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Thursday, March 04, 2004

Mr. Timothy P. Murray
Mayor of Worcester
City Hall Room 305
455 Main Street
Worcester, MA 01608

Dear Mayor Murray,

We have enclosed our final report titled, "Brownfield Redevelopment Database Initiative" for the Mayor's Brownfields Property and Business Owners Education and Outreach Committee.

We would like to extend our gratitude for the opportunity to work with the City of Worcester. We greatly appreciate all the help given to us and we hope that you find this project useful and well done. If you have any questions in regards to this report or the project please feel free to contact any of the members via our email address. Thank you again for your time and help in making this project a reality.

Sincerely,

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BROWNFIELD REDEVELOPMENT DATABASE INITIATIVE

An Interactive Qualifying Project Report
submitted to the
Mayor's Brownfields Property and
Business Owners Education and
Outreach Committee
and the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by

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Date: March 04, 2004

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Abstract

Worcester has been burdened by a lack of suitable land for commercial and industrial business to develop for years. Brownfield sites are considered economically or financially dangerous due to possible liability issues. In order to organize information about suspected sites, and reduce hesitation about developing on brownfields, our group created a database accompanied by a maintenance manual for potential developers and the City of Worcester.

Acknowledgements

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Table of Contents

1 Introduction 1
2 Background 4
2.1 History of Worcester 4
2.1.1 Pre-Industrial Revolution 5
2.1.2 The Industrial Revolution 6
2.1.3 Post-Industrial Revolution 7
2.1.4 The 1990s 9
2.1.5 Worcester's Present Condition 10
2.1.6 What Has Been Accomplished in Worcester So Far 12
2.1.7 What Else Can Be Accomplished 14
2.1.8 Conclusion 14
2.2 Classifying Brownfields in Worcester 15
2.2.1 Phase I 16
2.2.2 Phase II 17
2.2.3 Post-Investigation Process 17
2.3 Laws and Regulations 17
2.3.1 Federal Legislation 18
2.3.1.1 Owner Liability and Funding Incentives 19
2.3.1.2 Tax Benefits and Credits 20
2.3.2 State Legislation 21
2.3.2.1 State Acts/Policies 21
2.3.2.2 Lender Liability 22
2.3.2.3 Tax Benefits and Credits 23
2.3.2.4 Conclusion 24
2.4 Past Dealings with Brownfields 24
2.4.1 Brownfield Redevelopment in Other Cities: Applications in Worcester 25
2.5 The Purpose of the Brownfield Database 26
2.5.1 From Physical Information Systems to Electronic Databases 26
2.5.2 Worcester's Current Brownfield Information System 28
2.5.3 Types of Data within Databases 28
2.5.4 Database Models 29
2.5.5 The Entity-Relationship Data Model 30
2.5.6 The Relational Data Model 32
2.5.7 Databases and Worcester's Brownfields 33
2.6 Electronic Databases to Geographic Information Systems 34
2.6.1 Advantages and Requirements of Geographical Information Systems 35
2.6.2 Geographical Information Systems and Brownfield Redevelopment 35
2.6.3 Conclusion 36
3 Methodology 37
3.1 Methods of Data Collection 37
3.1.1 Physical Data Collection Process 38
3.1.2 Electronic Data Collection 39
3.1.3 Interviews 40
3.1.4 Focus Groups 41

3.1.5 Necessary Data for Decision Making 42
3.1.6 Brownfield Site Visits 46
3.1.7 Conclusion 46
3.2 Data Analysis and Conversion into a Database 47
3.2.1 Software Use 47
3.2.2 Conclusion 48
3.3 Project Schedule 49
3.3.1 Time Frame and List of Activities 49
3.3.2 Team Member Jobs 49
4 Data Analysis 51
4.1 Introduction to Qualitative Findings 51
4.1.1 Structure of the Database 51
4.1.2 Database Attributes 52
4.1.3 Database Maintenance 53
4.1.4 Presentation of the Database 54
4.2 Database 57
4.2.1 Standards Followed 57
4.2.1.1 MassGIS Standards 58
4.2.1.2 Other Standards 59
4.2.2 Features 60
4.3 Summary 63
5 Conclusions 65
5.1 Recommendations 65
5.1.1 General Recommendations 65
5.1.2 Technical Recommendations 68
5.2 Project Conclusions 71
5.2.1 Accomplishments 71
5.2.2 Improvements 72
5.3 Implications 73
5.4 Summary 74
References 75
Appendix A – Interviews and Focus Group 80
Non-Developer Interview Questions 80
Developer Interview Questions 81
Database List for Interviews 82
Interview Procedures 83
Focus Group Procedures 84
Focus Group Questions 85
Appendix B – Standard Field Names 86
PARCEL Table 86
ASSESSOR Table 86
DEP Table 88
Appendix C – Database Manual 95

Table of Tables

Table 1: Archival Research 39
Table 2: Critical Path Method Diagram 49
Table 3: Searchable Fields 52
Table 4: Database Data Fields 53
Table 5: GIS Usability 55

Table of Figures

Figure 1: An Entity-Relationship Diagram (Ullman & Widom, 2002) 32
Figure 2: Example Microsoft Access Table 61
Figure 3: Example Microsoft Access Query 62
Figure 4: General Data Entry/Search Form 63

1 Introduction

Worcester introduced over one thousand businesses and industries into the developing American economy (Southwick, 1998). Worcester's economic growth and prosperity continued to increase until it reached its peak at the end of World War II (Little, Inc., 1960). Since then, there has been a steady decline in Worcester's industrial base resulting in decreases in tax revenue, population, and jobs (Worcester Municipal, 1997).

Fortunately, Worcester has an existing industrial infrastructure that can help the City reclaim its previous industrial status and encourage other businesses to take root. Revitalization of the City's economic base through an increase in tax revenue received from newly developed industries in Worcester (Worcester Regional, 2003) is what the City needs right now. However, past environmental contamination of Worcester's industrial and commercial properties damage the potential of revitalization.

Contamination is a result of the improper disposal of hazardous chemicals and other environmental wastes, as well as industrial accidents such as spilling due to the corrosion of underground tanks storing oil. These contaminated sites are now known as "brownfields," which are defined 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" (Environmental Protection Agency [EPA], 2003).

An important opportunity for industrial revitalization in Worcester lies in the promise of companies outside of Worcester investing in the City (Jacobson, 2003). Several investors demand storage and facility space (City of Worcester, 2001), such as single story, modern facilities with at least 30,000 square feet and contiguous land for

storage and or parking (Murray, 2003). Meeting these investor demands is challenging for an older industrial city like Worcester. The City has commercial and industrial land space to offer, but many sites are classified as, or perceived to be brownfields. Due to the possible liability acquired when purchasing a brownfield property, investors and developers are deterred from participating in the development of the land. As a result, the City of Worcester fails to gain tax revenue from these underutilized properties. Other industrial based cities have taken advantage of brownfield redevelopment to induce economic prosperity, and Worcester has planned to do the same with the initiation of new projects (Worcester Municipal, 2000).

In order to meet the demand for commercial and industrial space in Worcester, the City must first identify and classify available property for potential investors (Murray, 2003). With the commercial and industrial properties identified, developers and investors can then more easily find a property that suits their needs. If Worcester does not classify and identify the available property, companies may be forced to look outside the City for property meeting their requirements (Worcester Regional, 2003). Additionally, the lack of data and organization of important details concerning brownfields such as site condition, lot size, and the owner contact information, has slowed down the brownfield redevelopment process that the City depends on.

The purpose of this project was to create a prototype database complete with geographic information systems (GIS) that Worcester can use for future investor inquiries on brownfield sites. This database includes the necessary information about the sites and is accompanied by a user manual with the purpose of aiding in the maintenance, usage, and updating of the brownfield database and GIS. Also included in the manual are

suggestions on where and how to find resources needed to collect data about the remaining unknown brownfield sites to aid in future research on brownfields. This database and manual were created by examining twenty potential brownfield sites. These efforts will help investors in making informed decisions on whether it is feasible or not for them to purchase or invest in these underutilized properties.

In order to accomplish our goals we researched the history of Worcester's brownfields and examined different methods of database construction and implementation. Next, we determined the standards for the data to be included in the database with the aid of archival research, interviews and focus groups, and then physically collected the data. Finally, we used the data to mold the structure of the database, and formatted the data in a way that is presentable to our target audience: developers, investors, property owners, companies, and the City.

2 Background

For the last seven years, brownfields have made a significant impact in the processes of city planning and the development and environmental news of many major cities. Environmental organizations and even the government have gone out of their way to provide certain cities with grants of thousands, and sometimes millions of dollars to help with the redevelopment process of brownfields (Jacobson, 2003). Congress, state, and local legislatures have also helped brownfield cleanup by creating laws and policies to support it (Gerrard, 2003). Brownfield redevelopment will increase Worcester's revenue and will help revitalize the once prosperous city. This chapter focuses on the historical and legal aspects of Worcester as a city and the brownfield redevelopment process. The chapter also examines the validation of brownfield redevelopment for Worcester and how the redevelopment of underutilized properties has aided other cities. Also examined is how to create a database and a Geographic Information System and how they aid in the revitalization of both brownfields and the City of Worcester as a whole.

2.1 History of Worcester

The history of Worcester plays a key role in the creation and evolution of brownfields in the City. This segment of the background chapter provides a brief history of how Worcester became the post-industrial city that it is today. It also includes a discussion of negative environmental actions and decreasing flow of business through the industrial revolution to the end of World War II affecting Worcester to bring it to its

present state, and what can be done to help decrease the amount of commercial/industrial brownfield properties in Worcester.

2.1.1 Pre-Industrial Revolution

By 1840, five years after the Boston & Worcester railroad began service, the population of Worcester had grown to almost 7,000 (Southwick, 1998). Worcester lacked large amounts of suitable land for farming and with a growing population, some type of industrialization had to occur (Muir, 2000).

Worcester could not provide the large shipping needs necessary for big business. Waterpower, a commodity for industry, was scarce in Worcester. The large textiles mills, which initially shaped the landscape of cities like Lowell, could not be supported by the amount of waterpower in Worcester or the available modes of shipping (Lebarron and Hubbard, 2003). Small industry fit perfectly into the landscape of Worcester, because small industry required less waterpower and had fewer shipping needs. The result was a very diverse community of industry, but this diverse community marks the initiation of a future of diverse types of contaminants now found in the ground.

In 1828, the Blackstone Canal was completed between Providence and Worcester. It was the first major waterway to and from Worcester, and finally provided the rapidly expanding town with direct access to the ocean (Nelson, 1934). With the Canal came big business. In 1827 the first large industries developed. Paper mills were erected and five large machine shops were opened along with a few other smaller businesses. The year 1827 was just the beginning of a much larger phenomenon, and by 1837, Worcester industry was manufacturing goods worth close a million dollars annually (Nelson, 1934).

The year of 1835 marked the opening of the Boston & Worcester railroad, which sped up the process of industrialization. Thirteen years later, Worcester was the rail hub between Boston, Springfield, Albany, Norwich, Providence, Nashua, and Rochester due to its' key location (Nelson, 1934). The railway system connected the Atlantic Ocean to the Erie Canal, which allowed cheaper and faster travel to the west encouraging industry expansion in Worcester.

2.1.2 The Industrial Revolution

By 1865, the population in Worcester had grown to around 30,000 (Southwick, 1998). The amount of jobs increased with the rising population due to increasing industrial growth. By 1850, Worcester industry was producing tools, wire, boots and shoes, paper, woolen products, plows and other agricultural tools, shears, and boxes and cards to name a few (Southwick, 1998). The City was no longer an infant in the revolution by 1865, with over 1000 industries and businesses (Southwick, 1998). However, the success of the industrial revolution was already taking its toll on the environment. Sewers flowed freely into the Blackstone River, and black smoke and soot were produced in large amounts all over the City (Southwick, 1998). Other materials such as lead also started seeping into the ground (Environmental Protection Agency, 2003). And by 1898, the very diverse community of industry that had started industrializing the City of Worcester before the revolution now produced over 3,000 different goods which also meant that many different contaminants from several different industrial processes were entering the ground at an increased pace (Nelson, 1934).

The large amount of goods produced by Worcester in 1922 were increased by World War I because of the large war time contracts given to industries within the City to

produce for the war effort. Worcester Pressed Steel Company is an example of how large the manufacturing increase was for an individual company in Worcester. The company increased production from $5,000 a year before the war to $2,250,000 just afterwards (Nelson, 1934). The City was setting itself up for disaster. If the production could not keep up then there would be a loss of jobs when the war was over. Fortunately, for Worcester much of the country still had not industrialized which provided Worcester with an advantage over most cities at the end of the war. People would still need goods and Worcester was still one of the only fully industrialized cities that could provide them.

2.1.3 Post-Industrial Revolution

The 1940s brought about the end of the Industrial Revolution. World War II was ending. The lack of a need for such a large industry base in Worcester after the war was apparent when the census stated there would be potentially 12,000 unemployed at the end of the war, because only 72,000 jobs would be available out of the projected 84,000 jobs needed in Worcester to account for all employees (Committee for Economic, 1943). Rapid industrialization across the country to help in the war effort had provided a much larger industrial base for the entire nation, and therefore cities like Worcester began to loose business.

Ports in Baltimore, New York and Norfolk were now taking much of the import export business originally controlled by New England (Eisenmenger, 1967). The manufacturing belt for the nation had shifted south, mainly between New York, Chicago, and Pittsburgh (Little, 1960). As a result, between 1951 and 1957, 147 manufacturing firms left Worcester or closed, compared to only 25 firms entering Worcester. During this period, 4,193 people lost their jobs while only 395 people got jobs from the new firms

coming in (Little, 1960). Due to the loss of taxable property, the tax rate on industry went up dramatically (Little, 1960). The amount of infrastructure and municipal services that Worcester could provide compared to other areas within the United States were main reasons why the City industrialized in the first place. To continue these services Worcester had to raise taxes on industrial and commercial properties to maintain previous revenues and therefore the same amount of services and infrastructure that people within the City were used to.

Besides the manufacturing belt moving south and the loss of much of the import export business, there were other factors that contributed to the loss of industry in Worcester. The City had developed before the industrial revolution and had grown to accommodate the demands of the time. In the late 50s and early 60s, factories in Worcester were considered obsolete by companies because of their age. The lack of other land in Worcester to build the new type of one-story suburban factories that most businesses wanted all factored against industry in the City (Little, 1960). Vacant lots provided excellent sites for the dumping of waste, which further helped in the degradation of the City (Worcester Municipal, 1997).

The population of Worcester for each decade starting in 1950 helps show the City's decline. In 1950, the population of Worcester was 203,486. In 1960 the population declined to 186,587, and to 161,799 in 1980 (Worcester Regional, 2001). Many factors lead to the movement of many businesses outside of Worcester, and therefore the drop in population. Industrial fuel and electrical energy were both more expensive in New England than in the rest of the country (Eisenmenger, 1967). Worcester was not able to

provide recourses necessary for most industry to run at a rate that would promote industry to stay in or move to the City.

2.1.4 The 1990s

Worcester continued to decline in the 70s and 80s. Since 1990, steps have been taken to remedy the tax revenue problem the City faces, but the problem remains. In 1990, there were 5,452 vacant housing units in Worcester, and in 2000 that amount had dropped to 3,695 vacant units (Worcester Regional Research Bureau, 2001). Due to the lack of clean or modern, large commercial/industrial lots, Worcester is turning into a suburb. People are living in Worcester but working outside of the City. Tax revenue continues to decrease because of this trend.

From 2002 to 2003, the overall assessed value of residential properties in Worcester went up by 18.6 % while the total assessed value of commercial and industrial properties only went up 2.3%. In 2003, 77.56% of the total assessed property value in all of Worcester was due to residential properties, and only 22.42% of the total assessed property value was due to commercial and industrial properties (Worcester Regional, 2003). This is the largest difference between residential and business properties in the history of Worcester. Such a low assessed value for all industrial and commercial properties in the City reveal how small the tax base is for these types of properties, resulting in high taxes for commercial and industrial parcels.

Because of the large difference, the commercial and industrial tax rate in Worcester is $31.44 for every $1,000 of revenue. The tax rate in the surrounding communities for commercial business is at least about $8.00 cheaper, and in most cases 15 to 20 dollars cheaper (Worcester Regional, 2003). Such a large difference in tax rates

in surrounding areas is not a good indicator for businesses coming to Worcester soon. Compared to other cities approximately the same size as Worcester, the City fared no better recording the second highest tax rate of all cities compared (Worcester Municipal, 1999).

Higher taxes, no available greenfields (a non-contaminated site), and the large amount of brownfields have taken their toll on the City's finances, and provide Worcester with few options to offer developers in terms of available properties ready for development without the redevelopment of brownfield parcels. Industrial and commercial tax rates will not substantially decrease and the total assessed value of industrial properties will not increase without the reclamation of brownfields because they are the majority of all available property in Worcester (Jacobson, 2003).

2.1.5 Worcester's Present Condition

Brownfields in Worcester are synonymous with industrially zoned properties and not with residentially zoned properties. The number of vacant lots in Worcester are decreasing but only because the number of vacant residential lots is decreasing. The number of vacant residential structures has decreased by 37 since 2001 and now stands at 114 vacant properties. Yet the number of vacant commercial and industrial properties has gone up by four over the past three years and is currently totals 49 (Worcester Regional, 2003). The trend seen in the number of vacant properties turned into usable land greatly favors residential properties and is not a good sign for the economic development of Worcester.

Economically, industrial and commercial properties are more important, and provide more revenue and economic potential to a city that is still rebuilding from the

movement of business outside of Worcester after WW II. If Worcester were to turn into a suburb then many important services provided by the City now would become non-existent because of the loss of industrial and commercial tax revenue.

Brownfields are important to the economic development of the City of Worcester. The cleanup and redevelopment of brownfield sites could provide the City with the tax revenue necessary to continue to support the many services that a City provides. Between 1994 and 1999, new construction spending in Worcester declined by 43.8%, while the rest of Massachusetts spent on average 48.1% more on construction (Worcester Municipal, 2000). Many of the cities that did increase their construction spending are facing the same problems as Worcester due to brownfields (Worcester Municipal, 2000).

Most of the industrial and commercial properties located in Worcester that are brownfields have to be cleaned in order for businesses to develop the land. Steps have been taken to improve the City's knowledge of brownfields in Worcester in order to effectively deal with them. The City has created a pamphlet "Brownfield Redevelopment." The pamphlet was made to centralize the information on potential funding options for brownfield redevelopment, in order for potential developers to have an easier time attaining funding information to assist with their brownfield reclamation projects.

Another step taken by the City to aid the brownfield redevelopment process was to form the Mayor's Brownfields Property and Business Owners Education and Outreach Committee. The Committee finds information necessary for developers on underutilized properties and informs developers on incentives the City or private organizations could provide to aid in brownfield redevelopment. By completing these tasks, the Committee

tries to aid potential buyers in finding places within Worcester suitable for the buyers to develop. The Outreach Committee however lacks much of the information necessary to aid potential buyers effectively due to the lack of organized and easily accessible data.

2.1.6 What Has Been Accomplished in Worcester So Far

Since 1995, Worcester and other agencies have received grants or donated money to brownfield reclamation in the City. In 1996, Worcester received a pilot grant from the EPA for $200,000 to assess brownfield properties (Worcester Municipal, 1997). In 1999, the EPA helped transform industrial properties into a visitor center with an industrial revolution theme (Environmental Protection Agency, 2003). The EPA also provided a $161,500 grant to assess properties in a 30-acre project area in Worcester. In 2003, a second grant of $200,000 was provided by the EPA to further assess, clean and redevelop the same area that would eventually provide affordable housing, a youth facility, and a recreational space. The City of Worcester, Clark University, and the Boys and Girls Club all cooperated and continue to cooperate with the EPA in this effort (Environmental Protection Agency, 2003). The EPA has also given $70,956 to assess the Coes Knife property in Worcester (Environmental Protection Agency, 2003).

The Central Massachusetts Economic Development Authority (CMEDA) provided $105,000 to develop the Marriot Courtyard hotel on 72 Grove Street (Worcester Regional, 2002). Previously the site had housed a foundry, which had allowed excess lead to seep in and contaminate the soil. The Marriot project created 25 construction jobs and 50 permanent jobs when the hotel opened. The hotel now provides the City with over $50,000 a year in tax revenue (Environmental Protection Agency, 2003).

Another major brownfield project is the Worcester Medical City project. The $215 million project is now completed and was a large task to redevelop. In total 16 companies had to be relocated; only eight remained in Worcester (Worcester Municipal, 1997).

Prior to the summer of 2002, the City of Worcester had received a total of $3.3 million in grants for the South Worcester Industrial Park (SWIP) project. The organization Clean-Start already has plans to demolish the site to make way for a 215,000 square foot manufacturing space (Clean Start, 2003).

For the upcoming year, the City of Worcester has already started many of its plans for the future. The City has received grants to develop a 25-acre brownfield in the inner city of South Worcester. A 25-acre site in downtown Worcester, formerly a drop forge, is now being cleared by the owner for future development. At the edge of downtown Worcester, a 38-acre site is in the process of being cleaned, and another company has proposed to build a new hotel on a brownfield next to the convention center. The site for the new vocational school, formerly an uncapped landfill, is also in the process of being reclaimed (Hoover, 2003).

The City will receive around an extra $600 million in tax revenue every year if all known and unknown commercial and industrial brownfield sites in Worcester were cleaned and had profitable businesses develop on them (Monahan, 2003). The City has begun the process of reclaiming brownfield sites in Worcester, and with time, the City could stop itself from turning into a suburb because of the reintroduction of usable land in Worcester.

2.1.7 What Else Can Be Accomplished

Massachusetts has set up a website dedicated to brownfields: http://www.MassBrownfields.state.ma.us. The site was set up so that buyers and sellers of brownfield properties including local governments could search for potential clients or buy something already available. Out of the 200 known brownfield sites in Worcester, none are listed on the website (Anonymous, 2003). There were 60 potential buyers listed for Brownfield sites in central Massachusetts. A lack of a centralized database to store information on brownfield sites within the City has hindered Worcester's ability to promote individual underutilized parcels.

Worcester has started taking a more proactive approach to brownfield reclamation by already creating the Brownfield Committee and the construction of a list of known distressed properties. The introduction of a database where information on all known and potential brownfield sites could be stored would aid the City in taking a proactive approach in the brownfield reclamation process by providing potential developers with information necessary to make informed decisions on whether or not to develop potential properties.

2.1.8 Conclusion

Worcester was initially developed because of a lack of suitable farming land for a growing population. Available infrastructure within the City and its location between major cities of New England provided companies and entrepreneurs with the incentives necessary to continue to expand Worcester industrially. After WWII Worcester lost business, and population to newly industrialized cities because of the same reasons that allowed the City to industrialize in the first place. The loss of companies created vacant

and underutilized properties throughout Worcester. Most of these sites had become contaminated during and before the industrial revolution and were now considered properties that were financially risky to develop because of the liability of having to pay for the clean up of contaminants potentially in the ground.

Worcester still possesses the qualities that provided the incentives for people to industrialize the City in the first place. Worcester is situated between major cities in New England; infrastructure has not declined but increased with the introduction of the Worcester Regional Airport and the inland port. Now Worcester again has the land available to industrialize the City. The problem with these lands available is that they are potential brownfields.

Worcester has now taken a proactive stance on redeveloping brownfield sites by aiding companies with information on incentives, and liability issues. The City would benefit greatly if necessary information on potential brownfield sites were available so the City could further help incoming businesses by trying to accommodate for each of their needs with the use of this information. Worcester taking a proactive stance has the potential to continue turning brownfield properties into usable properties.

2.2 Classifying Brownfields in Worcester

As a major step in the Brownfield reclamation process, the Brownfield sites must first be classified according to the types of contamination that is present. Two primary phases must be completed to determine the classification of the site. These two phases are the Initial Site Assessment and the Detailed Site Assessment (City of Worcester, 2001). Once these two steps are completed, clients will be able to have a thorough understanding of the property status and how to proceed in making decisions.

2.2.1 Phase I

The initial site assessment is the most important phase in classification because that is when any interested party can learn the most about a site and its history. Much of the information on the types of contamination at the site is on existing records, historical data, and other readily available sources. This preliminary research is done in many ways that include examining historical data to review uses and applicable federal and state reports of hazardous substances on the property, past and present owners and what types of activities were licensed on the site, comparing site characteristics to neighboring properties, check for prior environmental audits and assessments, and finally to review insurance policies to determine covered activities that might have involved potentially-hazardous chemicals (City of Worcester, 2001).

The next step is to make an economic assessment of the site. Sites are categorized into three different groups that include viable sites, threshold sites, and non-viable sites (City of Worcester, 2001). Viable sites are economically feasible for investing in, where the leading investors in this sector are private owners, with no public assistance. They have very low potential for environmental liability, or such high potential rates of return that the advantages outweigh the risks from the project sponsors' perspective. Threshold sites are only partially viable, meaning that they will not be developed without public assistance. They tend to have fewer economic advantages than the viable sites, or they may have greater potential for environmental liability. Non-viable sites tend to have the most potential for environmental liability and/or whose economic advantages are minimal at best (City of Worcester, 2001). They need substantial public assistance to begin the redevelopment process, so sometimes they are neglected.

2.2.2 Phase II

In the case that the client has an ardent interest on a given property, a more detailed site assessment will take place. This investigation takes place solely to determine the level and extent of environmental contamination of the site. From state to state, both the thoroughness and cost of this phase varies greatly. In addition, if certain amounts of contaminants are discovered and there is potential for even more contamination, a more expensive and detailed assessment is then performed (City of Worcester, 2001). This process involves environmental engineering, sampling, and chemical analysis. Because of this process can be so expensive, many in the private sector refuse to pay for it.

2.2.3 Post-Investigation Process

After a thorough investigation process has been completed, the client is informed of the property status and given suggestions on what path would be best for the property development. Feasibility studies are conducted and the development of a financing plan for the cleanup and for the redevelopment is done (City of Worcester, 2001). This portion of the redevelopment process involves meetings with everyone who will be affected by the reclamation project. Once everyone has given their input in what should be done, the cleanup planning and execution will take place, and redevelopment will be in full gear so that the site can be cleared and construction can begin.

2.3 Laws and Regulations

This section discusses some of the major laws and regulations that have been made up to date affecting brownfield redevelopment.

2.3.1 Federal Legislation

Federal policy provides the backbone necessary to offer support for the cleanup and redevelopment of brownfields in the Worcester region. The federal government has created numerous legislative acts over the years that grant tax incentives and that offer partial and zero liability clauses to provide businesses with the incentives necessary to invest in the cleanup and development in brownfields instead of opting to build on greenfields, sites that are environmentally sound. Through policy, federal agencies also provide loans and grants to help spur local governments and regional agencies into cleaning up and devoting time and money into brownfield sites.

One federal act of significant importance is the "Small Business Liability Relief and Brownfields Revitalization Act," Public Law 107-118 which was signed by President Bush on January 11, 2002 (H.R. 2869). The law was created in hopes of helping to convince investors to clean up toxic or underutilized properties in order to restore the land to a healthy state, which in turn would bring in economical gains to the government (Brownfields and Smart Growth, 2002). It did so by combining two bills, the "Brownfields Revitalization and Environmental Restoration Act of 2001" and the "Small Business Liability Protection Act". The combining of these two statutes amended the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (Small Business Liability Relief, 2002), otherwise known as CERCLA, and reshaped how the Superfund, the Federal government's program to clean up the nation's uncontrolled hazardous waste sites, dealt with specific concerns about contaminated and underutilized sites. (Welcome to the Superfund, 2003) Some other laws and regulations

include the Community Reinvestment Act and the EPA's Brownfield Tax Incentive, both of which provide tax benefits to prospective buyers.

2.3.1.1 Owner Liability and Funding Incentives

The Brownfields Revitalization and Environmental Restoration Act of 2001 deals with funding and liability for assessing and cleaning up contaminated properties (Brownfields and Smart Growth, 2002). It authorizes both funding for assessment and cleanup of brownfields properties (Greening Brownfields, 2001), which protects the client if there were to be preexisting contamination on the site. The Act also exempts contiguous property owners, prospective buyers, and innocent landowners from Superfund liability (Small Business Liability Relief, 2002). In addition, the Act authorizes funding for State response programs and limits the EPA's Superfund enforcement authority at sites cleaned up under a State response program (Brownfields and Smart Growth, 2002). All of these characteristics were combined to make just one section in the Small Business Liability Relief and Brownfields Revitalization Act.

The Small Business Liability Relief and Brownfields Revitalization Act also deals with the "Small Business Liability Protection Act", which exempts "*de micromis*" contributors of hazardous substances and households, small businesses, and nonprofit generators of municipal solid waste from liability for Superfund response costs at National Priority List sites (Brownfields and Smart Growth, 2002). "*De micromis"* refers to the exemption of those persons who can prove that they are not liable for the pollution or that they contributed very little to the contamination of the property. The bill also provides for expedited settlements with certain persons based on a limited ability to pay. It also aims to create a border between large contributors of contamination and small

companies that only disposed of small amounts of waste over time (Small Business Liability Protection, 2001). As a result, this Act ensures that only eligible persons may receive liability protection. Through financing and providing liability relief for small business owners (Small Business Liability Relief, 2002), the government is trying to motivate more and more people and companies to invest in brownfield sites, including smaller businesses that could not do so in the past due to lack of funding and liability relief.

Enacted in 1977, the Community Reinvestment Act (CRA) became yet another important factor in brownfield redevelopment throughout America. The Act requires banks and other lending agencies to provide capital in low- and moderate-income urban neighborhoods (CRA Fact Sheet, 2003) in order to help a nationwide problem of areas in decline and to help raise awareness about these areas. In response to lenders shying away from investing in these brownfield sites and searching in other cleaner areas, the EPA announced its original Brownfields Action Agenda. This agenda encouraged a cooperative approach by EPA, lenders, and prospective purchasers to ease fears of financial liability and regulatory burdens.

2.3.1.2 Tax Benefits and Credits

Since their initial enactment, amendments have been made in order to create incentives within the CRA regulations for economic revitalization and development. One of those incentives is that now lenders who are subjected to the CRA can claim community development loan credits for loans made to help finance the environmental cleanup or redevelopment of an industrial site when it is part of an effort to revitalize the low- and moderate-income community in which the site is located (CRA Fact Sheet,

2003). The reason for this provision is to ignite urban economic activity. As a result, financiers are more likely to take a closer look at financing industrial property redevelopment, as they receive CRA credit and the community that they operate becomes more attractive.

The EPA's Brownfields Tax Incentive is yet another means in which to encourage brownfield redevelopment. It was amended in December 2000 in hopes of minimizing financial disincentives of brownfield restoration. The EPA and the Department of the Treasury worked with lawmakers to create the incentive (Brownfields Tax Incentive, 2003). The creation of the Tax Incentive is helping to bring back thousands of abandoned and underutilized industrial sites back into productive use, providing a foundation for neighborhood revitalization (Brownfields & Smart Growth, 2002).

2.3.2 State Legislation

With the federal government laws and regulations providing the backbone for Brownfield cleanup, the governments at state and local levels in Massachusetts have a steady structure to work with when it comes to the reclamation process and its regulations. Many of the state laws are derived from federal legislature, so it only makes sense that the most important law dealing with Brownfields in Massachusetts closely resembles those discussed previously.

2.3.2.1 State Acts/Policies

Without question, the 1998 Massachusetts Brownfield Legislation, commonly referred to as the Brownfield Act, is the most important statute in the Brownfield recovery effort in the state. Governor Celucci signed the Act on August 5, 1998 (Gerrard,

2003). It was drafted with the intent of providing "legal and financial incentives for the cleanup and redevelopment of contaminated urban and industrial property in Massachusetts" (Brownfields and Smart Growth, 2002, 19).

As stated in the Act, the redevelopment of a site must contribute to the economic revitalization of the community and must provide public benefits, such as new, permanent jobs, housing benefits, historic preservation, or the revitalization or creation of open space where people can interact (Greening Brownfields, 2001). A development plan following these guidelines describing the proposed use or reuse of the site and the proposed public benefits must be submitted in accordance with regulations under the Brownfield Act.

2.3.2.2 Lender Liability

As motivation to proceed with the cleanup of a site, incentives have been made available to hopeful clients (Gerrard, 2003). One of the incentives is lender liability (Brownfields and Smart Growth, 2002). Lender liability incentives are aimed at protecting lenders (Gerrard, 2003) that have been:

> Concerned about the risk of incurring owner/operator liability in the event that the borrower defaults on the loan and the lender is either deemed to 'participate in the management' of the borrower's operations in its efforts to secure repayment, or, in the event that the lender forecloses, it acquired the property and is unable to sell it within the statutory time limits (Brownfields and Smart Growth, 2002, 21).

These lenders are also worried about the worth of polluted sites as collateral as well as how to recover the face value of the loan by foreclosing on and selling the contaminated property (Brownfields and Smart Growth, 2002). Because of these concerns, the government has implemented a way of providing relief to lenders when dealing with

polluted sites. This is to motivate them to lend against these sites, hence jumpstarting the land's "acquisition, cleanup and redevelopment" (Brownfields and Smart Growth, 2002).

2.3.2.3 Tax Benefits and Credits

The other focus of the state "Brownfields Act" is on tax incentives as credits against Massachusetts personal income and corporate excise taxes to those people who complete the cleanup of contaminated sites while conforming to specified set of criteria. In simpler terms, to make these claims, one must be free from environmental liability in relation to the specified site (Brownfields and Smart Growth, 2002).

To be eligible for tax credits, the current owners or operators must have not contributed to the contamination in question. (Gerrard, 2003) Another rule for being considered as "eligible" is that the property must be in an Economically Distressed Area (EDA), an area designated as an Economic Target Area (ETA), an area that is eligible for designation as ETA, or an area that is the site of a former manufactured gas plant (Brownfields and Smart Growth, 2002). These are the types of places that could possibly be redeveloped and sold, which in turn would bring in much needed and desired tax revenue for the city or town. Because of the fact that the city wants to bring in more tax revenue, it is only economically viable that the property must be used for business purposes (Brownfields and Smart Growth, 2002).

The redevelopment process must present a permanent solution or remedy status to the contamination as well in order to be eligible for tax credits (Gerrard, 2003). The cleanup must be completed before the credits can be applied for, and the operation status must be filed to the DEP. These lender liabilities and incentives are not only to promote

redevelopment, but also to restrict redevelopment and its benefits to those parties that are motivated to do the job in the proper manner.

2.3.2.4 Conclusion

State and federal laws and regulations are very important in the Brownfield redevelopment process. Without them, potential buyers would be at great financial risk with government agencies if they were to purchase contaminated land without knowing. However, since these laws were established, clients not only receive liability relief, but they also receive other tax benefits and credits as a reward for cleaning up the property, serving as motivation for more investors to put their money into Brownfield redevelopment.

2.4 Past Dealings with Brownfields

During the late- 1980's through the mid-1990's contamination of land and water began to subside and began to transition into a clean up analysis effort for several large companies like the General Electric branch in Pittsfield Massachusetts, who were contributing to environmental deterioration of surrounding communities (Hileman, 1998). This transformation came about with increased awareness to environmental deterioration and increase in legal pressures on businesses in regards to how they dispose of contaminants. In comparison to the decades of inappropriate dispensing of contaminated substances, this ten-year evolution occurred rapidly. Yet the process of undoing such massive environmental negligence starts slowly, only growing momentum by the main factors of awareness and a great deal of capital, both of which take dedication to rise.

2.4.1 Brownfield Redevelopment in Other Cities: Applications in Worcester

The best way to understand this promising redevelopment process is by researching examples of other cities' experiences with brownfield redevelopment. We examined many cities both around Worcester and in Massachusetts, as well as cities outside of Massachusetts. Lowell is an excellent benchmark. Situated 30 miles northwest outside of Boston, Lowell was another thriving manufacturing town just like Worcester. Yet before the last 1990's the City was damaged financially, environmentally, and aesthetically. It was a ghost town with abandoned mill factories lining the contaminated river. One of its larger neighborhoods, Acre Neighborhood housed a 42% poverty rate (Ryan, 1998). Yet as Karen Lee Ryan, from the American Planning Association claims, Lowell has truly begun to thrive as a city again. This process was spurred on with the help of being chosen as one of the 228 Brownfield Assessment Demonstration Pilots by the EPA in 1995.

Lowell now receives a variety of New England residents as they crowd the doors at events held in the Tsongas Arena (seating 6,600) and the LeLacheur Stadium (seating 5,100). The stadiums not only welcome outside interest of residents and companies but also provide hundreds of new full and part time jobs (Ryan, 1998). The prosperity that Lowell has experienced with redeveloped brownfields, are excellent examples for Worcester to strategize by since both cities have similar industrially based structures. With proper strategy, Worcester too can provide its citizens with new jobs, revenue, and community via brownfield redevelopment. This progress can already be seen in Worcester where three former textile mills and an ash dumping ground is presently in the

process of redevelopment and will be providing a new ballpark and sports arena promising 450 new jobs (Ryan, 1998).

By assessing the present sites, the City can continue the next phases of brownfield redevelopment and present chosen sites as available for interested investors. Worcester needs to use the land it has in order for money to circulate back into the city, and the threat of possible contamination of this land should no longer deter those interested in investing in the city. The introduction of an easy to access, informative database that this project offers would help notify and educate these investors in regards to facts and fiction of brownfield redevelopment. The city cannot afford to lose the possibilities of revenue that will come in if this land is finally utilized after cleanup. The Gateway Park and South Worcester Industrial Park (SWIP) project are just a few promising examples of what Worcester can look forward to if brownfield redevelopment is successfully undertook by the city and not left in the hands of private investors only (Nemeth, 2003).

2.5 The Purpose of the Brownfield Database

The Mayor's Brownfields Property and Business Owners Education and Outreach Committee requested our assistance in collecting valuable information on brownfield opportunity areas. In response, we have created a central database that synthesizes key information on each of the brownfield areas.

2.5.1 From Physical Information Systems to Electronic Databases

Data are facts from which information can be derived ("Databases", 2001). A person's address, phone number, sex, and age are all facts. The past and present owners, past and present site use, the proximity to infrastructure, and property value of a parcel of

land are all facts as well as specific to our project. Information systems, widely used in today's society, attempt to organize and store facts, or data. The data that an information system organizes must be stored on physical devices such as file drawers, pieces of paper, card catalogs, and personal files (Hawryszkiewycz, 1984). A business executive's file drawer, a doctor's prescription, a library's card catalog, and a city's phone book are all examples of information systems. Examples of information systems housing brownfield data include the Worcester Fire Department's list of industrial and commercial abandoned buildings, as well as various assessment records maintained by the Worcester City Clerk.

The information systems mentioned above all require paper as the method of storing data. With the introduction of computers, the implementation of information systems changed drastically. Computers are now increasingly used for implementing information systems; storing data; interpreting data; and making data available and accessible at various locations (Hawryszkiewycz, 1984). Computers organize information systems in what is known as a database, a collection of data or information stored in a form that may be accessed by a computer ("Database," 2001).

Computer databases have consistently proven to be more effective at storing and managing data over traditional methods such as paper. With proper implementation, a database allows immediate access and revision, and generally decreases the amount of human time necessary to manage the information system ("Databases," 2001). The use of computers in implementing information systems has made data more readily available to users as well (Hawryszkiewycz, 1984). The earliest databases were used in airline reservation systems, banking systems, and corporate records systems (Ullman & Widom,

2002). Presently, even consumers use databases to manage personal items such as a digital phone book or personal finances.

2.5.2 Worcester's Current Brownfield Information System

The first major problem in obtaining information on brownfield opportunity areas in Worcester is that most information is stored in a physical format, such as on paper, as opposed to an electronic format. The Worcester Fire Department, for example, implements their list of industrial and commercial abandoned buildings as a card catalog (Spokis, 2003). The second major problem in obtaining information on brownfield opportunity areas in Worcester is that the information is spread out among various sources. The Worcester Fire Department, the Worcester Board of Health, the Worcester Tax Collector, the Worcester Public Library, as well as many other archival organizations house information applicable to brownfield opportunity areas.

This project is to ease the search for key information pertaining to brownfield opportunity areas. The database fully informs the developer on the history of the parcel of land, enabling the developer to make decisions of higher accuracy in the purchasing of the land parcel, measure risk of purchase easier, and understands more thoroughly the liability and tax incentives associated with the property. This project attempts to relieve these two major issues by converting paper archives into an electronic format and unifying the data on Worcester's brownfield sites into a single database.

2.5.3 Types of Data within Databases

Databases can store different types of data: words; numbers; images; and sound. Additionally, a multimedia database combines these media. Many databases are word and

number oriented, and includes bibliographic and full-text databases. The earliest electronic databases were bibliographic databases involving the fields of science, engineering technology, and medicine. Full-text databases, such as the *Worcester Telegram & Gazette Online* and the *Harvard Business Review* allow internet access to news and journals respectively. The Interactive Data Corporation, covering monthly exchange rates for 22 currencies, puts number oriented databases into practice. Sound databases may track the development of a genre of music. Finally, image databases represent shapes, distances, geometrical relationships, photographs, maps, and more ("Database," 2001). Geographic Information Systems (GIS), such as ArcView and MapInfo, are multimedia database applications that unite image data, specifically two dimensional map data, with words and numbers.

2.5.4 Database Models

There exist different types of data, as well as different models to store and process data. No matter the model, all databases must account for many of the following: data redundancy and inconsistency; difficulty in accessing data; data isolation; multiple users; security problems; and integrity problems (Korth & Silberschatz, 1986). The database models used today are the entity-relationship model; the relational model; the hierarchical model; the network model; and the distributed model. However, in today's applications, usually only the entity-relationship and relational models are used extensively. In the implementation of a database model, there exist three broad categories of construction: the design of databases; the programming of databases; and the system implementation of databases (Ullman & Widom, 2002).

The programming of databases and the system implementation of databases deal with the coding of database queries and other operations, as well as the processing of those queries and operations (Ullman & Widom, 2002). As database programming and system implementation focus more on technical issues, database design focuses on the concepts and theories of databases alone. Database design is used to develop a useful database by determining what kinds of information should be included in the database, how that information is structured, what assumptions are made about the types or values of data items, and how the data items connect (Ullman & Widom, 2002). Our group will design a database that will accurately depict brownfield opportunity areas to developers, property owners, and companies. Due to convenience, we used an existing framework already programmed and implemented to process and present the data that we collected, such as a geographical information system.

2.5.5 The Entity-Relationship Data Model

The entity-relationship data model is a graphical model, using boxes and arrows to represent data elements and their connections (Ullman & Widom, 2002). According to various sources (Ullman, 1988; Korth & Silberschatz, 1986), the purpose of the entity-relationship model is to aid in visualizing the abstract, conceptual scheme of the database without attention to technical details. Due to the abstractness of the entity-relationship model, it is never used directly in the implementation of a database management system (Ullman & Widom, 2002). Instead, the entity-relationship model is assumed to be later converted to a more concrete scheme in another model, such as the relational model (Ullman, 1988). In beginning our database, it was helpful for us to use the entity-

relationship data model to grasp the conceptual scheme of our project, without too much worry over technical details.

The three principal elements used in constructing an entity-relationship data model are entity sets, attributes, and relationships. An entity set is a collection of similar entities, which are abstract objects (Korth & Silberschatz, 1986). Attributes are properties of entities in the entity set, usually assumed to be atomic values, such as strings and integers. Relationships are the connections among entity sets. The most common type of relationship is the one-to-one or binary relationship (Ullman & Widom, 2002). There also exist one-to-many, many-to-one, and many-to-many relationships (Korth & Silberschatz, 1986).

The entity-relationship diagram brings entity sets, attributes, and relationships together, represented by nodes of the graph. The entity-relationship diagram represents entity sets by rectangles, attributes by ovals, and relationships by diamonds. Lines, or edges, connect an entity set to its attributes as well as connect a relationship to its entity sets (Korth & Silberschatz, 1986). In certain relationship connections, such as a unique relationship, a directed edge or arrow is used to represent the relationship (Ullman, 1988). Advanced entity-relationship models use constraints that go beyond the structural and type limitations imposed by entity sets, attributes, and relationships (Ullman & Widom, 2002). Figure 1 shows an entity-relationship diagram representing a simple database about movies. The entity sets are *Movies*, *Stars*, and *Studios* (Ullman & Widom, 2002).

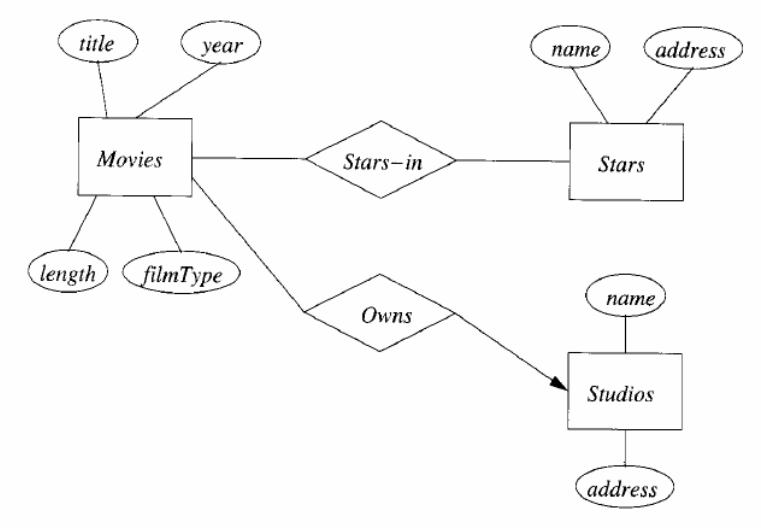

Figure 1: An Entity-Relationship Diagram (Ullman & Widom, 2002)

To clarify the figure, a rectangle encloses the entity set *Movies* and the lines extending from the rectangle connect the entity set to its attributes, enclosed by ovals. The attributes of the entity set are title, year, length, and film Type. Furthermore, the diamonds enclosing "Stars-in" and "Owns" and the lines connected to them show how the entity set *Movies* is related to the other two entity sets, *Stars* and *Studios*.

2.5.6 The Relational Data Model

While the entity-relationship model may be used to describe the structure of data, the model does not allow for actual implementation of the database. Almost all of today's database applications use the relational model. The relational model focuses on one concept: the "relation," a two-dimensional table in which data is arranged. As the entity-relationship model is used for designing a database and the relational model is used for implementing a database, there must be some translation from the entity-relationship model to the relational model (Ullman & Widom, 2002).

There are many steps for converting an entity-relationship model to a relational model due to the various special cases. However, a first approximation of converting from an entity-relationship model to a relational model is to turn each entity set into a relation with the same set of attributes, and replace a relationship by a relation whose attributes connect the entity sets (Ullman & Widom, 2002). A completed relational model, according to Hawryszkiewycz (1984, p. 20), possesses the following properties:

1. There is one column in the relation for each attribute of the relation. Each such column is given a name that is unique in the relation.
2. The entries in the column came from the same domain.
3. The order of the columns or attributes in the relation has no significance.
4. The order of the rows is not significant.
5. There are no duplicate rows.

In summary, the relations of the relational model will be unique, non-redundant, valid, and consistent. After using the entity-relationship data model to grasp the conceptual scheme of our project, the next step was to convert the model to the relational data model, accounting for the technical details of the database.

2.5.7 Databases and Worcester's Brownfields

In summary, two common models exist for database design and implementation: the entity-relationship and the relational models. The entity-relationship model brings abstract concepts and theories into sight, and the relational model leads to physical implementation of these concepts. The two models may be used for constructing databases dealing with words, numbers, images, and sound. In constructing a database for our project, we worked with words, numbers, and images. Pittsburgh's Carnegie Mellon University implements infrastructure assessments and impacts modeling to a database of brownfield sites (Angelo, 1997). Additionally, and more frequently, various cities and

organizations use geographic information systems to represent visually brownfield databases. Geographic information systems use the entity-relationship and relational models to create databases containing words, numbers, and images. It is also quite possible to convert from a spreadsheet to GIS implementation. In order to better promote the reuse and reclamation of brownfield sites in Worcester, it was of great importance that we create an electronic database unifying the data on Worcester's brownfield sites.

2.6 Electronic Databases to Geographic Information Systems

Geographic information systems (GIS), first introduced in the 1950s, organize and manipulate spatial data, as well as analyze geographical data (Holdstock, 1998). Various sources define GIS as:

> An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information (Holdstock, 1998 & Environmental Systems Research Institute [ESRI], 1995, 2).

In order for GIS to manage geographically referenced information, the system must integrate three areas of computer technology: cartographic capabilities, relational database management capabilities, and spatial analysis capabilities (Holdstock, 1998).

Geographic information systems are applicable to various applications. Many organizations concerned about the effects of changes to the environment can find a use for GIS. The Delaware Department of Agriculture, the United States Forest Service, and the Long Island Lighting Company are examples of organizations utilizing GIS (Puttre, 1992). Furthermore, geographical information systems are applicable to more than environmental analysis, GIS is often used for traffic analysis, library and warehouse planning, and tracking the spread of human diseases.

2.6.1 Advantages and Requirements of Geographical Information Systems

A significant advantage that geographic information systems provide over more typical information systems, such as spreadsheets, is the ability to perform spatial operations. Many software packages, such as SAS and AutoCAD are able to handle simple geographic or spatial data, but the packages are unable to perform spatial operations on the data (ESRI, 1995). GIS is able to represent socioeconomic phenomena as well as provide a bridge between scientific theories and the 'real world' (Raper, 1999 & Martin, 1999). Additionally, GIS' methods of spatial representation enable new ways of exploring structure, relationships, and causality in the world (Raper, 1999).

In order for geographical information systems to perform spatial operations, the system requires spatial and attribute data (Cox, 1995), provided by database systems (Worboys, 1999). According to Worboys (1999), the relational database model is the most prevalent current database paradigm, and has two methods of managing spatial data: putting spatial and non-spatial data in the relational database (integrated approach), or separating spatial and non-spatial data (hybrid approach). Worboys (1999) and Cox (1995) both conclude that the relational approach has significant flaws, such as the rate of data retrieval, and suggest the use of an object-oriented approach using the entity-relationship model. By any method, GIS organizes the spatial data provided into layers. Each layer represents a single theme and has a distinct type of feature (Holdstock, 1998 & Cox, 1995).

2.6.2 Geographical Information Systems and Brownfield Redevelopment

The various analyses and applications that geographic information systems provide are applicable to environmental analyses, as well as brownfield redevelopment.

In order to meet the growing demand for housing in the United Kingdom, it has been proposed that the redevelopment of brownfields will enable the country to meet the growing demand for housing. The City of Worcester finds itself in the same situation, except Worcester's demand is for commercial and or industrial properties. Similar to Worcester, there exists a lack of integrated and comprehensive knowledge on brownfield sites in the area. Due to this, it has been proposed that GIS be used in brownfield redevelopment (Boott, Haklay, Heppell, & Morley, 2000).

The United Kingdom is not the only nation to use geographic information systems in brownfield redevelopment. Various state organizations within the United States take advantage of GIS to aid in the brownfield redevelopment process: Kenton County, Kentucky; Texas; Miami, Florida; Emeryville, California; and Concord, North Carolina. Furthermore, pilot work has all ready begun using GIS to aid Worcester in the fight for brownfield recovery. Clark University organizes a research fellowship called HERO. Funded by the National Science Foundation, HERO stands for Human Environmental Regional Observatory. Our project group used GIS in carrying out our project goals, as the cartographic, relational database, and spatial analysis capabilities show promise in aiding the users of the database in the best manner possible.

2.6.3 Conclusion

After becoming familiar with the different forms of electronically organizing data and the usefulness of GIS we were then able to implement these findings into the construction of our brownfield database that unifies scattered information presently found in physical format.

3 Methodology

The objectives of this project are to create a user-friendly database containing necessary information for developers and the city of Worcester on suspected brownfield sites. A set of quality standards were created in order to provide merit to all data collected. A GIS mapping system was linked to the database to provide a visual interpretation of the data as well as making the data more understandable. A manual on how to update and operate both the database and GIS was made to promote longer use of the created systems. Also included in the manual is information on how and where to research information on potential brownfield sites. As a result, a database/GIS system was created, and provides information and guides to aid in the long-term maintenance and existence of brownfield reclamation.

3.1 Methods of Data Collection

Various methods of data collection were used in order to obtain information and create standards for the types of information within the database. To aid in creating standards for which information was judged, the group reviewed previous databases on brownfields in an electronic format provided by other cities using a database to aid in their brownfield redevelopment process.

Most of the data concerning abandoned or underutilized properties in Worcester is in a physical format. It was our objective to obtain this information on twenty sites from various archival facilities throughout the City. Focus groups and interviews were conducted with the Mayor's Brownfield Forum, involving city appointed officials and local developers, all experts in brownfield redevelopment. These face-to-face meetings

provided us with information from individuals who deal with brownfields on a daily basis.

3.1.1 Physical Data Collection Process

We identified many archival facilities that aided in the physical data collection process. The Worcester Fire Department list of industrial or commercial abandoned buildings, the Worcester Board of Health list of vacant industrial or commercial properties, and the Worcester tax collector list of tax title industrial or commercial properties provided us with specific information on the twenty potential brownfield sites we examined. Other resources such as the Worcester Public Library provided general information on the history of Worcester's land, properties, and maps. The Worcester Courthouse Library, the Worcester City Clerk, the Worcester City Hall (including the Economic Development Office, the City Manager, the Assessors Office, the Tax Title Office, the Mayors Office, and Technical Services) all provided government specific information concerning liability and regulations in regards to brownfield redevelopment. We visited the various archival facilities continuously, from week two until week five (Table 1).

Archival Research								
	B-TERM	C-TERM						
ELECTRONIC		WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7
DEP			X	X				
EPA	X		X	X			X	
MassGIS		X	X	X	X	X	X	
Worcester Tax Collector	X		X	X	X			
PHYSICAL								
George C. Gordon Library	X	X	X					
Worcester Assessor's Office			X	X	X			
Worcester Board of Health	X			X	X			
Worcester City Clerk		X	X	X	X	X	X	
Worcester City Hall Technical Services		X	X	X	X	X		
Worcester City Manager		X	X					
Worcester Courthouse Library	X							
Worcester Economic Development Office					X	X		
Worcester Fire Department	X				X	X		
Worcester Mayor's Office		X	X	X	X	X	X	X
Worcester Public Library	X			X	X	X		
Worcester Tax Collector	X			X	X			

Table 1: Archival Research

Much of the information, specifically on property history, is still only in paper form. Due to the large amount of physical information to be processed, the group conducted in depth archival research at these facilities to gain necessary data on the twenty sites, which aided in the creation of the brownfield research manual as well as the quality, type, and format for future data input into the database.

3.1.2 Electronic Data Collection

Just as there are many archives storing physical data, many archival facilities store electronic data as well. The Department of Environmental Protection, the Worcester Board of Health, and the Worcester Tax Collector all house electronic data pertaining to the contamination of brownfield opportunity areas. There also exist other government and private organizations involved in the brownfield redevelopment process, all storing information necessary to our project: the Worcester Department of Environmental Protection, the Environmental Protection Agency, and many other business and economic developmental organizations. The electronic data found on these sites provided

information necessary to the formation of the brownfield database in Worcester. We referred to these sources of information from week one until week five (Table 1).

Another way used electronic data is for the study of other brownfield databases created for other cities. These databases provided us with example standards of how previous databases were created and the depth of knowledge each of these databases contains in order to provide developers with an accurate representation of the property. These examples of various database standards helped us create a set of standards for potential Worcester brownfield sites.

3.1.3 Interviews

In addition to physical and electronic data collection, another relevant method of information gathering is by interviewing. Interviews are used to gain a rich, detailed picture of people's experience and to answer any questions that one might have that require your physical presence to "guide people through the process of answering questions". Interviews were essential to our project thanks to the variety of insight that we gained from holding them with an evenly varied group of developers and non-developers. It was important to talk to these experts on brownfield redevelopment to make sure that we were heading in the right direction in regards to contents to be found in the database. At each interview we presented them with a list of questions that we were going to ask them so they became familiar with what our intents were for the interview and they were also presented with our original database attributes standard list. By interviewing with them, we were able to make changes to our initial list that would improve the quality of information that was included in the database.

We organized and held the interviews by an Interview Procedures protocol that we created (Appendix A, p83). This protocol was very helpful in keeping our interviews professional and organized. It also allowed us to really extract the most important key points to each interview so that we could apply it to the database we created. Out of the two interview methods we found, we realized that an In Depth Qualitative Interview method was more flexible and conversational than a Standardized Interview. This more exploratory structure of interview accommodated the personalities of those interviewed and worked better for us to gain more understanding of each of their personal experiences with brownfield redevelopment.

3.1.4 Focus Groups

The use of a focus group provided a way to form a structured discussion on the types of information that is necessary to clients. A discussion involving individuals directly participating in the buying or selling of brownfields helped us format the standards for necessary data previously set through archival research to make the standards applicable to Worcester. Our research team also benefited from the experiences of the individuals participating in the focus group. Questions focused on why each piece of information desired is useful and how it can help potential buyers make informed decisions focused the ideas of the participants, creating a very informative atmosphere on the topic. One focus group with the Brownfield Forum sufficed for all of the specific focus group questions that our team had for this project. The Forum is composed of six people, each with a wide array of knowledge about the City, who ranged from Worcester appointed officials to developers in the area. One moderator and at least two note takers

ran the focus group, the note takers helped prevent any discrepancies that either might have had with an issue being discussed.

Focus groups were even more instrumental when we encountered barriers in the accessing of different brownfield databases or in other resources that we had. We were able to replace these different forms of research with a focus group. The focus group increased our knowledge of standardizing our list of database attributes and we applied it to the construction of our database. We conducted the focus group during the second week of the implementation of our project (Table 2).

3.1.5 Necessary Data for Decision Making

With the commercial and industrial requirements of the potential buyer in mind, we determined the information necessary for buyers to make informed decisions with the aid of our sponsors, interviews with both developers and non-developers, and focus group (Mayor's Brownfields Committee, 2003). Prospective developers, property owners, and companies desire useable lots that suit their various commercial and or industrial needs. In order to present all applicable properties to the prospective buyer, all necessary information concerning those properties has to be provided in order for the buyer to make educated decisions. The following sections describe the potential variables that are included in the database and are derived from meetings with our sponsors.

Land Area Square Footage

The most important requirement for a prospective buyer is the land parcel's area in square feet (Mayor's Brownfields Committee, 2003). The area required depends greatly upon the needs of the client. Certain industries require little property space, whereas other industries require an abundance of space. Furthermore, some industries

may easily build up, utilizing various stories of a building. On the other hand, other industries may not easily build up, and all expansion moves outwards. Due to this, the land area of the property is of critical value to potential buyers.

Proximity to Infrastructure

Another critical value to potential buyers is the land parcel's proximity to infrastructure. Worcester's infrastructure provides a United States Customs port, an interstate highway system connecting to other industrial or commercial areas, a railroad system connecting Worcester to every major city in New England, a regional airport, as well as a fiber optic system providing rapid transfer of electronic data between users (Mayor's Brownfields Committee, 2003). Prospective buyers rely on existing infrastructure to transfer goods and ideas in today's fast-paced society, and a property's proximity to infrastructure increases its appeal to the buyer.

Geographic Location

In addition to the proximity to an established infrastructure, the location of the land to other similar commercial and industrial sectors in the city is vital in order to be competitive against other establishments in the same industry (Mayor's Brownfields Committee, 2003).

Existing Utilities

Existing utilities are also of much importance (Mayor's Brownfields Committee, 2003). Similarly to an established infrastructure, depending on the prospective buyer's use of the land, these utility needs will vary. For example, the amount of water a developer may need depends on the use of the land. If the buyer wishes to use it for a water park, the water needs will be very large compared to that of an advertising

company. The size of the water pipes and drainage systems vary tremendously between these two industries. The same goes for heating and other utilities. The advertising company would obviously have a greater need for heating than the water park. It can be a simple, yet important factor in the purchasing of land, as it may affect the total value of the land tremendously when it comes to developing it.

Property Value

The value of the property is clearly of much importance to potential buyers as well. Total property value depends on two categories: the building value and the land value. The building value is the worth of the existing structures on the property. The buyers might wish to know this in the case that they need to decide whether to demolish the existing buildings and construct new ones, or to use the original edifices, in hopes that they will suit their intended purposes (Mayor's Brownfields Committee, 2003). It is a large economic decision that must be made, and the building value is an important factor that the developer's decision depends heavily upon.

The land value is also of importance for making financial decisions on whether or not to purchase the lot. The potential for profit on the land investment itself is great because if the land originally was not in good condition, and it were to be cleaned up, the value would skyrocket. However, if the land were in great condition, there would not be a significant change in the value of the land itself. While the value of the land is a function of the marketplace, the value drastically depends on the quality of the existing structures as much as the location of the site. As a result, the total current value of the property can make or break a potential buyer's decision on whether or not to invest in the land.

Property Tax Balance

Another key piece of information for the client is the tax balance on the land. The potential for loss on a property deal with liens or taxes against it is bad indeed. It is vital that the hopeful buyer looks into this with a lawyer to determine all liens that are against the property to protect the prospective buyer from financial problems in the case that there are liens on the land (Mayor's Brownfields Committee, 2003). If the client was not aware of the financial status of the land, he could be held liable for the payments in question. Altogether, this is an extremely vital piece of information for any buyer hoping to avoid as much financial risk as possible.

Owner Contact Information

In addition to the aforementioned, to get an idea of what kind of land the developer is dealing with, contact information for the past and present owners is necessary to have in possession (Mayor's Brownfields Committee, 2003). With the aid of the owners, both past and present, an interested party has the ability to find out almost everything about the property if all the owners are willing to give useful information. The buyers will be able to determine what the site has been used for in the past, and from that, they can make assumptions as to both the environmental and financial status of the land, which in turn will greatly influence the client's decision.

In conclusion, we have compiled a list (Appendix A) of information that we believe will help in creating a thorough and informative database that will help clients make decisions on any given underutilized real estate and its potential future use. Sometimes the buyer will only need some of this data to make a decision, such as lot size, but at other times, the client wants as much information as possible. In any case, by

providing all the information that we have deemed vital and ensuring that all of it is correct to the best of our knowledge, the investor will be able to make a solid educated decision on whether or not the purchase of the land and its reclamation is an economically viable investment (Mayor's Brownfields Committee, 2003).

3.1.6 Brownfield Site Visits

In order to determine whether a site is underutilized the group traveled by car to a portion of the twenty brownfield sites during the first two weeks of project realization (Table 2). The purpose of traveling to sites was to determine visually whether potential sites can be easily arranged into one piece of land or if there are any utilized sites next to these potential Brownfield sites that are looking to expand. This type of visual approach to determine if separate sites can be arranged together as one parcel benefited the group when creating the GIS portion of the project. Knowledge obtained visually about different parcels of land provided the group with a better understanding of how different sites can connect on a map, or through infrastructure. Therefore, the group achieved a greater understanding of how GIS plays a role in brownfield development and how to communicate the understanding to others who will use the database.

3.1.7 Conclusion

These forms of data collection aided the group in finding all necessary information pertaining to the twenty brownfield sites and the standards of quality for the data contained in the database. Each form of data collection provided a different view of the site status and the type of data analyzed and composed in a way to provide necessary information for the project. The methods of data collection also helped in the creation of

the manual on how to collect data on potential brownfield sites. The manual aids in the long-term maintenance and existence of brownfield redevelopment as a guide for further research on these underutilized sites.

3.2 Data Analysis and Conversion into a Database

The project group utilized various computing resources to create and analyze the brownfield database. The project team first used Microsoft Access to create the database, unifying important information concerning vacant or abandoned properties in Worcester. The database created using Microsoft Access is exportable to a geographic information system, such as MapInfo. A manual on how to update, maintain, and use the brownfield database and geographic information system were created in order to increase usability and long term use of the database and GIS programs.

3.2.1 Software Use

With the Microsoft Access database exported to MapInfo, the project team graphically analyzed the data collected concerning brownfield opportunity areas in Worcester. Where Microsoft Access may convey opportunity area information to potential buyers alphanumerically, the geographic information systems convey the same information in a visual manner, providing various modes of data representation. GIS shows a property's proximity to infrastructure, the location of the property within Worcester, the zoning attributes of the property, and other qualities potential buyers value. We learned how to use GIS software throughout the six weeks of the implementation of our project, with the assistance of Professor Fabio Carrera on the WPI campus (Table 2).

3.2.2 Conclusion

Through GIS and the database, the group was able to display to people interested in brownfield redevelopment in Worcester the example twenty sites of all unknown sites in the City. This information is important for brownfield redevelopment in Worcester. The foundation set by the creation of the database, GIS, and manual on how to maintain each previously mentioned information technology tool could be the beginning of the solution to the economic development problem in Worcester caused by the underutilization of brownfield sites.

3.3 Project Schedule

3.3.1 Time Frame and List of Activities

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Travel to sites				→	←		
Meetings with liaisons	→	↔	↔	↔	↔	↔	←
Focus Group		↔					
Learning GIS	→	↔	↔	↔	↔	←	
Setting Standards	→	←					
Analysis of information including standards assessment	→	↔	↔	↔	↔	←	
Archival Research		→	↔	↔	↔	←	
Database Creation		→	↔	↔	←		
Filling in of Database		→	↔	↔	↔	←	
GIS Creation			→	↔	↔	←	
Writing Report	→	↔	↔	↔	↔	↔	←
Finalizing Report						→	←

Table 2: Critical Path Method Diagram

3.3.2 Team Member Jobs

In order to complete this project in our given window of time, we divided most of the work that we had to complete. This provided us with the most efficient means of completing the project not only in a timely manner, but of also allowing the most qualified individuals to be in charge of their field of expertise, ensuring the desired result.

Jared was in charge of formatting GIS and creating a user-friendly database of the necessary information and partly in the writing of the manual on how to properly use and update each program. Elizabeth, Ned, and Timo were all in charge of archival research, focus groups, interviews, the quality standards, and also with the writing of the brownfield research manual and project report. There are many sources of information in different locations and it was vital that we had as many people as possible collecting the desired information. Team members were not strictly limited to these areas of research

and were working together editing and compiling further research in all areas of the project. The entire group was traveling to the different Brownfield sites in order for all group members to acquire an accurate visual representation of the overall purpose of the project and its status.

4 Data Analysis

This chapter covers two main topics: qualitative findings from interviews and a focus group, as well as how potential users can use the database to analyze properties. Both topics help define the database and how it will be used in the future.

4.1 Introduction to Qualitative Findings

Our group determined how to create the database by performing a thorough data analysis on the information obtained from interviews and a focus group. The objectives of these interviews and focus group were to determine the key features of a successful database (refer to chapter 3): the structure, maintenance, and overall presentation of the database. These features make the database as useful, informative, and easy to use as possible. Through holding interviews and a focus group, we were able to determine the most efficient and productive techniques to create a very functional and useful database.

4.1.1 Structure of the Database

To determine the appropriate structural qualities for the database, we asked each contact specific questions about what each of them would search by in a database in order to find a property. There was a difference between developers and non-developers, as shown in the table below.

Searchable Fields							
CONTACT	INTERVIEW DATE	LAND SIZE	BUILDING SIZE	ASSESSED VALUE	CONTAMINATION	AVAILABLITY	PRIOR USE
NON-DEVELOPER	1/30/2004	X	X	X			
DEVELOPER	2/2/2004	X	X	X	X		
NON-DEVELOPER	2/3/2004	X			X	X	X
DEVELOPER	2/4/2004						
DEVELOPER	2/5/2004	X	X	X			
NON-DEVELOPER	2/12/2004				X	X	

Table 3: Searchable Fields

In all of the interviews conducted, none of the developers cited the availability of a site as an important factor to search by. This is important because developers may not be particularly concerned with land availability, which could indicate the developers we interviewed are proactive in gathering information when finding sites. The potential for underutilized properties that are not necessarily available have a greater chance of redevelopment into fully functioning properties with a proactive approach. All contacts that were not developers implied with their answers that they were more willing to wait for sites to become available, then assess the potential contamination of the property, and finally make a decision on the site.

Each group of contacts wanted several fields to be searchable in the database. Therefore, we designed the database to be searchable by any potential field of information. Flexibility, we felt would allow any potential users, based on the assortment of responses we obtained, to search by any field of information they desired. This flexibility helps make the database more user friendly.

4.1.2 Database Attributes

Before holding interviews and the focus group, we created a preliminary list of database fields that we felt were necessary as information for potential developers to

make informed decisions on properties (Appendix A, p82). This list was provided to each contact before the conversation began, and then everyone provided their own input on what other attributes they felt were necessary to include in the database, either agreeing or disagreeing with our list and modifying it.

Each interview provided us with additional attributes that could be added to the database. The table below provides all of the attributes stated and which contact gave them.

Database Data Fields								
CONTACT	INTERVIEW DATE	BUILDING QUALITY	ZONING	PHASE STUDIES	HISTORICAL VALUE	ECONOMIC BENEFITS	AVAILABILITY	PRIOR USES
NON-DEVELOPER	1/30/2004							
DEVELOPER	2/2/2004	X				X		
NON-DEVELOPER	2/3/2004		X	X			X	X
DEVELOPER	2/4/2004							
DEVELOPER	2/5/2004		X		X			
NON-DEVELOPER	2/12/2004			X		X	X	
FOCUS GROUP	1/30/2004							

Table 4: Database Data Fields

The interview and the focus group on 1/30/2004 both supported that the list we provided was adequate, but the developer on 2/04/2004 did not believe that any database would be useful stating that a more proactive approach of sending letters to all underutilized businesses as well as potential developers was the only way the City would recover these properties. Feedback from the rest of the contacts lead us to include zoning, phase studies, economic benefits, and parcel availability into the database, because each of these attributes was stated with more frequency than the rest.

4.1.3 Database Maintenance

Many questions surrounded the maintenance of the database and the future of the database after the project completion. We asked members of the Outreach Committee to provide our group with their suggested guidelines for database maintainability since they

are the ones responsible for maintaining the database after the project completion. Through questioning, the guidelines set were:

1. The database needs to be easily maintainable.
2. The database should be able to import data from other sources of information.

Further questioning revealed the database needed to follow these guidelines because the Committee did not have a plan in place for maintaining the database once it was completed. The only option they thought viable would be to hire an intern to update the database every six months. Further questioning revealed the database needed to follow these guidelines because the Committee did not have a plan in place for maintaining the database once it was completed. The only option they thought viable would be to hire an intern to update the database every six months.

After dealing with different technical complexities, for example, a problem with importing data as well as analyzing data received from the focus group, we decided to create a manual to aid in the maintenance of the database. The manual would provide systematic instructions on how to fill, modify, search, and update the database, allowing anyone working on the database in the future the ability to continue with the development of the database.

4.1.4 Presentation of the Database

In order to make the database more presentable, we decided to incorporate GIS to visually display the data. Our contacts provided insight to the usefulness of GIS and the useful features provided by GIS.

GIS USABILITY								
CONTACT	INTERVIEW DATE	USEFUL	NOT USEFUL	PROXIMITY TO INFRASTRUCTURE	ZONING	CONTIGUOUS PROPERTIES	VISUAL REPRESENTATION OF AREA	UTILITIES
NON-DEVELOPER	1/30/2004	X					X	
DEVELOPER	2/2/2004		X					
NON-DEVELOPER	2/3/2004	X		X	X	X		X
DEVELOPER	2/4/2004	X						
DEVELOPER	2/5/2004	X					X	
NON-DEVELOPER	2/12/2004		X					
FOCUS GROUP	1/30/2004	X		X		X	X	

Table 5: GIS Usability

Only two contacts stated that GIS would not be helpful in aiding in the presentation of the database. The first contact stated their company and similar ones prefer to physically go to a site of interest rather than look at it on a map, and that the map would just add another step to the redevelopment process. The second contact did not agree with using GIS in the database because he did not believe that the City would be able to maintain it, and soon the GIS would just provide out-of-date information on the sites.

All other contacts felt GIS would be helpful with visually presenting the information contained in the database. Each contact also explained why GIS would provide more information than just a database could, such as stated in the table above.

Geographical information systems, such as MapInfo Professional, do more than merely present textual data in a visual format, they allow for spatial analysis as well. GIS not only allows users to put a property "on the map," but also allows the user to perform complex, spatial analysis calculations. It is able to calculate, with accuracy governed by the data supplied, a property's proximity to infrastructure, such as main access roads, highway exits, and railways. GIS also provides the user with a visualization of the property boundaries as well as the property's building footprints, and even provides information on the appearance of land surrounding the property.

Many data layers which can be described as databases with coordinates have already been created for use in GIS. Data layers containing information on roads, railways, ponds, streams, demographics, census data, water table data, elevation, utility data, and even the locations of underground storage tanks are obtainable. Many of these data layers prove useful to developers and potential property owners. If a developer would like to purchase a property with easy access to a major highway, GIS can show the user the exact access route to the highway. Similar calculations can be done in respect to proximity to other infrastructure as well.

GIS not only allows working with line distances, but with radial distances as well. If a company wants to purchase a property that targets users of a certain age, gender, or race within a one-mile radius of the property, GIS may be used to help plan for the purchasing of a property in a viable area. Similarly, if a developer is looking to purchase residential property no farther than two miles from a park, GIS may again come in handy.

Finally, GIS allows for non-spatial numerical calculations as well, such as coloring a region based upon its population density or the number of fire hydrants located within the region. A complicated procedure made easier by the use of GIS is value analysis. Value analysis analyzes a region based on various user-defined economic variables, such as size, population density, pollution amounts, etc. GIS makes it is possible to take all of these variables into account using a complex formula and colorize the regions based on the results of the analysis.

Through our research, and through correspondence with our sponsors, we have determined that GIS must be able to utilize our database to its fullest potential. We have constructed our database so that it can be imported into GIS without difficulty and so

spatial analysis and other methods of analysis only feasible by GIS may be carried out. We have therefore designed our database so that developers and city officials may use GIS to carry out complex analysis they could not before due to a lack of centralized information.

4.2 Database

The main goal of this project was to create a database for compiling information on brownfields and underutilized properties. The database allows users to analyze the information contained within to make accurate and informed decisions on the land they are interested in purchasing. To create a standardized database, we used MassGIS standards as guidelines. The database also has many features and uses that could be used to analyze different properties.

4.2.1 Standards Followed

Standards exist to promote the enhancement of industry for both suppliers and clients. The standard household light bulb, for example, may be purchased from any manufacturer and fit the lighting fixtures within a home. The light bulb and the lighting fixture both comply with standards that allow the two objects to "fit" together. Memory devices for digital cameras, another example, follow standards as well but they do not all follow the same standard. A device designed to print pictures from digital cameras may have five or more different "slots" for accepting memory equipment due to the various standards followed. Manufacturing standards, such as the ones described above, exist for the easy replacement and portability of products. Increasing the number of available,

differing standards for a product increases the risk of difficult replacement and a lack of product portability.

Compliance with various standards aids in the Brownfield Database's ability to adapt to changing user needs. In addition, due to the availability of vast amounts of data as well as the various formats that they are supplied, it is necessary to design a database capable of utilizing as much of the available data as possible. For our project, we used different standards as guidelines for the remediation of these issues.

4.2.1.1 MassGIS Standards

MassGIS standards ease city planning using property boundary data by mandating a set of standards. MassGIS, according to the Commonwealth's Office of Geographic and Environmental Information, has the legislatively signed authority and mandate to "set standards for the acquisition and management of geographical and environmental data by any agency, authority or other political subdivision of the Commonwealth." We created the Brownfield Database with the future compliance of the MassGIS Digital Parcel File standard and the MassGIS Standard for Documentation of GIS Coverages, Tables, and Data layers in mind. Version 1.5 of the MassGIS Digital Parcel File Standard has five purposes:

1. Provide communities a flexible specification for developing a digital parcel file suitable for use in a GIS. Because text labeling and the creation of a master address file are integral to extending the usefulness of a digital parcel file, portions of this standard address the creation of those datasets.
2. Make it possible to merge digital property information from more than one community for multi-town mapping and spatial analysis.

3. Being able to identify a single property parcel statewide based on a single unique identifier.
4. Assure a minimum level of spatial accuracy.
5. Assure a minimum and consistent set of attributes.

The Brownfield Database looks to comply with Level I of the MassGIS Digital Parcel File Standard, the minimum acceptable standard for developing a digital parcel file. To obtain further information on the MassGIS Digital Parcel File Standard, see the MassGIS Standard for Digital Parcels and Related Data Sets (Version 1.5) at the following internet address: http://www.state.ma.us/mgis/muniparc.htm.

The MassGIS Standard for Documentation of GIS Coverages, Tables, and Data layers presents standards and guidelines for complete documentation of GIS data within the MassGIS library. The standard provides a structure for traditional data dictionary elements and other information that makes it possible for any user to access and use unfamiliar data. The Brownfield Database looks to comply with the Standard for Documentation of GIS Coverages, Tables, and Data layers. To obtain further information, see the MassGIS Standard for Documentation of GIS Coverages, Tables, and Data layers at the following internet address: http://www.state.ma.us/mgis/standard.htm.

4.2.1.2 Other Standards

MassGIS is not the only mandate to set standards concerning geographical and environmental data. Other organizations, such as the Federal Geographic Data Committee (FGDC) and the U.S. Geological Survey (USGS) both mandate standards concerning metadata, documentation on GIS or other data, which may all ready be familiar to the

City's GIS coordinators. The FGDC Content Standard for Digital Geospatial Metadata provides a common set of terminology and definitions for the documentation of digital geospatial data. The USGS provides not only information concerning metadata but tools to aid in the metadata creation process as well. Eventually, metadata must accompany the Brownfield Database, and the creation of metadata can be a costly and time-consuming process. MassGIS offers funding resources, viewable at the following internet address: http://www.state.ma.us/mgis/munifund.htm

To obtain further information on the FGDC standard, visit the following internet address: http://www.fgdc.gov/

To obtain further information on the USGS standard, visit the following internet address: http://geology.usgs.gov/tools/metadata/

4.2.2 Features

The database we created has many features, among them are: tables for storing data, queries for sorting and viewing data, and forms for viewing, maintaining, modifying and adding records into the database. The tables enable the user to store related data in groups. These groups can be linked together by creating relationships between them, making the tables all work together as one large table.

Every table contains fields, or columns, where data is stored. Both data and fields can be added and deleted while maintaining the table format. This enables users to create new fields in the future without having to create entirely new tables, therefore, making the database easier to maintain. The figure below shows an example table.

ASSESSOR : Table

MBL	PROPERTY ID	TOTAL VALUE	FISCAL YEAR	LOT SIZE	UNITS
06-33B-00007		$123,700.00	2003	34535	SQFT
07-003-00001		$13,900.00	2003	4213	SQFT
07-003-00002		$186,500.00	2003	75050	SQFT
07-003-00003		$409,000.00	2003	106172	SQFT
07-003-0001A		$36,300.00	2003	16512	SQFT
07-003-0002A		$526,600.00	2003	66375	SQFT
07-003-0002B		$244,000.00	2003	65172	SQFT
07-003-0003A		$366,600.00	2003	59938	SQFT
07-003-0003B		$15,900.00	2003	30246	SQFT
07-004-00012		$70,500.00	2003	95157	SQFT
07-004-0003A		$46,500.00	2003	14619	SQFT
07-004-001+2		$378,200.00	2003	33602	SQFT
07-004-09-11		$164,000.00	2003	27973	SQFT
23-002-00007		$412,300.00	2003	66810	SQFT
23-002-00009		$189,900.00	2003	206880	SQFT
23-002-0000B		$2,562,600.00	2003	237894	SQFT

Record: 20 of 20

Figure 2: Example Microsoft Access Table

Another feature, a query, functions primarily to sort and view data in different formats. Fields from multiple tables can be put into a query and rearranged in any order desired by the user. For example, site owner and contamination fields can be viewed together and sorted by owner or by type of contamination. Users may want to view a selection of information, but not all data, on different properties, but need to sort the information by attributes they feel are important. Queries provide the user with this option. The figure below shows an example query.

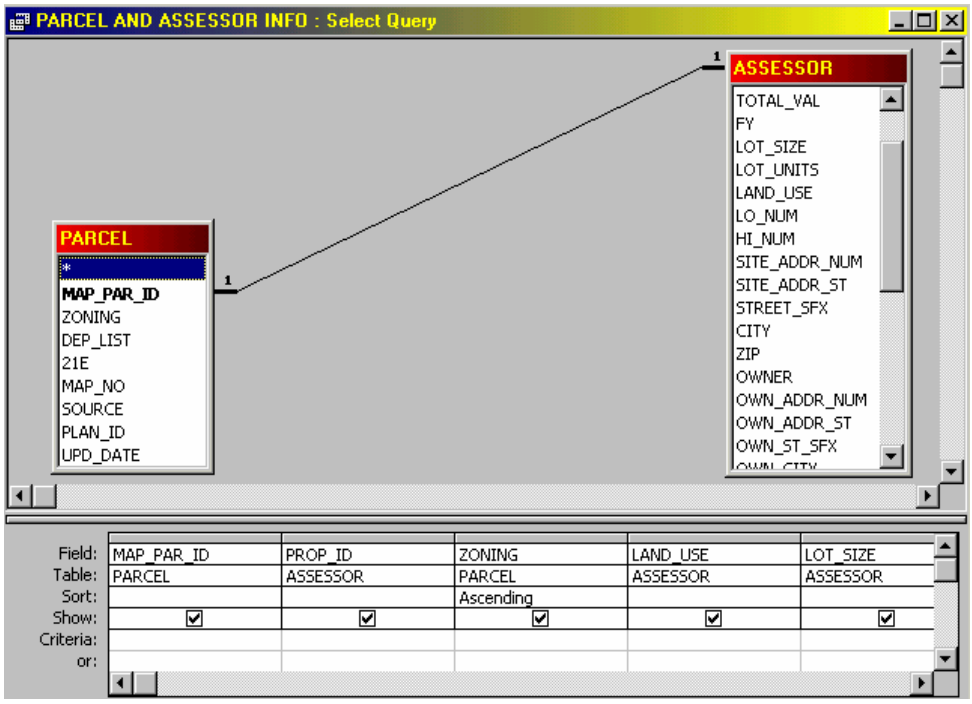

Figure 3: Example Microsoft Access Query

Forms are primarily used to maintain, view, filter, and create new records. The user can create new records within the database by entering information into a blank form, as well as search for records with specific attributes. It is also possible to sort records by specific attributes after completing a search to organize the related records. The user can also maintain the database by finding and updating a specific record, which entails searching for that record and changing the field values as necessary. For example, if the user wants to update information for the site located at 2 Pullman St, the user would go to the form view and use the Filter by Form option to find the site. To update the information, the user would enter the correct data into the field in question, and the updating will be complete, as shown in the figure below.

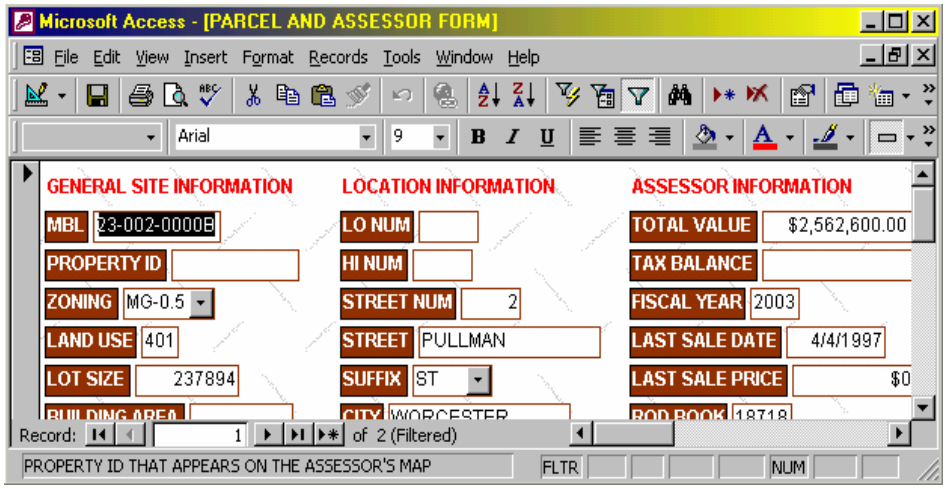

Figure 4: General Data Entry/Search Form

A list of all the field names in the database can be found in Appendix B. The database creates a centralized location for storing information from many sources. This database allows the user to efficiently search through all the information from the separate locations where data originated.

4.3 Summary

In summary, the qualitative findings from our interviews and focus group enabled us to better determine the structure of the database, the database attributes, maintenance, and the presentation of the database. Through our interviews, we discovered that developers and non-developers had significantly different requirements in regards to the structure of the database, due to developers taking a proactive approach to acquiring property. The focus group did not add to our initial attribute list, although our interviews provided us with many new fields for the database. From our focus group, we learned that the database needs to be easily maintainable and that it should be able to import data from outside sources.

Based on our focus group and interview results, we decided that designing the database so that it is presentable in a geographical format would aid the City of Worcester in assessing a property's economic risk. In order to aid with external applications of the database, we followed MassGIS standards as guidelines for the database structure. We determined to follow the MassGIS Digital Parcel File Standard as well as the MassGIS Standard for Documentation of GIS Coverages, Tables, and Data layers. Finally, we implemented various features, based on our focus group and interviews, to aid the City of Worcester in both using and maintaining the database.

5 Conclusions

This chapter details specific information about how the project can be taken further through proposed recommendations. The chapter includes an overview of our accomplishments, possible improvements to our methodologies, and a discussion of the social implications of the project.

5.1 Recommendations

This section of the report focuses on the various improvements that can be made to the database to make it useful in the future, as well as what the City of Worcester can do as a whole to further their cause in brownfield redevelopment. Our recommendations our based on what we have learned due to this project, and what we still see as improvable.

5.1.1 General Recommendations

One of the most urgent follow-up issues for this project is the need for a qualified person(s) to be responsible for the maintenance of this database in the future. The person will need to be well versed in computer science and GIS as well as understand the economic implications this database can offer to the Worcester Community. In order to make this database useful, the City needs to hire someone who can maintain the database and implement the following suggestions to make the database more user-friendly and help with brownfield redevelopment in Worcester.

It is urgent that the database be filled quickly and accurately. The sooner information is compiled into a central database the sooner it will be used by a variety of

interested parties. After the initial information is entered into the database, it is equally urgent that the information in the database be updated on a regular basis. We suggest that after the database has been implemented it is updated once every 2-3 months to keep the availability of land accurate. Several developers that were interviewed during this project expressed this as a topic of concern. In their opinion, they would be wasting their time looking into a potential property if it was already being used or not available by other means. We suggest this time frame because we recognize how long it takes to complete the task of communicating such information between all the parties involved. Organizing this information is still a big endeavor yet it is not impossible, as we have learned, as the data entry remains incomplete. We hope to see the time between updates become smaller as data collection is completed over time and as someone is hired officially to maintain the database.

We also recommend that a list of developers be developed and the developers be notified when land becomes available. This would keep communication between City and developers open and active. We feel after our interviews and focus group that the best way for developers to gain interest in the City's underutilized land is to be aware that it is available to them.

Another recommendation specifically involves the DEP. A large portion of information that we received for the creation of the database came from the DEP. Some information was available to us online, and other forms of it we had to pursue personally at their offices. A problem we encountered with data collection at the DEP was that after tracking down information needed, much of it was not up to date or it was organized in a form that was not standardized in the same way that other that other information was

which we received from other offices. The most important difference being that the DEP identifies sites by release tracking numbers (RTN numbers) and not map block lot numbers (MBL numbers). The fact that DEP does not identify sites with MBLs causes great difficulties for importing information into the database because all of the MBL numbers then have to be manually inserted.

In an effort to see these recommendations come to pass to aid in the success of this database, our team is preparing to hold an exit interview with some members of the Brownfield Committee as well as a faculty member of Clark University, specializing in GIS, in order to offer any further assistance in the understanding, and development of the future of this project for the success of Worcester. During this interview our team also plans to go over the manual that was developed for future database maintenance and to answer any other questions that those who will be working further on this project may have.

Our team also recognized the need to confront two other broader questions in this project and its success. We recognized the need to confront whether or not the City plans to use this database publicly or privately. The future of the database maintenance schedule, how it will be presented, and what - features will be added or removed in the future really depends on who the City will be offering it to. If this database is strictly to be used by the City to solely organize information on underutilized land, then many aspects of presentation could be ignored. However, we recognize the potential that this database has as a tool for the City and recommend that it be made public. This database could be used as a marketing tool for the awareness of underutilized property and ultimately for the redevelopment of these sites. When developers request land availability

information from the City, the City can redirect them to this database that encourages open communication between both parties about the redevelopment of these sites.

Another recommendation that we are making is the need for a Worcester Brownfield Website. A website specialized on Worcester's brownfields is a perfect place to tie all aspects of this project together for the benefit of the City. The brownfield database could be found here, public or private, as well as photos of available brownfield sites, and several links to important aspects of brownfield redevelopment such as tax incentives (a link online is a lot easier for developers to refer to rather than a pamphlet that can be lost or overlooked), and an EPA link that encourages developers to explore the benefits of brownfield redevelopment. In addition, the link would provide information on Worcester brownfield success stories such as Medical City. This website, especially with the inclusion of the informative database would encourage and provide an example to several other cities both inside and out of Massachusetts who deal with the problem of significant amounts of brownfields and other underutilized land.

A recommendation for the website is to have a direct link to the DEP website. A link to the DEP would allow potential developers to search updated information incase the database is not updated as frequently as necessary.

5.1.2 Technical Recommendations

The following recommendations are based on discoveries by our team over the seven-week project period, and are recommendations because were unable to implement them either because of time or technical experience constraints. It is our hope that the recommendations are of help and practical for the benefit of the City of Worcester.

Our first recommendation is to create a program, or programs, to automate the updating of the Brownfield Database. This may be a costly and time-consuming task, as coding will be required for each source of data. The program must also change every time the structure of the database or the structure of the external data changes. Ideally, this program will allow for updating of the database on the fly, allowing the database to provide the most accurate information available to the user.

If the City is unable to create a program to import external data, the City must manually fill certain areas of the database. To aid in this process, the City may use the General Data Entry form for the manual entry of data into the database. For this task, we recommend the City hire a part time or summer intern to perform the manual maintenance and updates of the database.

Another recommendation, similar to the first recommendation, is the pairing of the DEP's Release Tracking Numbers (RTNs) with the City's Map Block Lot numbers (MBLs) within existing data sets. For our project, we were forced to match the RTNs of a property with its MBL manually, by matching the site locations of the DEP database to the City's Assessor database. Two solutions are recommended for this issue. The first solution is to create a program that matches the RTNs and MBLs automatically, similar to the updating program mentioned previously. The second solution is to have the DEP record the MBL of the property when creating environmental reports. This will solve all future issues, but the matching problems will still occur for all ready created environmental reports.

Our next recommendation is to create procedures to determine the availability of a parcel, being primarily determined by the owner being willing to sell the property. The

City may also wish to "score" the possibility of the owner being willing to sell, without needing to contact the owner. This score may be based on variables such as the contamination of the property, the amounts of taxes owed, or the possibility of the property going to land court. In order to accomplish this task, the City should design a standardized, economic model.

If the City of Worcester wishes to promote the redevelopment of brownfields publicly and wishes to use the Brownfield Database to do so, we suggest that the City creates a brownfield website, which may or may not be kept private, so that developers, City of Worcester employees, and possibly the public may have access to the database. We advise cautions of confidentiality when making the database either partially public or completely public. If it is necessary to preserve confidentiality, we recommend that the City investigate creating secure accounts for interested developers to limit access to the database. Finally, we recommend that the City link to outside sources of data, so that the user does not need to rely solely upon the Brownfield Database and that they may check the original source of information for accuracy.

Finally, we suggest that the City of Worcester seek to comply with the MassGIS standards used as guidelines throughout the project, as they will aid in the database's ability to be used by other authorities as well as between the City's departments. The City may also wish to comply with other related standards. Our team was only able to make certain aspects of the database comply with the MassGIS standards, as some of the requirements were unable to be met with our technical background, such as creating metadata and horizontal datum.

5.2 Project Conclusions

The conclusions represent what we as a group accomplished and what we could have done better. We feel that discussing both the flaws and accomplishments of our project is important due to their importance making this project better.

5.2.1 Accomplishments

The task handed to us by the City was to create a database that contained the following information:

- Current and past owners
- Current and past site use
- Known contamination
- Property size, zoning, and proximity to infrastructure
- Existing utilities serving the property

We have accomplished this and more, also providing:

- Information on the registry of deeds
- Any economic incentives for a parcel
- The tax balance on a parcel
- If there are any underground tanks at the site
- The category, time frame, and status of the contamination at a particular parcel
- The type of land where the contamination occurred, the source, and the amount of the contaminant
- Which phase of cleanup a parcel is in
- The identification number of the Licensed Site Professional who performed any analysis on the site

With this information, we believe that anyone using this database will be able to make informed and accurate decisions on any parcel they are interested in. Our group also thinks that this database is a great step by the City in taking a proactive stance towards brownfield redevelopment, especially in a marketing aspect if they so choose to use the database in such a fashion.

We created a manual to aid in the use and maintenance of the Brownfield Database. Feedback from potential users as well as the outreach committee of the mayor's brownfield task force commented on the structure of the database and played an active role in the development of the manual. The manual discusses the technologies used by the team throughout the project, the standards the team looked to for guidance, quality assurance and quality control guidelines monitored, data resources utilized, methods of database creation, methods of database maintenance, analysis using geographical information systems (GIS), and economic incentive information. We created the manual to serve as a stand-alone document for our sponsor, so that with the help of the manual the City of Worcester can continue the project.

In order to test the manual's effectiveness, we tested it both within and out of the Property and Business Owner's Education and Outreach Committee. A few members from the Committee tested the manual by following it's guidelines using varying computers to account for software setup differences. We also provided those who aided in the development of the manual the ability to review the manual for effectiveness. Those who reviewed the manual had no concerns. By testing the manual both within and out of the group, we identified and resolved any discrepancies.

5.2.2 Improvements

There are some areas of the project that we felt could have been completed more thoroughly, the first being interviews. We conducted five interviews, one email interview, and a focus group. Each of these interactions with experts in the field provided us with useful information pertaining to the project. More interviews would have brought more insight in understanding the overall brownfield problem in Worcester. From a

marketing standpoint, more interviews would have allowed more people involved in redevelopment in Worcester to become up to date on the steps the city was taking to make brownfield redevelopment easier to accomplish.

Our advisors also recommended conducting a focus group with developers interested in the Worcester area. The focus group could have allowed many developers to throw ideas off each other and allow us to come up with a standard list of information within the database that each developer agreed upon. We instead created the list of information ourselves based on each contact's recommendations.

A lack of computer software and programming knowledge hindered our ability to create the database and the GIS efficiently and more user friendly. If time to learn certain pieces of software had been given, or if we had been fortunate enough to have someone knowledgeable in computer science with us during this project, we feel that the database would be more user friendly. Many of the problems involving importing files to the database could have been overcome.

5.3 Implications

If all brownfields and underutilized properties in Worcester were back on the tax roll, the City would receive $600 to $800 million in increased tax revenue (Monahan, 2003). For a City with an annual budget around $400 million in 2003 (DelSignore, 2003) the annual budget could almost double. This extra money could help municipal services such as the library to be fully funded.

Evidence can already be seen of what can happen when brownfield sites are cleaned up and redeveloped. Medical City, and the Marriot Courtyard hotel which provided 50 permanent jobs and $50,000 in tax revenue per year (Worcester Regional,

2002), are examples of success stories due to brownfield redevelopment. With the information obtained by the 20 sites already in our database, the City can go ahead and try to redevelop these properties as well and turn them into success stories.

Throughout its early history, Worcester has been an epicenter for economic development in New England. The infrastructure is available, and the City is now preparing to pull developers in. The database will be an integral part of this process, and will only help the City with their goals of economic redevelopment.

5.4 Summary

Our project may be advanced in many ways; by a computer science or GIS expert, or through an intern capable of routinely updating and adding onto the existing database with new properties. The project may certainly aid developers and other interested parties in the process of gathering information to both accelerate and ease the redevelopment process. We feel that the database we have provided, along with the manual, will prove critical to the redevelopment of brownfields in the City of Worcester due to our efforts. We have made various recommendations to our sponsors in order to ensure success of the project in the future.

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Appendix A – Interviews and Focus Group

Non-Developer Interview Questions

1. How is your department involved in brownfield redevelopment?

2. What was the most recent involvement you or your department has had in brownfield development? Please explain the most recent substantial involvement. Substantial involvement being at least the thorough researching of a potential site.

3. What was the duration of time of your most recent substantial involvement?

4. Where was the location of development and what type of land (commercial or residential) was developed?

5. What problems have you faced in brownfield redevelopment?

6. Was the amount of information on brownfield or suspected sites easily available? Why or why not?

7. How and where did you obtain information on these potential brownfield sites?

The list we provided below gives you an idea about information we feel is necessary for a database on brownfield sites in Worcester.

1. Do you think there are any pieces of information missing, if so what are they?
2. Are there any pieces of information that should not be included that we have or do not have in the initial list?

Database Quality Questions:

1. What are the most important features you would like to search by in a database for brownfield properties?
2. How familiar are you with databases in general? Are you comfortable using databases?
3. How familiar are you with GIS? Are you comfortable using GIS?
    a. What are the most important attributes that you would like to see within GIS?

Closing Question:
Where do you think the future of brownfield redevelopment is heading for Worcester?

Developer Interview Questions

1. Where is your company located?

2. When and why did you become involved in brownfield redevelopment?

3. What was the most recent involvement you or your company has had in brownfield development? Please explain the most recent substantial involvement. Substantial involvement being at least the thorough researching of a potential site.

4. What was the duration of time of your most recent substantial involvement?

5. Where was the location of development and what type of land (commercial or residential) was developed?
    a. Why did you choose Worcester for redevelopment?

6. What has deterred you from completing a brownfield project besides just a bad investment?

7. Was the amount of information on brownfield or suspected sites easily available? Why or why not?

8. How and where did you obtain information on these potential brownfield sites?

9. How has brownfield redevelopment affected (positively and negatively) you or your company?

The list we provided below gives you an idea about information we feel is necessary for a database on brownfield sites in Worcester.

1. Do you think there are any pieces of information missing, if so what are they?
2. Are there any pieces of information that should not be included that we have or do not have in the initial list?

Database Quality Questions:

1. What are the most important features you would like to search by in a database for brownfield properties?
2. How familiar are you with databases in general? Are you comfortable using databases?
3. How familiar are you with GIS? Are you comfortable using GIS?
    a. What are the most important attributes that you would like to see within GIS?

Closing Question:

How do you or your company plan to pursue brownfield development in the future?

Database List for Interviews

- **Past/Present Owner** – Used to contact past and present owners in order to research the history of the property.
- **Past/Present Site Use** – A history of the property's commercial usage.
- **Area, ft^2** – The amount of space a parcel of land offers. This includes both lot area and useable building area.
- **Existing Utilities** – The existing utilities serving the property, such as methods of providing electricity, heating, water, etc.
- **Land Value** – The value of the parcel of land.
- **Building Value** – The value of the building contained on the parcel of land.
- **Total Value, Fiscal Year 2003** – The sum of the land value and the building value.
- **Tax Balance** – The amount of taxes the current owner owes to the city of Worcester.
- **Street Location** – The street location of the parcel of land.
- **Map Block Lot (MBL)** – A unique parcel identifier assigned to each individual property in the city of Worcester.
- **Known Contamination/Chemical Type** – The type of chemical(s) used or created at the facility and has the potential to be in the ground or remain on the property.
- **Proximity to Infrastructure (GIS Only)** – How close and accessible Worcester's infrastructure is to the property, such as highways, railroad, high-speed internet, the Port of Worcester, etc.

Interview Procedures

- Contact each person the group would like to interview using an initial contact sheet.
    - The contact sheet will be used to provide each person being interviewed with a standard set of information.

- A formal letter will then be emailed or mailed to every contact that agrees to an interview that briefly states the purpose of the interview and inquires if they have further questions about the project or the interview in general.

- A list of interview questions will then be sent in order to allow each contact the opportunity to prepare for the interview.

- A person from the group will call each contact to confirm the time, date, and place of the interview the day before the interview.

- The group will arrive 15-20 minutes early to each scheduled interview in order to prepare and set up each interview.

- The group will meet for 15-20 minutes after each scheduled interview to go over notes and clear up any initial discrepancies that any of the group members may have.

- We will then go over the tape recording, rewrite it verbatim for notes, and we will also organize the notes taken, and apply the answers given by the interviewees to our project.

- Send “thank you” notes to participants.

Focus Group Procedures

- Send a letter to each individual that we want in the focus group asking if they will participate.
- Each contact must then be emailed and phoned in order to determine a time for the meeting that will fit into everyone's schedule.
- Focus group members will be contacted a second time with a final date and time for the focus group bases on their previous responses.
- Group discussion questions will then be sent to each member to allow each member of the focus group to prepare before the discussion.
- Final contact is made a day before the scheduled meeting to each of the group members to remind them of the set date, time, and location of the proceeding.
- We will practice a focus group on ourselves to determine a suitable process to run the focus group with.
- Arrive at the scheduled meeting 15-20 minutes early so that we can set up the focus group.
- Hold the focus group.
- The group will meet for 15-20 minutes after each scheduled interview to go over notes and clear up any initial discrepancies that any of the group members may have.
- We will then go over the tape recording, rewrite it verbatim for notes, and we will also organize the notes taken, and apply the answers given by the interviewees to our project.
- Send "thank you" notes to participants.

Focus Group Questions

1. How has data availability affected brownfield redevelopment in Worcester? Are there any particular instances anyone can think of?

2. Once the database is complete, do you think there will be sufficient support for its expansion and further maintenance? If so, where will it come from?

3. The database will quickly become outdated due to constantly changing variables, such as lot availability and property owners. What plans are in place to keep the database current?

4. (If a maintenance strategy is in place all ready) Are there parameters on attributes such as historical information on past property owners that we need to follow within our database to aid in the maintenance strategy?

5. In your opinions, what do you feel are the most important attributes necessary for the database so that every potential user of the database will find it informative and helpful?
    a. Where can information about these attributes be obtained and is it easily accessible?
    b. How detailed should the information be and what are the boundaries for historical data?

6. We propose several project deliverables:
    a. A well-designed database that meets the needs of the City, developers, and property owners
    b. A manual aiding in the collection of data for the database.
    c. A manual aiding in the maintenance of the database.

7. We feel that these manuals can be helpful in keeping this database useful and current for those using it. Are there any preferences that you may have in the contents, organization, and presentation of information within these manuals?

Appendix B – Standard Field Names

The following is a list of the standard field names present in the Brownfield Database tables, sorted by the table that the fields are present.

PARCEL Table

1. **MAP_PAR_ID** – This attribute is the property ID that appears on the assessor's map. This attribute tells the user the lot's specific identification number.
2. **ZONING** – Zoning classification, if available in the Assessor's database (character field), tells the user the possible land uses, for example, commercial use.
3. **ABANDONED** – Tells the user whether the site is abandoned or not.
4. **DEP_LIST** – Allows a user to tell if a site is DEP classified.
5. **21E** – Tells if the site is classified as Chapter 21E.
6. **MAP_NO** – Map number of the assessor's map sheet from which the mapping of the parcel in the digital file was created (character field).
7. **SOURCE** – Boundary feature source (character field; valid values are ASSESS MAP, SUBDIV, SUBDIV ANR, ROAD PLAN, OTHER).
8. **PLAN_ID** – Identifying information for plan (e.g., subdivision or road plan) used to update the digital file (character field).
9. **UPD_DATE** – The date of update to the property boundary. Should include the year and month of the update (character field, size 6, entries formatted as YYYYMM).

ASSESSOR Table

1. **MAP_PAR_ID** – This attribute is the property ID that appears on the assessor's map. This attribute tells the user the lot's specific identification number.

2. **PROP_ID** – Constructed from information typically found in multiple columns in the assessor's database. It must be unique. This attribute is simply another property identifier.
3. **TOTAL_VAL** – Current total assessed value for land and structures (numeric field). It is important for purchasers to know how much the land is worth for monetary reasons.
4. **FY** – Fiscal year of assessed value (character field). It is important to know the year of the most recent assessment to adjust the land value for inflation.
5. **LOT_SIZE** – Deed area in EITHER square feet OR acres, but not both (numeric field, allowing for up to two decimal places). Buyers need to know how much land they have to use.
6. **LOT_UNITS** – Deed area units (character field; valid values are "S" for square feet and "A" for acres).
7. **LAND_USE** – State land use code (numeric field).
8. **LO_NUM** – The lowest house number associated with a parcel; for a single family home, this is the only house number associated with the parcel.
9. **HI_NUM** – The highest house number associated with a parcel when the parcel contains a multi-family dwelling with separately numbered doors. For single-family homes, this field would be blank.
10. **SITE_ADDR_NUM** – The property's street address number.
11. **SITE_ADDR_ST** – Street of site location.
12. **STREET_SFX** – Street suffix of site location.
13. **CITY** – City or town where the property is located.
14. **ZIP** – Zip code where the property is located.
15. **OWNER** – Name of first owner of record (character field).
16. **OWN_ADDR_NUM** – Street address number of first owner of record.
17. **OWN_ADDR_ST** – Street of first owner of record.
18. **OWN_ST_SFX** – Street suffix of first owner of record.
19. **OWN_CITY** – City of first owner of record.
20. **OWN_STATE** – State of first owner of record.
21. **OWN_ZIP** – Zip code of first owner of record.

22. **OWN_CO** – Country of first owner of record.
23. **CONTACT_1ST** – Owner's contact first name.
24. **CONTACT_LAST** – Owner's contact last name.
25. **CONTACT_TEL** – Owner's contact telephone number allows the user to get in touch with the owner to work out issues on the land or to help in purchasing the lot.
26. **LS_DATE** – Last sale date (character field, not data field because dates come in too many variations but are easy to place into a character field).
27. **LS_PRICE** – Last sale price (numeric field).
28. **LS_BOOK** – Last sale Registry of Deeds book (character field).
29. **LS_PAGE** – Last sale Registry of Deeds page (character field).
30. **ROD_YEAR** – Registry of Deeds Year.
31. **BLD_AREA** – Building area (square feet) for commercial/industrial properties as defined by the state use codes. (Only required if information available from assessor's database; numeric field; if not available, leave blank).
32. **ECON_INCENTIVES** – Informs the user on the available economic incentives to redevelop the property in question.
33. **TAX_TITLE** – Informs the user if the site is tax title.
34. **TAX_BAL** – Informs the user if there is a tax balance on the property. This allows the user the possibility to make an easier purchase of the site by working with the owner to get the site cheaper.
35. **PUR_AVAIL** – This column is for not only underutilized sites, but also sites surrounding an underutilized site. This attribute is helpful in trying to find smaller lots to form one larger lot.

DEP Table

1. **RTN** – Release Tracking Number is defined as Region # (1, 2, 3, or 4) followed by a dash and then a unique 7-digit number (i.e., 3-0002457 or 1-0012578).

2. **MAP_PAR_ID** – This attribute is the property ID that appears on the assessor's map. This attribute tells the user the lot's specific identification number.
3. **EPA_NO** – EPA identification number. Important to identify contamination and research property contamination history.
4. **UDRGRD_TNKS** – Informs the user if there are underground tanks present on the site. Helps the user to assess cleanup costs.
5. **OFC_NOTIF** – Official release notification date of release. Important to know when the last contamination occurred to understand the extent and chemical seepage into the ground.
6. **CATEGORY** – Release reporting category (e.g., "120 day","72 hour", or "2 hour" notifications). This describes the severity of the contamination on a time scale. For example, if the category is "2 hour", the contamination must be reported to the DEP within 2 hours. The same applies to the other options.
7. **PRIM_ID** – Associated ID, Related RTN number of release (9 digits).
8. **CURRENT_ST** – Most recent status of the contamination release on the site. The Current Status Acronyms are defined below:
    - **Status Code** – Definition
    - **ADQREG** – Adequately Regulated
    - **DEPMOU** – DEP Memorandum of Understanding
    - **DEPNDS** – Not a Disposal Site (DEP)
    - **DEPNFA** – No Further Action (DEP Determined)
    - **DPS** – Downgradient Property Status
    - **DPSTRM** – Downgradient Property Status Terminated
    - **INVSUB** – Submittal Invalidated by DEP
    - **LSPNFA** – LSP No Further Action
    - **PENNDS** – Pending Not a Disposal Site
    - **PENNFA** – Pending No Further Action
    - **RAO** – Release Action Outcome, a site/release where an RAO Statement was submitted. An RAO Statement asserts that response

actions were sufficient to achieve a level of no significant risk or at least ensure that all substantial hazards were eliminated.

- **RAONR** – Response Action Outcome Not Required
- **REMOPS** – Remedy Operation Status
- **SPECPR** – Special Project
- **STMRET** – Response Action Outcome Statement Retracted
- **TCLASS** – Tier Classification
- **TIER1A** – Tier 1A, a release receiving a total score equal to or greater then 550. These sites/releases require a permit and the person undertaking response actions must do so under direct DEP supervision.
- **TIER1B** – Tier 1B, a site/release where an NRS score of less than 550 and equal to or greater than 450. These sites/releases require a permit and the response actions may be performed under the supervision of a Licensed Site Professional (LSP) without prior DEP approval, unless such an approval is specifically required by DEP.
- **TIER1C** – Tier 1C, a site/release receiving a total NRS score of less than 450 and equal to or greater than 350. A site/release receiving a total NRS score of less than 350, but which also meets any of the Tier 1 Inclusionary Criteria specified in 310 CMR 40.0520(2)(a), is also classified a Tier 1C. These sites/releases require a permit and the response actions may be performed under the supervision of a Licensed Site Professional (LSP) without prior DEP approval, unless such an approval is specifically required by DEP.
- **TIER1D** – Tier 1D, a release where the responsible party fails to provide a required submittal to DEP by a specified deadline.
- **TIERII** – Tier II, A site/release receiving a total NRS score of less than 350, unless the site meets any of the Tier 1 Inclusionary Criteria (see above). Permits are not required at Tier 2 sites/releases and response actions may be performed under the supervision of an LSP without prior DEP approval. All pre-1993 transition sites that have accepted waivers are categorically Tier 2 sites.

- **UNCLSS** – Unclassified
- **WCSPRM** – Waiver Completion Statement Permanent
- **WCSTMP** – Waiver Completion Statement Temporary

9. **CURRENT_DA** – Date of most recent submittal that affected the Status.
10. **PHASE** – Indicates which part of the phased MCP cleanup process the release/site is in.
    - **Phase I** – Initial Site Investigation, including Tier Classification
    - **Phase II** – Comprehensive Site Assessment
    - **Phase III** – Identification, Evaluation and Selection of Comprehensive Remedial Action Alternatives and the Remedial Action Plan
    - **Phase IV** – Implementation of the Selected Remedial Action Alternative and Remedy Implementation Plan
    - **Phase V** – Operation, Maintenance and/or Monitoring
11. **ACTION** – Action types listed below.
    - **AUL** – Activity and Use Limitation
    - **DPS** – Downgradient Property Status
    - **IRA** – Immediate Response Action
    - **IRA-D** – Immediate Response Action DEP Lead
    - **PHASEI** – Phase I
    - **PHASII** – Phase II
    - **PHSIII** – Phase III
    - **PHASIV** – Phase IV
    - **PHASEV** – Phase IV
    - **RAM** – Release Abatement Measure
    - **RAO** – Response Action Outcome
    - **RAO-D** – Response Action Outcome DEP Lead
    - **RAO-P** – Partial Response Action Outcome
    - **RAONR** – RAO Not Required
    - **TCLASS** – Tier Classification
    - **URAM** – Utility-related Abatement Measure

12. **ACTION_ST** – Action status listed below.

- **ABCRCD** – As-Built Construction report Received
- **ACTAUD** – Action Audited
- **ADQREG** – Adequately Regulated
- **AMEND** – Amendment Received
- **APORAL** – Oral Approval of Plan
- **APORMD** – Oral Approval of a Modified Plan
- **APPRES** – Presumptive Approval of Plan
- **APTERM** – Approval to Terminate an Imminent Hazard
- **APWRIT** – Written Approval of Plan
- **ASSESS** – IRA Assessment Only
- **CSRCVD** – Completion Statement Received
- **DNORAL** – Oral Denial of Plan
- **DNWRIT** – Written Denial of Plan
- **FEECRD** – Fee Not Required, Fee Credited
- **FEEREC** – Fee Received
- **FEEREF** – Fee Not Required, Fee Refunded
- **I&MRCD** – Inspection and Monitoring Report Received
- **IHEVAL** – Imminent Hazard Evaluation Received
- **IHTERM** – Request to Terminate an Imminent Hazard Received
- **INTENT** – Notice of Intent to Conduct a URAM
- **MODRCD** – Modified Transmittal Received (DPS Transfer)
- **O&MACT** – Active Operation and Maintenance
- **O&MPAS** – Passive Operation and Maintenance
- **PLANMD** – Modified, Revised, or Updated Plan Received
- **PLANWR** – Written Plan Received
- **RAMIRA** – Approval to Continue RAM with ongoing IRA
- **RAORCD** – RAO Statement Received
- **RECPT** – Transmittal Received
- **REMOPS** – Remedy Operation Status Submittal Received

- **REQPLN** – Written Plan Requested
- **REVRCD** – Revised Statement or Transmittal Received
- **RTCLSS** – Related to a Tier Classified Site
- **SOW** – Scope of Work Received
- **STMRET** – Statement or Transmittal Retracted
- **STRCVD** – Status Report Received
- **SUSPEN** – RAM Suspended
- **T2EXT** – Tier 2 Extension
- **T2TRAN** – Tier 2 Transfer
- **TERMIN** – Action, Status, or AUL Terminated
- **TIER1A** – Tier 1A Classification
- **TIER1B** – Tier 1B Classification
- **TIER1C** – Tier 1C Classification
- **TIERII** – Tier 2 Classification
- **TRANS** – Related to a Transition Site (Not Tier Classified)
- **URAMNT** – Notification of URAM Received
- **WORKCD** – Work Completed
- **WORKST** – Work Started

13. **ACTION_DATE** – Date action received.
14. **RAO_CLASS** – Type of Response Action Outcome.
    - **A1** – A permanent solution has been achieved. Contamination has been reduced to background or a threat of release has been eliminated.
    - **A2** – A permanent solution has been achieved. Contamination has not been reduced to background.
    - **A3** – A permanent solution has been achieved. Contamination has not been reduced to background and an Activity and use Limitation (AUL) has been implemented.
    - **A4** – A permanent solution has been achieved. Contamination has not been reduced to background and an Activity and use Limitation (AUL)

has been implemented. Contamination is located at a depth of >15 feet but evaluation has determined that it is not feasible to reduce it.

- **B1** – Remedial actions have not been conducted because a level of No Significant Risk exists.
- **B2** – Remedial actions have not been conducted because a level of No Significant Risk exists, but that level is contingent upon one or more AULs that have been implemented.
- **B3** – Remedial actions have not been conducted because a level of No Significant Risk exists, but that level is contingent upon one or more AULs that have been implemented, and contamination is located at a depth of >15 feet but evaluation has determined that it is not feasible to reduce it.
- **C** – A temporary solution, which ensures the elimination of any substantial hazard, has been achieved at the disposal site.

15. **LOCATION_TYPE** – The type of area affected by the release (e.g., commercial, federal, municipal, open space, residential, right of way, roadway, school, state, or water body).
16. **CHEM_SOURCE** – The origin of the release (e.g., AST, boat, drums, fuel tank, pipe, tanker, transformer, unknown, UST, or vehicle).
17. **CHEMICAL** – The oil or hazardous material that has been released or poses a threat of release.
18. **AMT** – The quantity of contaminant that has been released.
19. **UNITS** – (e.g.: GAL, LBS, PPB, etc.)
20. **LSP_NO** – Licensed Site Professional identity number (4 digits).

Appendix C – Database Manual

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