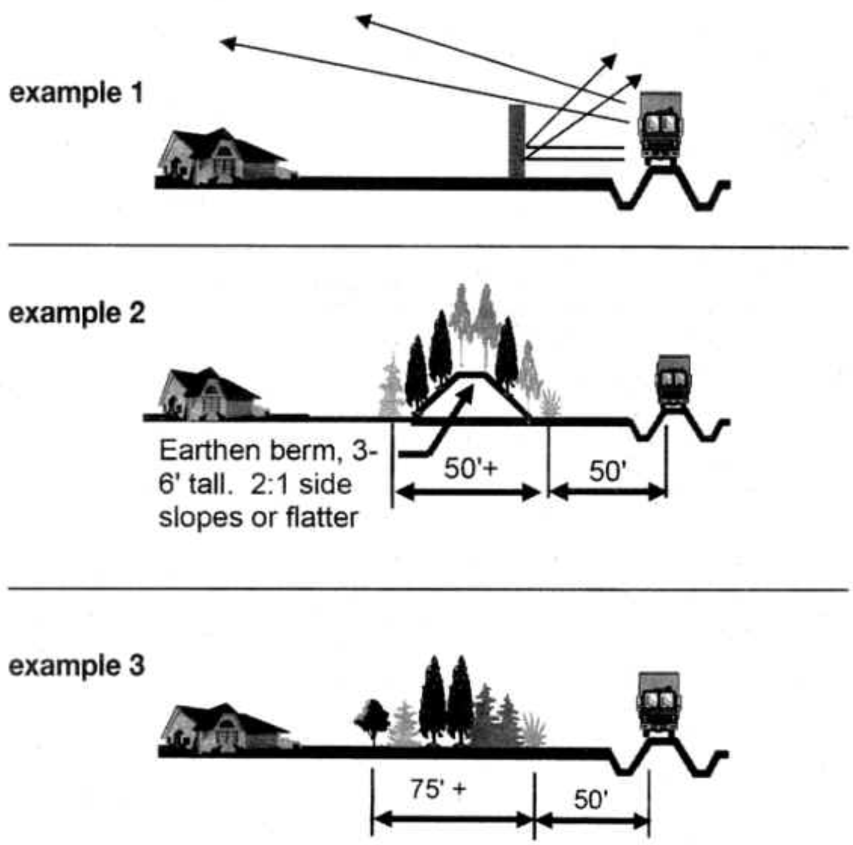


Figure 4.19: Examples of Planting Barrier (Antelope Valley Tree Farm, 2015)

Generally, a barrier that can absorb or deflect sound can reduce noise. A sound wall is very common on highways to help people who work or live near the road feel reduced impacts from noise. A sound wall is easy to install but may disfigure scenery. Instead, a planting barrier has more aesthetic and ecological value, so it would be the more suitable approach. Figure 4.19 shows two kinds of planting barriers. Trees can be planted in the ground or on a berm with a height of three to six feet. If planting in the ground, the width of the barrier should be at least 75 feet, while the width can be 25 feet less when using a berm. Besides noise, planting can also absorb dust particles as dust adheres to leaf surface (Nowak et al. 2013).

- Cultural Resources

Cultural resources also make contributions to the proposed site. The blue patches in Figure 4.16 are key buildings near the site. One of them is Harper-Smith House and the others are churches including Bethel African Methodist Episcopal (AME) Church, Antioch Baptist Church and St. John Baptist Church. Church attendants are potential users of the park. St John Baptist Church and Antioch Baptist are relatively larger than Bethel AME Church and their parking lots can be potentially used for park visitors.

Harper-Smith House, a memorable site, reflects local residents' respect and emphasis on education. Since members of the Bethel AME Church would like to make use of the house to provide educational programming for at-risk youth and families, the proposed site is a good space for the outdoor classroom. Linking to the Harper-Smith House is also a way to commemorate Mr. Harper and provide an example of local historic home preservation.

Considering the potentials above, designing the site to be a community park as well as a barrier for pollution, which connects to greenway and also provides residents with outdoor activities, is a way to solve most problems of the site. It should be noted that soil remediation must be taken into the design process.

CHAPTER 5

DESIGN APPLICATION

Landscape Architecture improves the environment by combining arts, ecology, history, culture, sociology and economy in design. The Blaze Recycling & Metal site and surrounding areas will be redeveloped by the combination of remediation technologies and landscape design, to reach the goals as following:

- Eliminate risks from soil contamination and reduce impacts of noise and dust pollution.
- Create a flexible space that meets residents' needs.
- Strengthen community's links to the city.
- Engage the site's existing facilities and keep the site's characteristics.
- Serve as an example to other brownfields that have potential to be reclaimed.

Design Principles

To realize the goals, this design proposal attempts to turn the abandoned site into a regional, culturally-based community park that serves nearby residents and also provides a connection o the city by extending the city greenway to this site. Rather than cleaning up the site first before starting design and construction, this design strive to explore a way that involves the process of eliminating pollution in landscape design. So "combination" is the key word of this design: How should one combine a community park with a greenway harmoniously? How should one combine remediation technologies and other depollution strategies with landscape design? These two questions are answered by this design proposal. The following outline describes the principles of this design:

- Combine landscape architecture with soil remediation and noise and dust reduction

Decorations without substance mean little to Newtown residents, therefore a landscape architecture approach, in which plant cultivation, terrain changes, and material selections are functional and aesthetic, will be used to solve the problem of noise, dust and soil contamination. For example, to combine environmental remediation with landscape design, the sources of noise and dust can be cut off by a landscape buffer, and soil contaminants can be absorbed by plants or isolated from people by pavements.

- Connect the community park to the city greenway system

A greenway is a corridor of open space that connects parks, nature reserves, cultural features, or historic sites with each other and with populated areas (Little 1990). Since it intersects and connects neighborhoods of different racial composition, connecting community and the greenway will improve the greenway's social value (Coutts 2011). Connecting the community park and the greenway will also largely increase the utilization rate of greenways. In the mean time, these accesses will give citizens from other areas a chance to learn about the cultural and historical significance of Newtown and the Fair Street area. By linking to the city greenways the site could mitigate effects of racial segregation and help Newtown residents integrate into city life. In addition, extending the city greenway will also benefit wildlife by creating habitat. However, linking to the greenway will attract more visitors here. To avoid the interference between neighborhood activities and greenway activities, it is better to separate the community park and the greenway but to provide an access pathway and visual interaction to link these spaces.

- Preserve existing facilities and create a sustainable landscape

Instead of demolishing everything on the site and constructing new facilities, using existing facilities is more economical and has less influence on the community. Thus, the existing tennis court, basketball goals, picnic pavilion and community garden will be kept and connected with the new community park. Moreover, to be committed to sustainable design, water, soil and plants on site will be treated as resources. Storm water will be collected to support plant growth and reduce the leak out of contaminants, while as much original soil and native plants as possible will be retained.

- Consider the surrounding context and keep industrial characteristics

The proposed site is located between residential and industrial areas. The park will keep the industrial characteristics by using materials with industrial feelings and displaying remediation theory on board, to remind people of the site's history and the importance of brownfield redevelopment. Also, the park will introduce exhibitions of the history of Newtown and the Fair Street area.

- Encourage residents to join in cultural and educational programs

A successful community park depends on the local community's willingness to visit the park and the degree to which the park fulfills the needs and demands of the community. From many news article in the Gainesville Times, one can read that Newtown residents care about and need cultural and educational, therefore the site proposal will meet this desire by dividing the site into different function areas such as a children's playground, exhibition gallery and performance stage, which can be used for programs all year round. The site will also provide an outdoor classroom for Bethel African Methodist Episcopal Church's educational programming and space for Newtown's regular farmers' markets. Combining cultural and educational programs with active and passive recreational activities will not only enrich residents' lives but also contribute positively to their health. Furthermore, such programs and activities will promote social interaction within Newtown and other community groups in the Fair Street area, through which community members can share emotional connection, life experiences and the history of time and place (Rogers 2009). Such communication will help people build sense of community and strengthen community cohesiveness. Children will also gain both physical and social benefits by participating in these activities (Oloumi et al. 2011).

Design Concept

In consideration of the site potentials and design principles, the site will be divided into a community park and greenway corridor (Figure 5.1) to serve the surrounding residents and greenway users. Residents will hold their own events, like performances and exhibitions, in the community park, while greenway users, who may not want to participate in such events, can continue on their way. Another reason for the separation of spaces is that residents may feel unsafe or intruded upon if visitors are frequently walking near their houses. A walkable berm is an ideal solution to differentiate these two parts that will also help reduce the noise and dust levels. Figure 5.1 shows the combination of a community park and greenway as well as the combination of depollution strategies and landscape design. Figure 5.2 simply illustrates how the space is divided by a greenway berm. Connecting ramps at each end of the park allow residents to make use of the greenway and others to come to know about the community (Figure 5.1).

Figure 5.1: Initial Design Concept

Figure 5.2: Section of Site Division

The placement of entrances is also based on how visitors intend to use the space (Figure 5.1). The main entrance is on Athens Street, which is the busiest street near the site. The entrance for greenway users is also on this street, but to avoid conflict between pedestrians and vehicles, an overpass is illustrated as an ideal way to extend the greenway to the site. There are also two secondary entrances that will make it more convenient for local residents to come to the park. One is at the crossing of Mill Street SE and McDonald Street SE, just opposite Bethel AME Church. Another one is on Desota Street SE, where DeSota Park and Community Garden is located, so that Newtown residents can access the site easily.

To meet potential users' needs, the following list details the proposed activities and functions that can be applied on the site:

1. Outdoor classroom (arts) – Gallery
2. Community events (performances or movies) – Amphitheatre
3. Farmers' market/Exhibition – Community Garden/Open space
4. Soil Remediation – Planting land/Bio-retention
5. Children daily play – Play ground
6. Sports – Sports fields

7. Passive recreation – Greenway

Figure 5.3 is a more detailed map of function divisions that combine remediation with proposed activities and functions. The arrangement is based on terrain and the land's existing facilities. For example, the amphitheater makes use of the berm and will help separate visitors from busy traffic. Bio-retention measures are set up at the lowest points of the site. Figure 5.4 shows the areas for active and passive recreation activities, based on the function divisions.

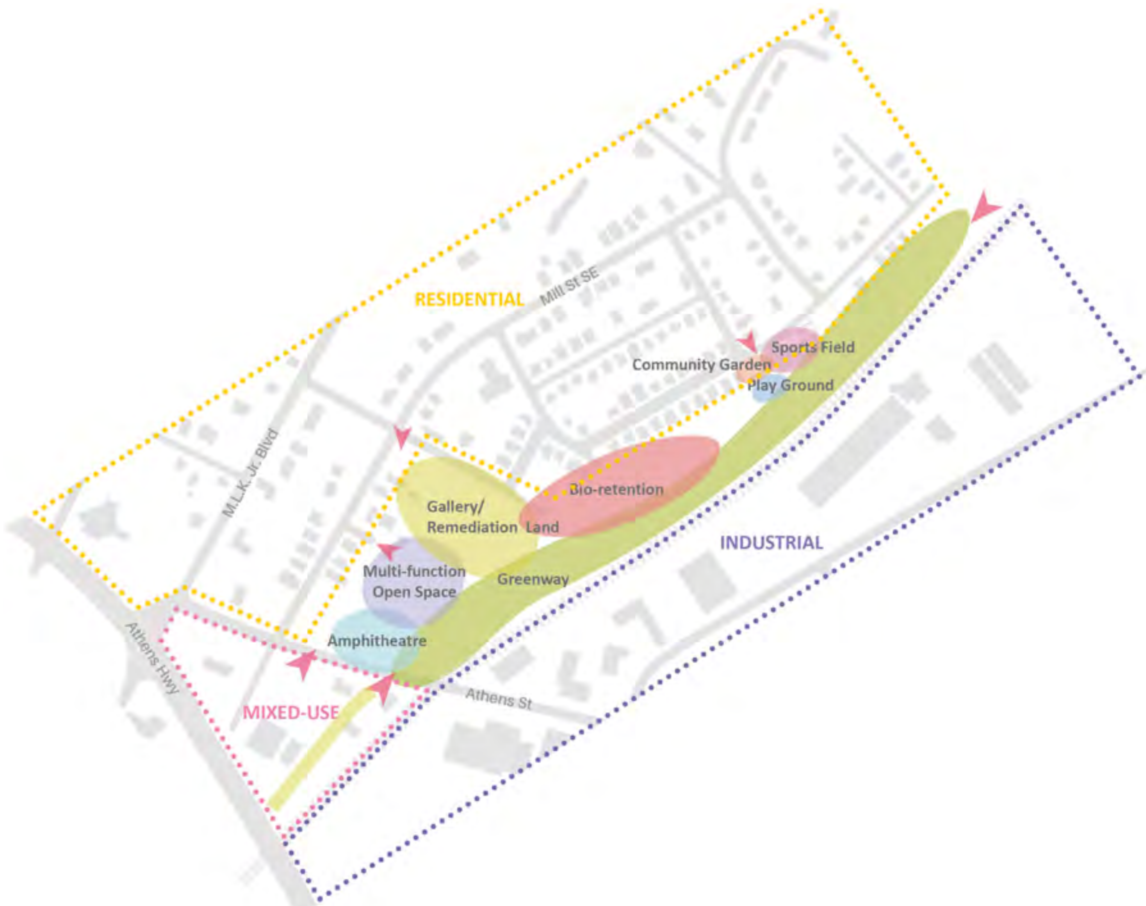


Figure 5.3: Function divisions

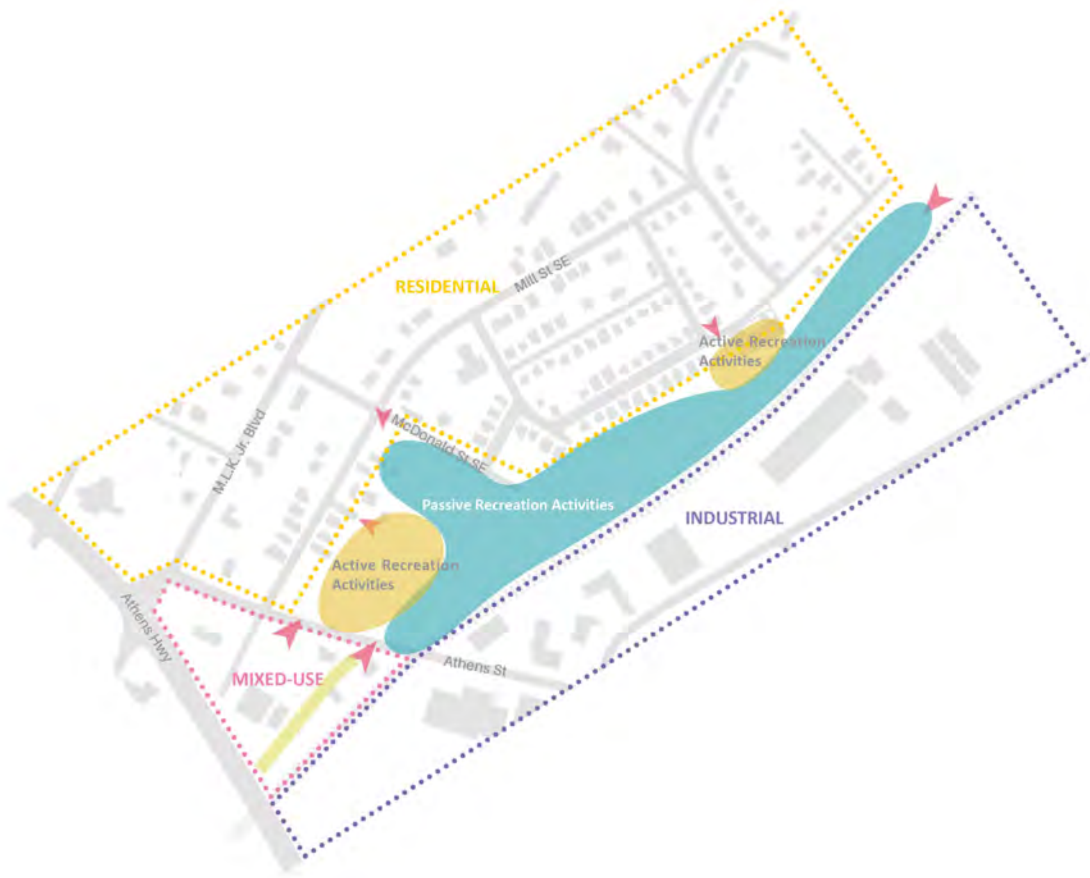


Figure 5.4: Divisions of Active and Passive Recreation Activities

<u>Scenario of Adaptive Remediation Approaches and Landscape Approaches</u>

1. Adaptive Remediation Approaches

With the uncertainty of the site's soil status, it would be rash to choose a specific remedial approach. Thus, at this stage, considering scenarios of adaptive remediation approaches for various soil statuses is the most suitable way to enable further development.

According to the Risk Assessment in Chapter 4, the soil pH may be acidic because of the recycling activities going on. Even though acidification is not the same as heavy metal contamination, it is important to consider acidification to be able to plan for plant growth. Furthermore, the adsorption and mobility of heavy metals is tied to soil acidity. As the ability of absorption and heavy metal mobility increases, the biological accessibility rises, which may lead to heavy metal poisoning (Dinev 2008). To avoid heavy metals further leaking out of soil, saturated lime is an ideal material to use to improve soil pH because of its innocuousness (Dinev 2008).

However, limiting pollutants is not enough to clean up soil and remediate the site. The following selection of remedial approaches will take the pollution degree and costs into consideration, based on possible results of future tests.

Pollution measurements are divided into three levels: severe, moderate and mild. The level of contamination depends on which metals most pollute the soil. High concentration of one or more kinds of heavy metals can be considered a "severe". If there is moderate concentration of one or more kinds of heavy metal, it can be considered "moderate". If one or more kinds of heavy metal slightly exceed regulatory limits, then it could be counted "mild". Each concentration level of each heavy metal is based on regulatory limits. For example, as to lead remediation in The Steel Yard project, "1000ppm to 4000ppm" is "moderate" while "more than 4000ppm" is "severe". Since the U.S. EPA sets 400ppm as the maximum safe limit, "400ppm to 1000ppm" can be considered as "mild".

Figure 5.5 shows the recommended remedial approaches and their estimated costs according to the assessment of each technology in Chapter 2.

First, encapsulating or excavating of soil can largely minimize concentrations of the "severe" level. Encapsulation is a way of containing or capping contaminated soils on site with clean soil, a clay layer, a waterproof membrane or a combination of these solutions (Hollander 2010). Excavation will remove all contaminated soils by hauling them to a regulated landfill with backhoes, bulldozers or front loaders (U.S. EPA 1992).

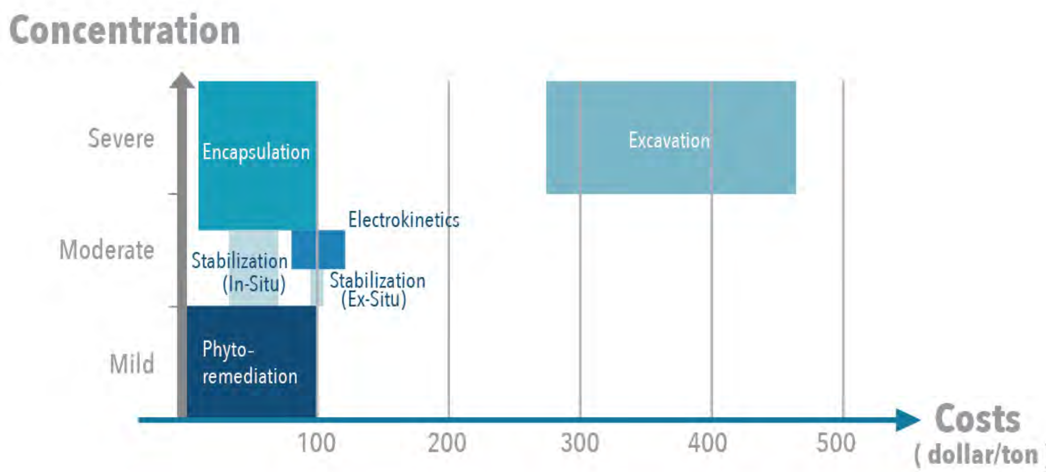


Figure 5.5: Scenario of Remedial Approaches Selection

Second, electrokinetics and stabilization are both applicable, economical technologies to apply to soils of "moderate" contamination. Electrokinetics uses electrochemical and electrokinetic processes to remove metals by causing metal ions to move toward a cathode (FRTR 2015). This technology can be applied on site and treats the soil with anywhere from a few to tens of thousands of ppm (FRTR 2015), but it is largely limited by soil humidity. Stabilization is more suitable for drier soil because it will bind and enclose contaminants in the soil with physical or chemical stabilizers (Reddy 1999). Stabilization can be applied both on site and off site, but it is easier and cheaper to handle on site within a short to medium-term timeframe (FRTR 2015). Generally, stabilization needs to be combined with encapsulation, as an impermeable membrane over the waste soil can prevent vertical migration of contaminants.

Third, since "mild" concentration levels will have little impact on human health, a milder remediation approach can be applied. Among the methods mentioned in Chapter 2, phytoremediation is used frequently because of its low cost, environmental compatibility, public acceptance, and incorporation of plants into design. It is the best technique for both the remediation of and aesthetics of brownfield landscapes. Plants absorb contaminants in the soil through their roots and can be harvested if the roots are saturated (FRTR 2015). For this reason, phytoremediation may not be applicable for moderate to high concentration soils, because of toxicity to plants (FRTR 2015). The selection of plants depends on the results of a soil test, as different plants absorb different metals. Phytoremediation is a long-term remedial technology, so long-term effects have not been fully studied yet (Kirkwood 2001; Hollander et al. 2010), but with growing interest in biological treatment, it will be a more mature technology in the future.

The scenario above is just a suggestion. The selection of specific technologies should be based on actual site cases.

2. A scenario of landscape approaches

To ensure that each remedial approach can be combined with landscape approaches and reach an ecological and economical result, this section takes each condition into account and gives a guide below to show how the combination works.

a. Excavation

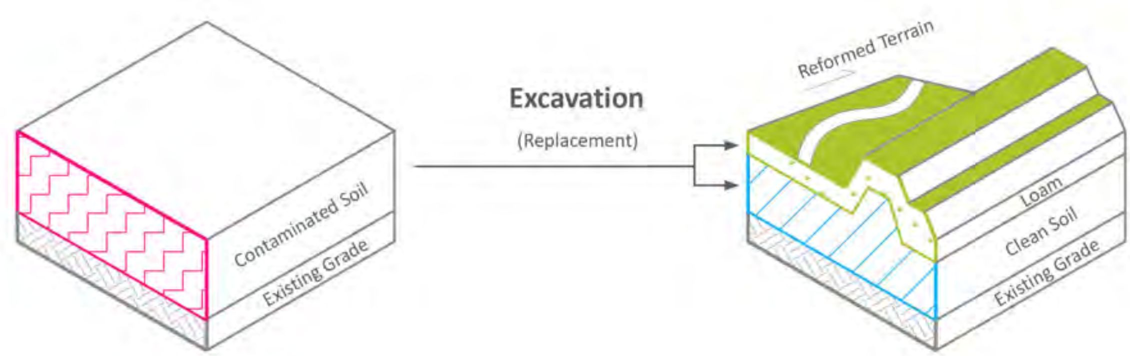


Figure 5.6: Excavation

If soil should be excavated, it will be replaced by clean soil. Generally, the backfilled clean soil is either soil from other sources or treated contaminated soil. To help plants grow well, it would be better to add a layer of loam on top. The process of backfill allows for changing the terrain. Terrain around a bio-retention facility or a rain garden can be further excavated and reformed to collect more storm water. In this way, more soil can be collected to build a berm. Excavation is a large project that will be expensive, but it is a fast way to clean up the site. Using soil reasonably can help reduce the budget.

Both stabilization off-site and electrokinetics require to clean soil first. So for this thesis two technologies also applies to this scenario.

b. Encapsulation/Stabilization

Keeping the contaminated soil on site is cheap, but the soil should be encapsulated so that park visitors won't be in direct contact with contaminants. It means that the contaminated soil should be isolated from people by other layers. Three steps are needed: First, a stabilizer should be applied on the site to avoid contaminant leak-out and

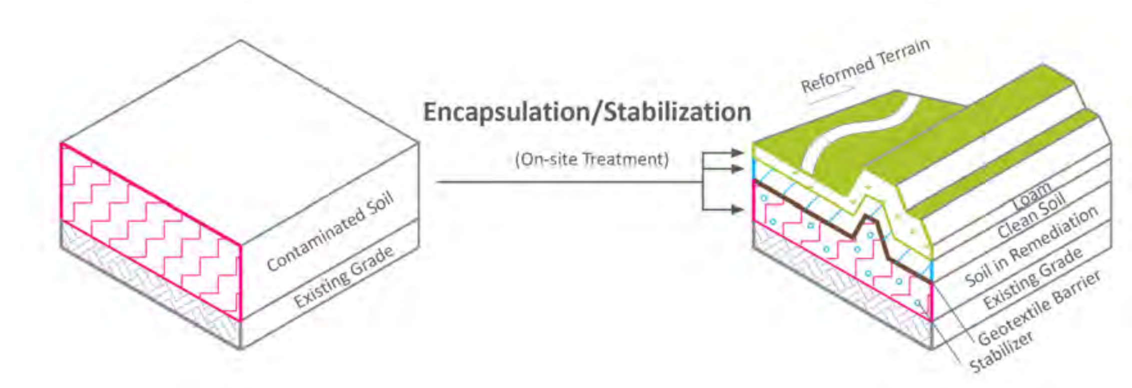


Figure 5.7: Encapsulation/Stabilization

infiltration into deeper soil and underground water. Second, to prevent water from spreading contamination, a geotextile barrier should be applied to separate the contaminated layer with surface runoff. Third, based on the space functions, a layer of clean soil, drainage base or other materials could be added on top of the barrier. Even though the treatment of soil is different from excavation, terrain reformation mentioned above also applies to this scenario to help use soil economically.

c. Phytoremediation

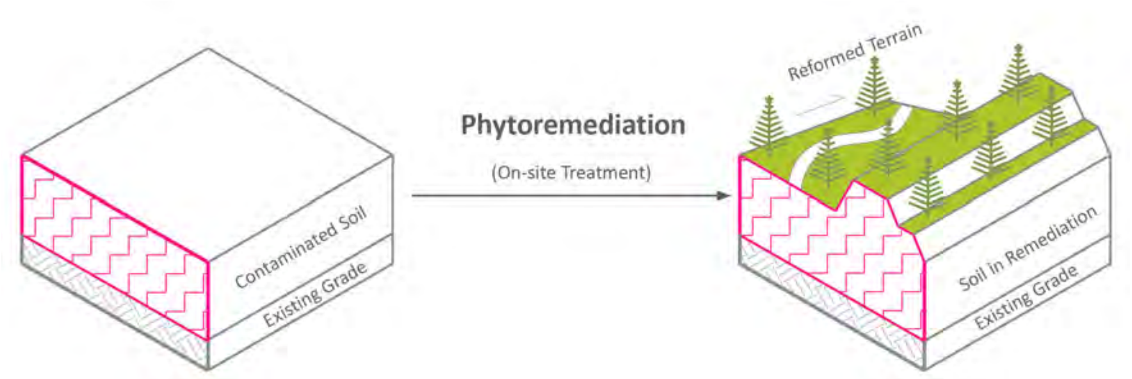


Figure 5.8: Phytoremediation

If the soil is slightly contaminated but relatively safe for human beings, the soil can be kept on site and treated with phytoremediation. Plants have both remedial and aesthetic values, so remediation can proceed when the site are put into use. The selection of plants is based on their ability to absorb contamination and provide aesthetic value. In fact, the contamination level of soils may vary in different parts of the site based on its former use. So the three ways of combination above can cooperate with each other to realize the most efficient result. If the soil is not contaminated, remediation is obviously not required. Only terrain reformation and soil fertility should be taken into account.

Plan and details

The master plan (Figure 5.9) derives from site analysis and design concept. In this plan, a long berm will be built along the railroad and Athens Street, protecting Newtown like a barrier by separating residents from the railroad and industrial areas. The berm and Newtown enclose an open space for residents' activities, of which the scale is intimate and close, creating a feeling of being immersed in the neighborhood. Such an enclosed space suggests that the site is a community park for the residents. Above the enclosed space, there is a corridor that serves as a greenway on the berm. The berm distinguishes the community park from greenway for residents and greenway visitors by difference in elevations, and two ramps provide connection between the two parts (No.10 in Figure 5.9).

1. Community Park

The main entrance of the park (Figure 5.11) is on the main street, Athens Street, and next to the sidewall of the amphitheater. The amphitheater lies on the berm along Athens Street, reducing the impact from noisy traffic and providing a leisure area for visitors.

Figure 5.9: Master Plan

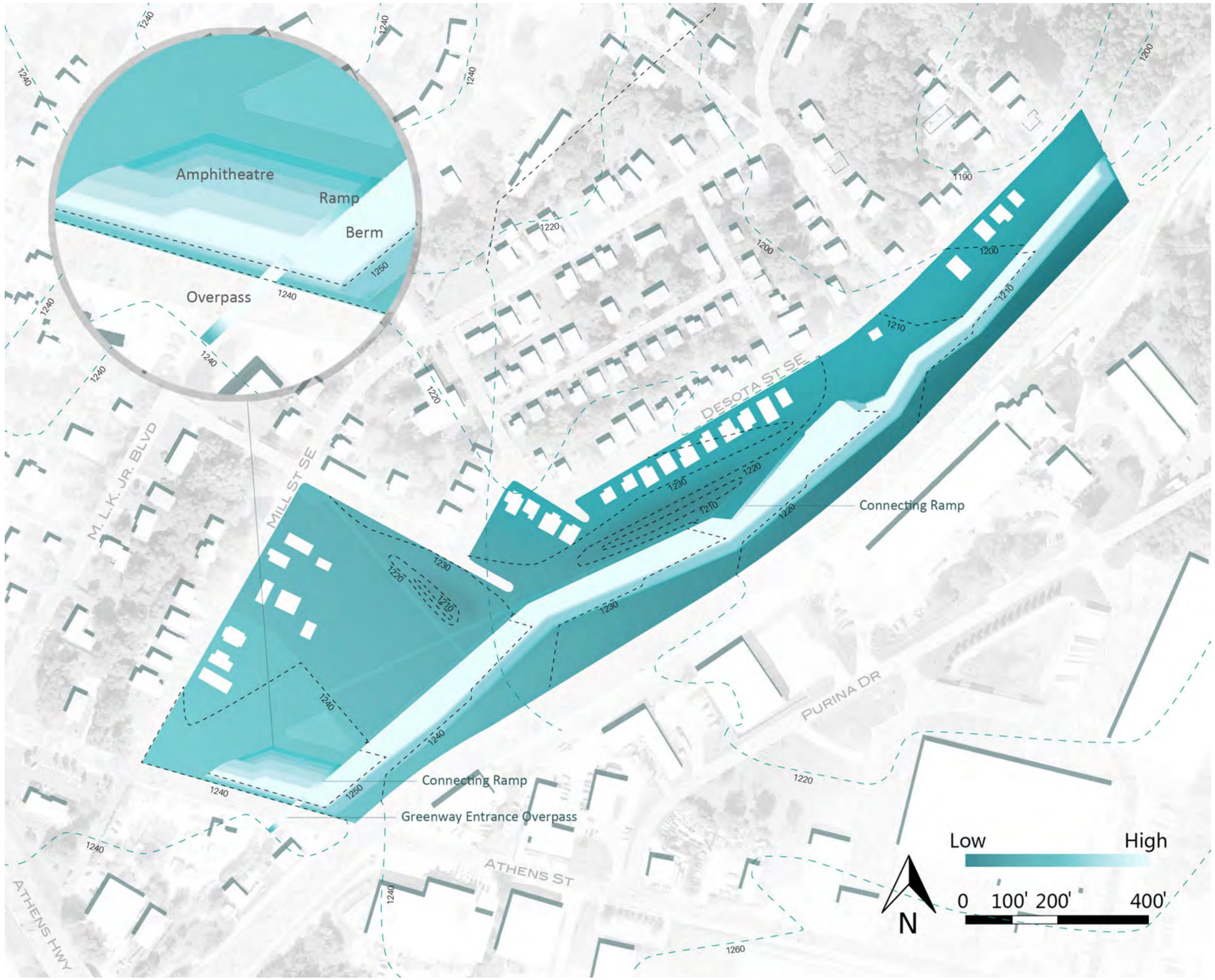


Figure 5.10: Elevation Plan

The central open space is a plaza (Figure 5.12) for holding various events. As the Newtown community has decided to hold a farmers' market every month, residents and other visitors can come and sit under the pavilion to enjoy fresh fruits and vegetables. The center stage can also be used for speeches, performances, competitions and outdoor movies to enrich local peoples' lives and encourage at-risk youth and families to participate in educational programming.

Figure 5.11: Main Entrance

Unlike The Steel Yard, there is no existing structure of Blaze Recycling & Metal that is worth keeping and reusing on site. But the wall of the berm and three exhibition walls in remediation field will use rusted steel be to reflect industrial feeling. The history

Figure 5.12: Community Park

timeline, stories and scenes will be carved on the berm wall to remind visitors of the local industrial history. Next to the center plaza is an exhibition space with a natural landscape used for arts education program. People in these programs can show their works on three exhibition walls. The grid-pattern land can be used for phytoremediation if pollution level is low and not harmful by direct contact with contaminants. After the soil is cleaned up, the site will be landscaped with new plants for an aesthetic appeal or turned into a community larger than the existing small one. The storm water of remediation land will be drained to bio-retention, which is located at a low-lying area to collect storm water on site.

The existing community garden, basketball field and tennis court are kept so that Newtown residents can continue using them. The footpath in the community garden is extended to the new park. A playground (Figure 5.13) for children is between the berm and sport courts with sand pit, climbing wall, slides and swings. Climbing wall and slides will be built by utilizing the height of the berm.

Figure 5.13: Playground

2. Greenway

An overpass on Athens Street will connect the planned greenway to the site. It will also serve as an ecological corridor that allows an exchange of wildlife between populations. After people walk across the over path, they can choose to walk down the slope to the community park or to continue walking the greenway.

A sequence of distinctive areas along the greenway, including the Viewing Balcony, Lawn, Wildflower Field, Playground and Long Bench, will enrich the trip experience. These areas allow visitors to rest and enjoy the natural landscape and community events.

People walking on the greenway will feel a strong contrast between residential and industrial areas, which emphasizes the site's mixed history.

3. Environmental Treatments

a. Soil

The remedial technologies for soil in this design are selected based on the assumption of soil contamination level on the site (Figure 5.14). The resultant design is mainly influenced by three factors: terrain, surface property (impervious/vegetation) and metal recycling activity. First, terrain determines the direction of storm water flows. As storm water will bring contaminants when it is flowing and help contaminants infiltrate into soil, lower points on site may collect more contaminants, especially when higher points are paved with impermeable materials. Second, the contamination level is associated with surface characteristics. It is hard for contaminants to infiltrate when the surface is impermeable. So the soil exposed to contaminants is more likely to be polluted. But for those areas that grow various plants grow in soil, it may help absorb some of the contaminants to reduce storm water contamination level. Third, the closer to metal recycling activity, the more likely soil gets contaminated. So the area that is still occupied by The Blaze Recycling & Metal may have more severe pollution than other areas.

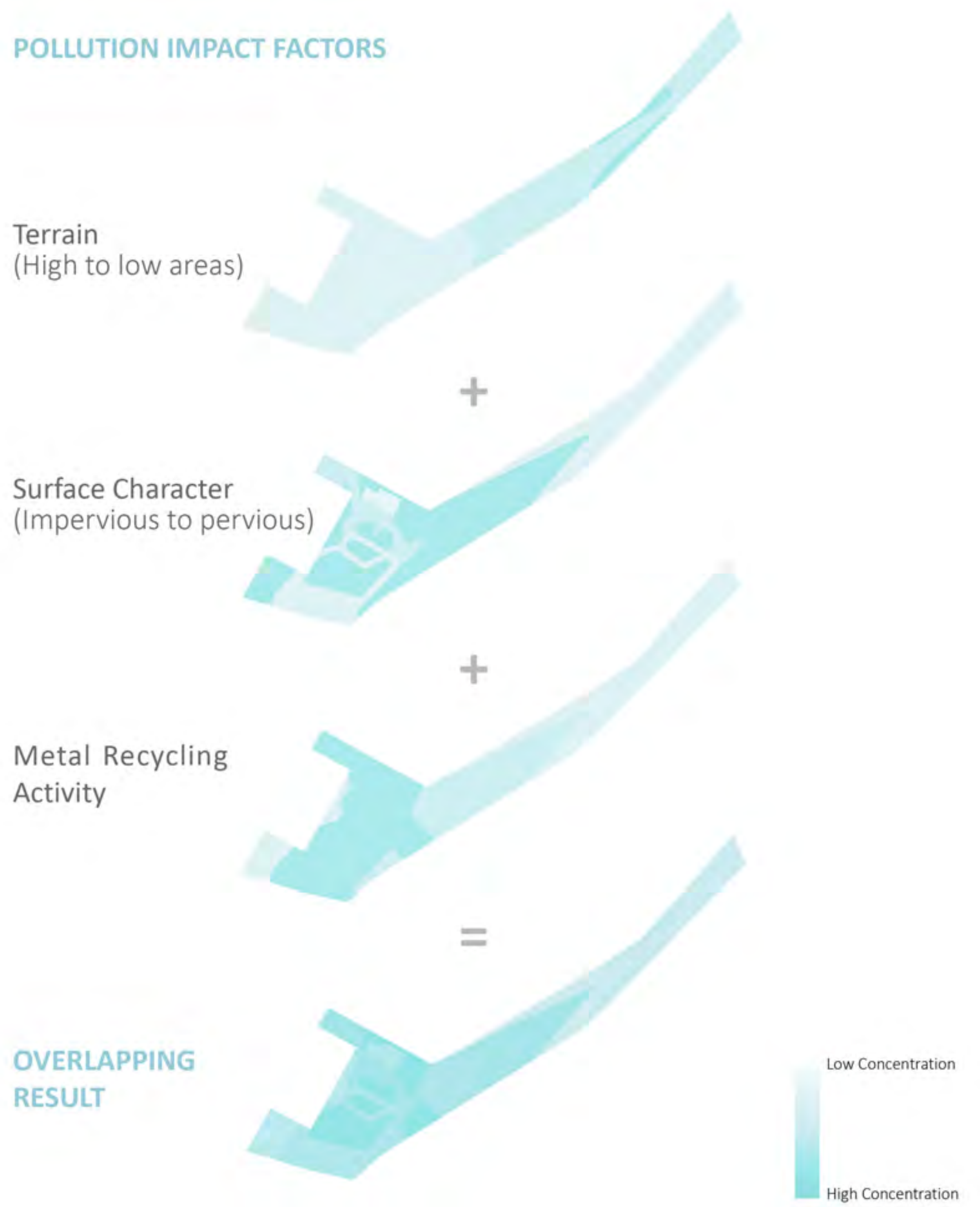


Figure 5.14: The Assumption of Pollution Level

Overlapping these three factors generates the final graphic of result (Figure 5.13). The darker the color is, the more severe the level of soil contamination. The following sections (Figure 5.15, Figure 5.16 and Figure 5.17) give examples about how remedial technologies work with landscape design. In Figure 5.15, the pollution degree is assumed "moderate", so the soil is treated with the combination of encapsulation and stabilization. For some areas, two or more technologies are required because the soils in these area are in different pollutiion levels. After excavating all the soil with a high concentration of contaminants, soil with a low concentration can be moved and treated intensively in the remediation, as Figure 5.16 shows. In Figure 5.17, exacavation, encapsulation and stabilization are used, so a geotextile barrier is used to isolate contaminated soil from clean soil. Most of the storm water on site will be collected on site by bio-retention to keep contaminants from leaking out.

b. Noise and Dust

The treatments for noise and dust rely on the berm. The berm is supported by pre-cast concrete. Generally a freight train is about 12 to 14 feet high (CSX 2015). The height of berm is 9 feet. A rough façade of the berm on the side of railroad is helpful in reflecting and absorbing sound. The heights of plants on the berm vary from 10 to 35 feet. So it will also help absorb most noise from railway and industrial area and reduce dust in air largely.

Most of these treatments are visible to the public and illustration boards will let the public know more about the impact of industrial activities and the importance of sustainable design.

4. Selections of Materials and Plants

To reflect the characteristics of industry and the former abandoned landscape, industrial and robust materials, like reclaimed wood, concrete, weathered steel and crushed stone, will be used. Permeable paving will help collect most runoff on site and the land gradation will direct it to the bio-retention facility.

The selection of plants should first meet the requirement of soil remediation and noise and dust reduction. On this basis, plants, especially grasses and perennials that help define a wild landscape will be chosen, like sunflower and sunshine vetivergrass. Native and easily colonized plants are also selected for their rapid growth and low costs, like River Birch and Tulip Poplar.

Species for phytoremediation vary depending upon the contaminants. Evergreen shrubs and trees are excellent for noise and dust reduction, as all parts of the plant – leaves, branches and twigs – are able to absorb sound and obstruct dust. The denser a plant is, the better sound-reducing effect is reached. So the best species are those that have many branches and broad leaves.

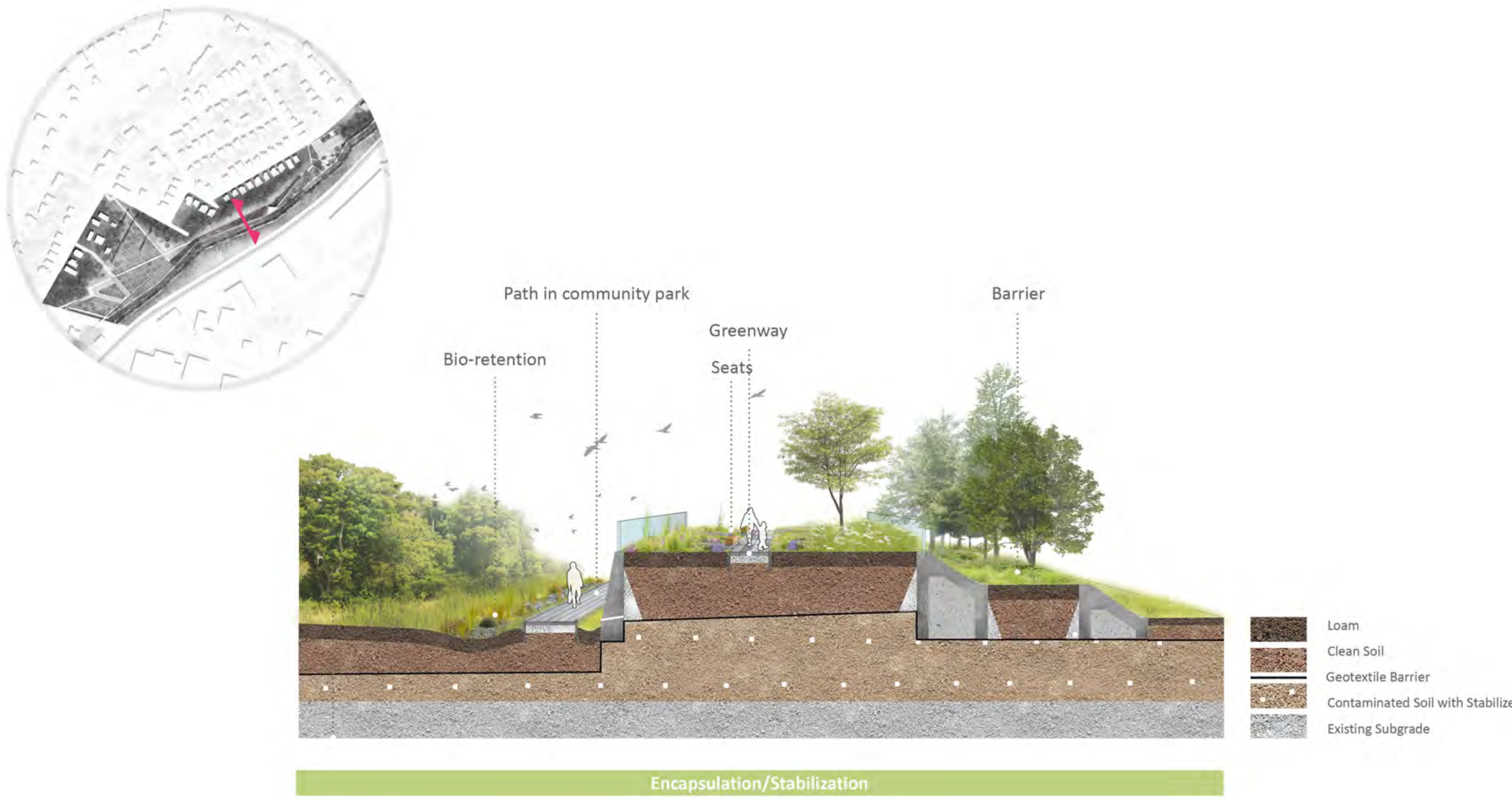


Figure 5.15: Section 1

Figure 5.16: Section 2

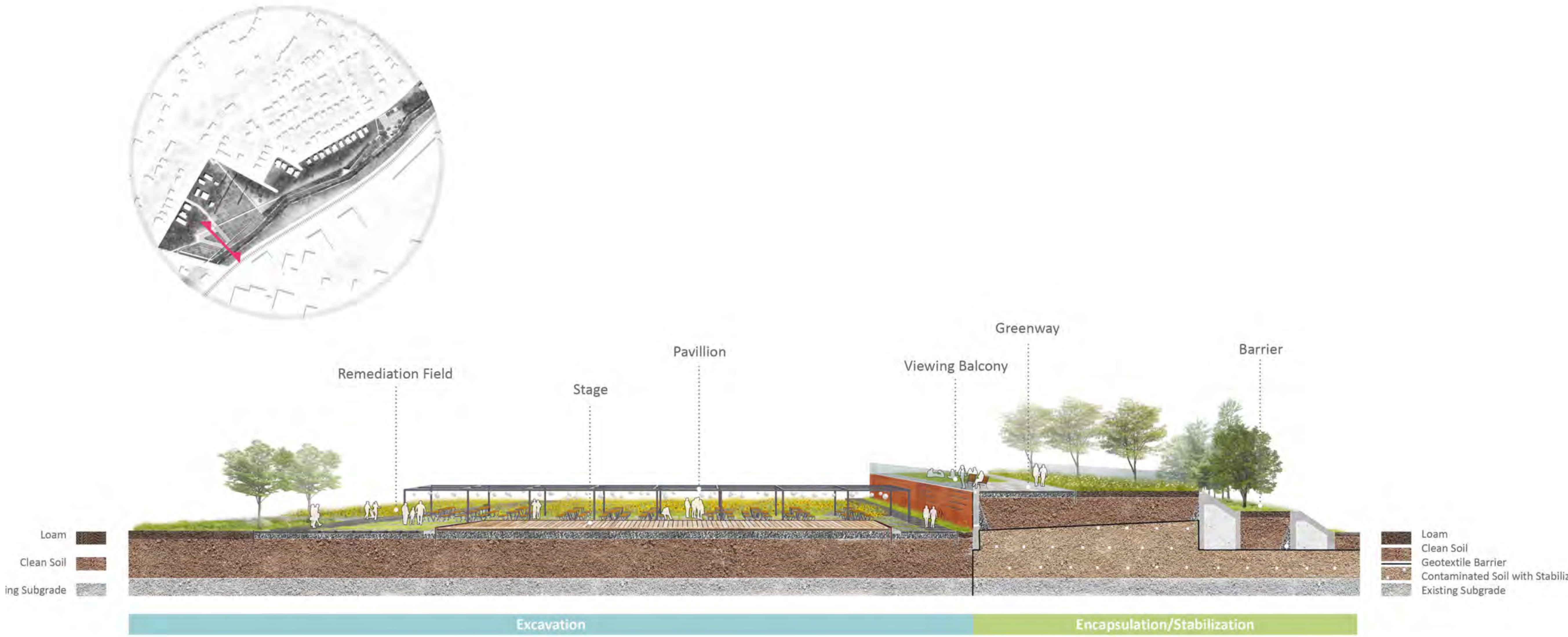


Figure 5.17: Section 3

CHAPTER 6

CONCLUSION

Contribution and Significance

This thesis aims to explore an effective solution to reclaim the brownfield, reduce the impact from industrial activities and turn the site into a park that serves the surrounding neighborhoods. The final design proposal is achieved by the combination of remediation technologies and landscape design and the combination of the community park and the greenway. It not only helps Newtown residents eliminate health risks, but also revitalizes the site by taking industrial history, the need for greenway connection and the surrounding land development into consideration. This thesis can be a reference for city planners and landscape architects to improve the environment of Newtown and Fair Street Area.

This design attempts to explore landscape architecture solutions to solve brownfield problems and land planning conflicts. It will provide ideas and thoughts for similar future projects. Landscape Architecture is not omnipotent; it will work better with other disciplines' support and when taking into consideration current research, like technologies with high effect, low cost and low negative impact. This thesis also encourages more people to pay attention to brownfields, especially brownfields near residences. By reclaiming brownfields, their negative impacts can be mitigated or removed, and local residents as well as the wider city will feel the benefits.

Further consideration

Even though the soil pollution level is uncertain at present because of the limited soil testing, the scenarios of how to deal with different soil pollution levels propose corresponding solutions for future reference. This design proposal is based on site potentials and the assumption of pollution level. To ensure that the solution best applies to the site, the following aspects are worth further consideration and research:

1. A soil test to determine contamination level is required before remediation. The level of contamination, type of contaminant, and the seriousness of the pollution should be defined.
2. Technologies for remediation are continually developing. A more appropriate technology for this site may arise , so exploring new technologies is recommended before project implementation.
3. The implemented plan should meet the emerging requirements of the regions and local residents. New community programs may need new facilities and the surrounding development, like shopping center, may bring new potential users.
4. Other similar cases will provide guidance, new ideas and new strategies for redevelopment.

Finally, to avoid other residents suffering from pollutants in future, people should resolve the brownfield issues fundamentally, rather than making efforts to reduce the impact of brownfields and industrial activities on residents. Thus, a reasonable, ecological and sustainable urban planning and an industrial pollution control plan are required to solve the issues so that residents can live away from pollutants.

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APPENDIX A

SOIL TEST REPORT

THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
Colleges of Agricultural and Environmental Sciences & Family and Consumer Sciences

Soil, Plant, and Water Laboratory
2400 College Station Road
Athens, Georgia 30602-9105
Web site: http://aesl.ces.uga.edu

Soil Test Report

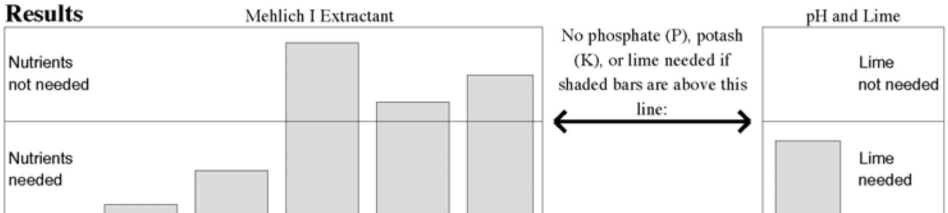
(CEC/CEA Signature)

Sample ID

Client Information xiweiwu@uga.edu	***Lab Information***	***County Information***
Wu, Xiwei 1005 Macon Hwy., Apt 1508 Athens, GA 30606 Sample: 1 Crop: Shade Trees	Lab #18918 Completed: Dec 4, 2014 Printed: Dec 4, 2014	**Clarke County** 2152 W. Broad Street Athens, GA 30606 phone: 706-613-3640 e-mail: uge1059@uga.edu

Results

Mehlich I Extractant



	Phosphorus (P)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)	Zinc (Zn)
Soil Test Index	14 lbs/Acre	148 lbs/Acre	2106 lbs/Acre	194 lbs/Acre	133 lbs/Acre

pH	
5.4	Soil Test Index

Recommendations

Can't find a specific grade of fertilizer? Try our Fertilizer Calculator: http://aesl.ces.uga.edu/soil/fertcalc/

Limestone: 105 pounds per 1000 square feet

Recommended pH: 5.5 to 6.0

Estimate canopy spread in square feet (width x width). Apply 2 cups of 10-10-10 fertilizer per 100 square feet of canopy spread. Reduce the rate by one-half for conifers such as pine, cedar, hemlocks and juniper or for trees located in a fertilized lawn. Broadcast the fertilizer evenly underneath the foliage mass and extending well beyond the dripline, if possible. Apply only when lawn grass is dry. Nitrogen fertilizer is most efficiently used and poses less risk of environmental contamination if applied to dry soil and watered into the soil the same day.

Fertilization of deciduous trees and shrubs should begin as buds swell, approximately two weeks before bud break. Thereafter, if using conventional fertilizers, reapply fertilizer every 16-20 weeks with the last fertilizer application occurring in August (North GA) or September (South GA). Fertilization of broadleaf evergreen and needled evergreen trees and shrubs with conventional fertilizers should coincide with the emergence of new growth in the spring and again in the early fall; as most evergreen trees and shrubs have two active growing periods annually and undergo a dormant period during summer months. Fertilization outside of active growing periods is not necessary. Applying conventional fertilizers to any ornamental plant in late fall or early winter can cause significant winter damage and should be avoided.

In both deciduous and evergreen trees and shrubs, the use of controlled-release (syn: slow-release) fertilizers can be used to minimize the number of fertilizer applications annually. Controlled release products are available that only need to be applied once annually, typically coinciding with the onset of spring growth.

Learning *for* Life
The University of Georgia and Fort Valley State University, the U.S. Department of Agriculture and counties of the state cooperating.
Cooperative Extension offers educational programs, assistance and materials to all people without regard to race, color, national origin, age, gender or disability.
An equal opportunity/affirmative action organization committed to a diverse work force.

APPENDIX B

TOTAL ACID DIGESTION (TOTAL ELEMENT ANALYSIS)

UGA Soils Report - Total Acid Digestion

Soil, Plant, and Water Laboratory

Client Information xiweiwu@uga.edu	***Lab Information***	***County Information***
Wu, Xiwei 1005 Macon Hwy., Apt 1508 Athens, GA 30606	Completed: Dec 4, 2014 Printed: Dec 4, 2014	**Clarke County** 2152 W. Broad Street Athens, GA 30606 phone: 706-613-3640 e-mail: uge1059@uga.edu

Results

Lab		18918
Sample		**1**
Al	(ppm)	**16899**
B	(ppm)	**8.496**
Ca	(ppm)	**1483**
Cd	(ppm)	**1.510**
Cr	(ppm)	**13.59**
Cu	(ppm)	**25.51**
Fe	(ppm)	**11426**
K	(ppm)	**1254**
Mg	(ppm)	**660.7**
Mn	(ppm)	**153.3**
Mo	(ppm)	**<1**
Na	(ppm)	**111.2**
Ni	(ppm)	**9.288**
P	(ppm)	**342.2**
Pb	(ppm)	**69.52**
S	(ppm)	**326.8**
Zn	(ppm)	**166.3**