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**LAND USE LAWS AND POLICIES  
SUITABILITY OF INDUSTRIAL LANDS  
PIONEER VALLEY, MASSACHUSETTS**

**FALL, 1991**

The Center for Economic Development at the University of Massachusetts, in Amherst, is part of the Landscape Architecture and Regional Planning Department, and is funded by the Economic Development Administration of the U.S. Department of Commerce, and the University of Massachusetts.

INDUSTRIAL SUITABILITY OF LANDS ZONED  
FOR INDUSTRIAL USE IN THE PIONEER VALLEY

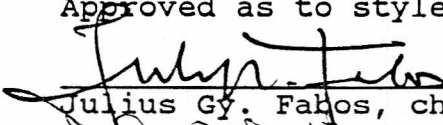
BY  
F. SHAN MCADOO AND ERIC J. VONBERG


A Masters Project Submitted to  
the Department of Landscape Architecture and Regional Planning  
of the University of Massachusetts in partial fulfillment  
of the requirements for the degree of

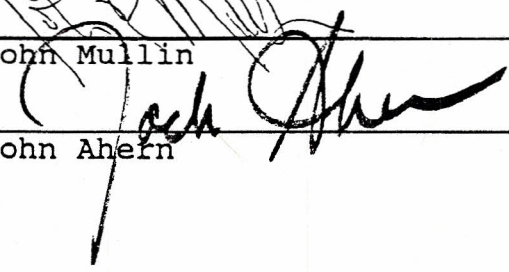
MASTERS OF REGIONAL PLANNING


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# 1. INTRODUCTION

## Project Statement:

This study examines the suitability of industrially zoned land for industrial development within the Pioneer Valley. The premise being that a significant portion of the land now zoned for industry is not suitable for development due to environmental, physical, and political constraints. Towns, when developing their zoning schemes, did not have the ability or the knowledge available to adequately inventory, analyze, and assess the natural and cultural factors of their land, thereby making zoning decisions without a full understanding of the consequences of their decisions.

### 1.1 Description of Problem

The Pioneer Valley has historically relied on agriculture as its main employment and tax base. With the growth of large agribusiness in the Western U.S., supplemented by federal water and irrigation programs, the viability of farming to sustain the economy of the valley was threatened.

Industry was recruited to the valley, although most concentrated in and around the major urban centers since this land was ready for development (Roads and infrastructure was already present). Towns in the region added to this trend by not allowing, or limiting industry. The lack of available industrial land for development limits a towns tax base and the opportunity for employment of a large sector of the area's population.



It seems that towns allowing for industrial zones have generally not looked carefully at the actual suitability for development of the lands they zoned for industry. Nor have they prepared these areas for development. This is partially due to a lack of information on the physical constraints of the land, and political pressure to limit industrial development. They have also allowed the encroachment of other uses into these industrial zones that are not compatible with industry, such as residential subdivisions. This has created a shortage of useable industrially zoned land. A report produced by the PVPC this year addresses this problem. One of its concerns for the Valley is having adequate lands available for industrial development. This report is discussed below.

REGIONAL MERITS The Strategic Plan for the Pioneer Valley, released by the Pioneer Valley Planning Commission in April of 1991, states that the valley's second asset is its "Room to Grow". One of the key issues they discuss is :

"it is important that the region's communities seek to maintain the supply of properly zoned available land with public waters and sewer."

Under their heading "What The Region Can Do", their first and last proposals state:

1. Identify and keep a regional inventory of industrial land to insure adequate and appropriate space for continued growth.

7. Develop and promote changes to the development review process which meet the goals of protecting communities but which coordinates the numerous layers of review through which projects flow before all necessary approvals are granted.

This report has been developed to address the issues discussed above. It is designed to be used at the regional level using readily available data.

### 1.2 Why The Pioneer Valley

Funding for this project was provided by the Center for Economic Development and the METLAND Research Group, in the Department of Landscape Architecture and Regional Planning, University of Massachusetts at Amherst. One of the main goals of the center is to help areas in economic decline. Their wish to focus on the Pioneer Valley, combined with its inherent diversity, accessibility and development potential made it an ideal case study. METLAND has done significant work in the valley developing and applying physical suitability models. METLAND found this study an unique opportunity to assist the Center with technical and personnel support for developing the GIS model to be used for this study, and to establish a research partnership between the two groups that could be of great benefit to both groups, and the valley, in the future.

The Pioneer Valley is located in the western part of Massachusetts and is bisected by the Connecticut River. The Valley includes the cities and towns along the shores of the river from the Connecticut state border on the south to the Vermont State border on the north. The study area includes 40 cities and towns within the Pioneer

Valley that were thought to have industrial zoning, including the Springfield - Holyoke - Chicopee metropolitan area. These cities and towns also fall within three counties, Franklin County in the north, Hampshire County in the middle and Hampden County in the South.

The physiography of the landscape in the region is varied with floodplains in the valley and uplands on the east and west of the Connecticut River. The major physical boundaries are the Quabbin Reservoir to the East and the Berkshire foothills to the west. The region is virtually equidistant between Boston and Albany and is approximately 150 miles from New York City. This makes the Pioneer Valley a crossroads in New England and geographically valuable as a marketplace.

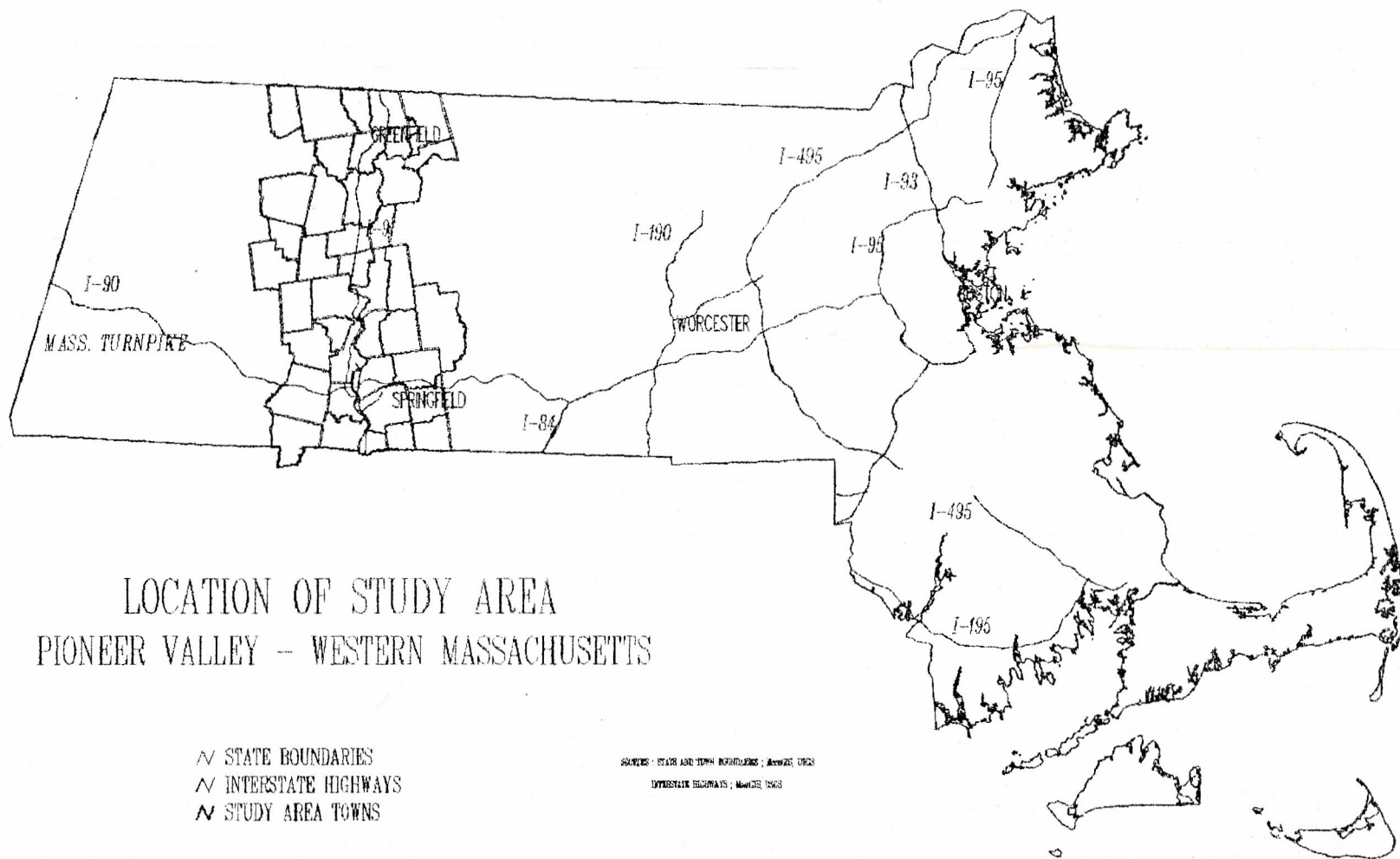
Transportation Access to the Pioneer Valley is very good with Interstate 91 traversing the center of the valley north to south, and the Massachusetts Turnpike (Interstate 90) crossing through the southern part of the valley, east to west. Rail lines are also abundant in the valley with active and inactive rights of way. These connections in the Valley provide access to the entire road and rail network of the United States with direct connections to Canada.

Several airports are located either in the Valley or directly adjacent to it. Bradley international is located within 40 minutes



driving time of most of the Valley. Smaller facilities, including Barnes Airport in Westfield, La Fleur Airport in Northampton, and Westover Airforce Base in Chicopee that includes civilian operations, are located within the boundaries of the valley. These airports provide national and international air access.

The Pioneer Valley represents a diverse cross-section of land use patterns as well. The southern part of the valley can be considered urbanized or developed. The middle section of the valley can be considered partially developed, which would include the towns of Northampton and Amherst. The Northern section of the valley is considered ex-urban or rural by comparison to the southern valley. This allows for an examination of the industrial development potential of various land types.



# LOCATION OF STUDY AREA PIONEER VALLEY - WESTERN MASSACHUSETTS

- ~ STATE BOUNDARIES
- ~ INTERSTATE HIGHWAYS
- ~ STUDY AREA TOWNS

SOURCES: STATE AND TOWN BOUNDARIES; AERIAL PHOTO  
INTERSTATE HIGHWAYS; MAPS, 1963

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY



Produced by the METLAND Research Group  
Dept. of Land, Arch. and Reg. Planning  
University of Massachusetts, Amherst

### 1.3 Goals and Objectives of the Study

This project focuses on inventorying the availability of developable, industrially zoned land in the Pioneer Valley today. The problem being addressed is the lack of industrially zoned land that is actually available and suitable for development. The main result of the analysis is to achieve an understanding of the severity of this problem, and to provide the information necessary for a town to start remedying the issue of limited industrial land in the Valley in a manner which allows both town and industry to prosper.

Increasing a town's industrial base starts with identifying those lands physically suited for industrial development, the second step is to identify those factors within local control that are limiting industrial development. The third step is to mitigate those factors controlled by local government and direct growth towards areas found most suitable for development. The fourth step is to put forth design and development regulations to ensure that the needs of the community are met by the new industrial development. The goal and objectives of this study are designed to provide the information necessary to carry out these steps.



The goal of this study is:

To provide the information necessary for towns to begin assessing and administering changes to their Industrial Zoning and development regulations in an intelligent and knowledgeable manner. The results of this effort will lead to an improvement in the Valley's economy without sacrificing its historic rural character.

The specific objectives of the study:

- 1) To develop a computerized, GIS-based assessment procedure for identifying available industrial land and evaluating the suitability of that land for industrial development. This procedure will be designed so that it can be expanded for use on a state wide basis.
- 2) To analyze the current trends in industry and industrial development today, along with new approaches to zoning and other regulations for administering development.
- 3) To inventory available industrially zoned land in the Pioneer valley.
- 4) To do an industrial suitability assessment on selected towns.
- 5) To direct further studies on industrial development in the valley.

This study starts to address the larger problem of limited industrial land in the valley. The purpose is to demonstrate how little of the land zoned for industry is actually suitable for industrial development. Hopefully this demonstration will encourage a further study of all lands in the Pioneer Valley for its industrial suitability, showing where zoning changes can be made to stimulate industrial growth in the valley with minimum conflicts and environmental impacts.

#### 1.4 Organization of Report

This study is designed to provide the quality information necessary for towns to update their industrial zoning maps and ordinances. If towns are to update their industrial zoning properly, they need to understand how industrial development is being practiced today and what the future trends are going to be. This way they can design their Zoning Ordinance and Zoning Map to cater to those industries on the rise and target those suitable for this region.

The STATE OF THE ART, Chapter 2, is designed to first inform the reader of new trends in industrial development, which includes zoning and development trends, market trends, and physical suitability assessments. This includes two case studies on industrial suitability. "Geographic Information Systems and Computer Technology" describes the most recent GIS systems available today, how and where they are being used, and how GIS is being used in our study.

METHODS, Chapter 3, describes the suitability model, its process, and how data collection was handled from input to development and processing. Chapter 4, APPLICATION, discusses the results of our assessment and how the suitability model was applied to two towns in the Pioneer Valley. Chapter 5, CONCLUSION, discusses where future studies in the Valley should be directed based on our



preliminary findings and discusses the role of Geographic Information Systems in making land use decisions.

## 2. STATE OF THE ART

Prior to developing an industrial suitability model, research was conducted on the various trends in economic and industrial development. This consisted of library research, interviews with practitioners in the field, and the analysis of case studies. This research has been used to develop and calibrate the suitability model developed for this study.

This research has also been gathered as an information source for towns revising their Industrial Zoning. The Industrial Development and Zoning sections of the report are designed to assist towns in executing plans for developing their industrial base (Specifically steps 3 and 4 mentioned in section 1.4 of the report). The other sections relate to the first two Steps for developing one's industrial zoning. These are related to the suitability model.

### 2.1 Industrial Suitability

Assessing land for industrial suitability can be accomplished several ways. It has been attempted here to gather and analyze

industrial suitability projects that have already been done in the valley as well as across the nation. This has been done to understand projects already completed, and get a better knowledge of the issues involved with assessing industrial land, and factors that need to be addressed by the model. Some of the major sources used include suitability studies done by the Center for Economic Development, University of Massachusetts, the Urban Land Institute, and phone interviews with Environmental Systems Institute (ESRI), Inc. Landscape Planning Group. The difficulty in doing a state of the art chapter on suitability assessment is the fact that most studies done in the private sector are proprietary, a company is paying for the analysis to gain advantage over their competition. They therefore do not allow this type of information to be released. It is the private sector that is the most advanced in this field, especially regarding computer modelling.

#### **2.1.1 Industrial Development**

Industrial development, as well, is accomplished in a myriad of ways. It is important to understand the business of industrial development, how it takes place and who the players are, prior to creating a strategy for attracting development to one's area.

Municipalities need to be pro-active in order to attract industry to their area. A town should look at its current industrial base,

regional, metropolitan, and multi-state growth trends, labor force characteristics, skill levels, training programs, and community characteristics such as industrial land, building inventory, natural resources, education, and housing. A town should target specific industries they want to attract. The key to success is targeting industry that will fit your community.

To target specific industries, towns need to assess an industry's financial status, real estate developments, industrial location practices, infrastructure requirements, and local requirements. The best way to perform this type of active recruitment is through a public/private marketing effort. A good location is a natural draw for industry. To create a good location, both the private interests and the municipality need to work together to make an area attractive to development. The results of this study are an attempt to provide towns with the information on the areas of their town that are a natural draw for industry. Towns can then use this information for developing their market development strategy.

The following sections on industrial development will describe in more detail what specific industries are looking for when relocating, trends in industrial development, the study of development suitability, and a review of various case studies on industrial lands in the Pioneer Valley.



#### 2.1.1.1 Trends

Developing industrial land and attracting industry to a town is important to its tax base and fiscal soundness. Having land suitable and available for industrial development is important, which is what the suitability model addresses. What is also important is understanding the industrial development market to know how best to develop, regulate, and market one's industrial lands to fit the trends in the industry. This section of the report analyzes the recent trends in industrial development.

Starting in 1987, industrial development was gaining popularity among developers. Other market segments were becoming saturated with high vacancy rates, office space being one of the highest. High vacancy rates translates into a lower investment return per development dollar. Although the popularity of industrial development has increased in recent years, it only accounted for 5.8 percent of private new construction from 1980 to 1988, according to the Department of Commerce (Urban Land, March 1990, p.15).

Shortages of warehousing space in some markets of the country was seen as a new market for developers who typically were involved with office development. This trend has continued through 1991 with warehouses still being the investment of choice for 1991.

This has created the potential for over-development nation-wide (Urban Land, March 1991, p.21).

The market peaked in 1989 with annual construction values assessed at a high of \$17.2 billion in 1989 and industrial building starts for the second-quarter at \$20.7 billion. 1990 second-quarter building starts dropped over 50 percent, yet still were the choice for development since warehouse properties are holding their value. Vacancy rates for industrial buildings over 100,000 square feet rose to 6.9 percent, its highest since 1979, which lowered its return to 8.7 percent. This is compared to a 12.6 percent return in 1988. Five of the highest vacancy rates in the country for 1990 were in the Northeast. The overall downturn in the economy has not helped matters(Urban Land, March 1991, p.20.).

The market for industrial space over 10,000 square feet , which is an estimated one-half of the total industrial space in the U.S., is occupied by manufacturers (55%), and independent wholesalers (22%). They breakdown their space use evenly between manufacturing and distribution/storage (41% for each), with the remaining 18 percent of the total square footage being used for research and other industrial uses. Custom-built, single tenant space makes up 75 percent of the total space. (Survey done by Coldwell Banker/Torto Wheaton Services as reported in Urban Land, March 1990, p. 18.)

opportunity for towns with rail lines along or adjacent to industrial sites. Creating a partnership between the rail and public sector for promoting industrial development could prove to be quite beneficial to all parties involved (Urban Land, March 1989, p.48.).

Gas and electric utilities are providing the same types of services as the railroad companies are providing. Public Service Electric and Gas Company of New Jersey (PSE&G) has a special feature in their site-finding program. They provide a discount rate plan for companies that build or expand in one of the 13 specific cities targeted for redevelopment. They will help search for existing buildings that will match the industrial needs of potential clients. The same kind of partnership potential exists with the utilities as described above with the railroads (Urban Land, March 1989, p.48.).

Understanding the industrial market and its demands is essential to creating industrial developments that will be viable and beneficial to one's community. Knowing the market trends, towns can better assess development potential and develop design guidelines to better assist developers, as well as their community. The key is flexible design and inventive land planning that will be able to accommodate the new, rapidly changing environment of industry. Avoiding project obsolescence will make or break an industrial park of the 1990's.



Warehousing is still a growing market for developers and towns in this area capitalizing on their lands near major transportation routes can benefit from this trend. With careful planning and marketing of a specific user group, an industrial park could become a succesful venture for a town in this area, as well as for the developer and the occupants of the complex. The town must take the innitiative in attracting the proper industry or company to its jurisdiction. If the project is economically viable, which the towns needs to be able to show, someone willing to develop the project will not be hard to find. The availability of labor in this area due to the recession can be used as a perk for attracting potential industry. Towns need to be creative and willing to work with industry. They also need information regarding the industrial lands they have available for development.

#### **2.1.1.2 Development Strategies**

It seems every town in the nation wants to attract high-tech, R&D industrial development and companies. It is was the cure-all of the 80's. It is a generally clean industry with high paying jobs and benefits a town's tax base tremendously without severe infrastructure or support costs. Many towns zoned land "Light Industrial" or "Limited Industrial" development without any real understanding of the high-tech market, its requirements, or the



opportunity costs lost by down zoning prime industrial land to limited industrial. To this day there is an oversupply of R&D facilities across the nation, although the market for R&D facilities is still stable. Towns interested in attracting high-tech industry to their area need to be aware of the market trends and the needs of R&D industries looking to expand or relocate (Urban Land, November 1983, p.25.).

High-tech development should follow the concept of a "campus environment" allowing everything from incubator space to mammoth chip manufacturing facilities on the same site. Reimer Associates designs their buildings and site plans to accommodate a density as high as 80 employees per acre with large lot sizes of 5 acres that can be easily aggregated to 25 acres. A survey of facility managers found the median size selected for development was between 5 and 10 acres with 25 percent of the managers looking for sites between 25 and 100 acres. This survey was completed in 1983, so recent trends might be different (Urban Land, November 1983, p.20.).

All-inclusive design guidelines should be prepared to insure quality developments with an emphasis on aesthetics to help retain property values. Expanded infrastructure capacities should be put in place based on market surveys of industry needs. Local demographics are increasingly becoming a factor in developing high-

tech parks. The area should be able to provide worker-oriented services that employees have come to expect and desire.

Three primary factors affect location decisions of high-tech companies (Source for the following section; Urban Land, December 1984, p.14-16.):

1. **Company Maturity** - Where a firm is located in the technology life-cycle.
2. **Corporate Strategy** - How a firm plans to capitalize on its key skills to exploit a target market.
3. **Type of Facility** - Whether headquarters, research and development, manufacturing, or field office space is desired.

Company Maturity of high-tech firms can be divided into three groups; **Start-up firms** that are usually spawned from key individuals leaving mature companies, **High-growth firms** which characteristically have introduced a successful product line and are growing rapidly in sales, and **Mature firms** that have seen a product line through maturity and have introduced new product lines and new markets.

The start-up firms will generally locate where they are "spawned", taking advantage of a recent innovation or market niche. If these companies expand, they may try to locate in an area to exploit a potential market. High-growth firms major location decisions are related to their R&D facilities that generally do not move. Their market development strategies will affect their location decisions,

of importance maintaining coordination with R&D. Mature firms balance their location decisions between R&D and market factors. Major location decisions are designed to gain a market share in specific areas.

The location of the R&D facilities for a high-tech firm depends on how well the coordination of activities with other facilities can be handled from that location and the degree of coordination necessary with any particular facility. Manufacturing facilities employ skilled or semi-skilled personnel, therefore need an appropriate labor pool. Cost and production quality generally drive location decisions, but coordination between R&D and manufacturing can sometimes be the driving force.

There are several secondary factors high-tech companies consider when locating a new facility. These factors include:

**Education** - location to a major university and/or community college can be essential.

**Labor supply** - the ability to quickly recruit the personnel needed for the type of facility located in the area can be essential for jumping on a new market development.

**Functional climate** - The ability to rapidly expand is a must for a firm to exploit a market window. Companies are willing to pay higher taxes if they know the community will work with them to allow easy expansion of their facilities when they are needed.



**Utilities** -High quality, reliable utilities are more critical in manufacturing and less so in product development. Cost becomes the critical issue as technologies mature and price competition dominates.

**Transportation** - Distance and time barriers to coordination are critical. This is more so with product development firms.

**Access to markets** - Product produced by high-tech firms generally have low shipping costs and are deliverable quickly so access to the market is low. Servicing a market can be more critical, especially for field offices that need quick access to their markets. R&D and manufacturing facilities will be strategically placed to coordinate both servicing customer needs and responding to corporate headquarters.

**Local economy** - High growth firms are generally small and need to pirate employees from other firms during boom times, therefore they need to locate in close proximity to other firms. Mature high-tech firms generally like to locate away from their competition for this same reason. They want to hold onto their employees.

**Lifestyle** - Employees in the R&D and corporate end of these high-tech firms are generally young and mobile with the expectation of receiving high salaries throughout their careers. Therefore quality of life and choice of lifestyle become greater influences over employee satisfaction than does cost of living. The manufacturing and middle management personnel are not going to receive the higher salaries of the former group so cost of living

plays a greater role, especially housing costs for the manufacturing employees.

No one area is going to have all the factors desirable by an industry. What a community can do is evaluate its commodities and decide which sector best fits its community profile for compatibility. An area will usually have one of three outstanding attributes, either proximity to a large metropolitan area, relatively inexpensive cost for manufacturing a firm's product, or it is near a world-class university. These three factors will judge an area's market potential. A point to remember is that an area's perceived potential is just that - perceived. A community that promotes itself effectively can positively affect this perception, overcoming local shortcomings by supporting an image of success.

### 2.1.2 Zoning

One of the major political factors restricting industrial development is a town's zoning. Zoning is controlled by the local legislative body to regulate land uses for the protection of the health and welfare of its citizens. *Euclid v. Ambler Realty Co.* in 1926 upheld the constitutionality of zoning, stating it increased the safety and security of home life and reduced street accidents (Mandelker, 1988, p.56). The zoning ordinance in question did not allow industry in residential zones.

Section 1 of the Standard Zoning Act authorizes the local legislative body:

"to regulate and restrict the height, number of stories, and size of buildings and other structures, the percentage of lot that may be occupied,... the location and use of buildings, structures, and land for trade, industry, residence, or other purposes" (Mandelker, 1988, p.108).

Section 1 implies the separation of uses into 3 major land use categories; commercial (trade), industry, and residence. Section 2 of the Act allows for the dividing of communities into districts based on use. This separation of uses has persisted to this day in the form of traditional "Euclidian" zoning, this term being derived from the court case mentioned above, *Euclid v. Ambler Realty Co.*



This separation of uses, or placing the nuisance (the loud or smelly factory) away from residence, has limited the industrial land available for development. First industry cannot be built in or near a residential zone - non-compatible use. Second, most towns zone the residential and commercial lands first, leaving the less desirable lands for industry. Third, towns may allow residential to be built in an industrial zone, known as cumulative zoning (Mandelker, 1988, p. 163), thereby limiting any industrial development in that zone to that which is not a nuisance to the housing. Residents of these areas have also been able to deny the approval of any industrial development in these areas through political pressure.

The other problem with "Euclidian" zoning is that it is inflexible in its application. The controls are tied to a specific area of land, control is only over the use and placement of the buildings, and control over its development comes only when permits are requested for development.

New land use regulations have been developed recently to combat some of the problems inherent with traditional zoning. These new techniques, developed as growth management tools, allow greater flexibility in negotiation between the developer and municipality. These techniques are discussed in the following section.

#### **2.1.2.1 Transactional Zoning**

Transactional Zoning is a bargained or negotiated agreement between developer and community regarding a specific piece of land. As a development regulation technique, it has a very distinct advantage over most other forms of control - it forms specific agreements based on detailed promises or conditions, for specific pieces of land.

Two of the major techniques used today are Conditional or Contractual Zoning, and Developer Agreements. Both of these techniques have been employed in several states (most notably California) and have proved useful in controlling development and assuring that the needs of the municipalities employing them are met.

Under contract zoning, the certainty of each use is assured. Just like a contract, what it states and shows in the zoning text and map is what is allowed and expected. If a developer seeks a zoning change or variance for any specific property, he must enter into a contract with the legislature sitting at the time. This is a contract between the developer and that legislative body. The rezoning is no longer controlled by the ordinance, but by the



contract stating the property's specific use along with any covenants or restrictions placed upon it (Babcock, 1966, p.9-10).

Development Agreements are defined as agreements between a municipality and a developer by which long-term developments can be carried out. These agreements, like contractual zoning, allow for negotiation between the developer and the town. The major difference is that development agreements allow for, and explicitly grant, vested rights for a project. Vested rights assure the developer that his claim in the property is valid over a specific length of time. Contractual zoning is used to get exceptions from the developer in return for re-zoning, but there is no guarantee that said development will not be stopped by a future legislative body. This is the main distinction between these two forms of development control (Mandelker, 1988, p. 222-230).

Development Agreements have the added advantage of not limiting the negotiation to the development or restriction of the property under debate. Because it is a contract between the developer and the town, the constitutionality of direct linkage to the land does not have to come into play. Development agreements are able to assure the developer the stability he needs to continue a project while allowing a city to attach the conditions necessary to ensure proper development, as well as deal with the details of development, such as proposed impacts, that under normal zoning might not have been possible.

Contractual Zoning involves a sophisticated understanding of the developer's intentions, the municipality's plan for the land in question, and the interaction of the developer's proposed land use with the rest of the community. The questions that a community using transactional zoning might look at are:

- 1) Does the municipality have the ability to use zoning as a tool for controlling the nature of development?
- 2) Is the developer entitled to ask for, and also receive a rezoning based on the simple fact that the proposed use will benefit both the community and the developer?

Questions generated by the resulting contractual zoning covenant would include:

- 1) Has the developer entered into an agreement that allows him fair value for his land?
- 2) Has the municipality entered into an agreement that represents the interest of the municipality and its constituents?
- 3) Were the terms of the agreement arrived at in a logical format and do the terms of the covenant accurately reflect the legitimate interests of both parties?

Municipalities should enter into these two types of agreements when normal rules of zoning satisfy neither the developer nor the municipality. Towns need to adequately assess their ability to negotiate with developers, and ensure they have the ability to track and enforce these contracts over an extended period before attempting to enter into these types of agreements (Ziebron, April 1983, p. 24).

Development agreements, as of this writing, are not legal in Massachusetts, yet they could be a great asset for communities to have. The PVPC, in their strategic plan for the valley state this as one of their needs for the region.

When bargains are carefully crafted they will solve problems that may have been considered impossible before. Bargains should be an ongoing process that can allow both developers and municipalities the ability to continue and shape their relationship. Transactional Zoning brings unparalleled flexibility to land use planning while also defining a whole new set of circumstances in which equity or inequity may flourish.

### **2.1.3 Natural and Physical Factors**

The main obstacle for doing a Natural Factors suitability analysis using GIS is having the appropriate data, knowing its accuracy, and how the different data sources are interpreted and constructed. If the data being used are inaccurate or were interpreted from sources at a scale much larger than the scale of the analysis, the accuracy of the results will be highly questionable. If digital data is not available, the cost and time constraints for creating the coverage needed must be examined to certify the feasibility of completing a suitability analysis using GIS.



Therefore, one of the objectives of this project is to create a model using readily available data. The difficulty in creating this type of model is in collecting and understanding the available data. Source data can come from a variety of sources and must be examined carefully to determine their appropriateness for a study. This section of the report examines how each of the sources used for this study were examined to determine the scale of the source, the amount of spatial and descriptive error, and in some cases the sampling resolution and interpolation procedures used.

#### **2.1.3.1 Soils and Slope Data**

The soil and slope data used in this study are the product of the United States Department of Agriculture, Soil Conservation Service (SCS). The SCS publishes soil surveys for each county. The survey consists of a description of the soils and a map approximating the location of these soils and the areas that these soils are present.

Soil Mapping data is done at the 1:24000 level, with a sampling size of approximately 1/4 acre. This resolution is accurate enough for a regional or town wide analysis of this type, but for smaller level studies a more detailed soil map should be constructed. This level of detail was chosen for this study, because the source data is available at a minimal cost and the study being done is at a regional level.



The soils maps themselves are printed on a 11 inch by 17 inch paper format. This size represents 1/3 of a USGS 7.5 min quadrangle. The map consists of a corrected orthophoto, with the soils approximations traced on top.

The soils descriptions are a classification of the soil, including classification of the slope. The soil class refers to a table for further description, and the slope class refers to a slope class A-E. For example, ExC refers to "Essex gravelly fine sandy loam, 8 to 15 percent slope, extremely stony. The name is one of approximately 14,000 nation wide. The C the slope class. The slope classifications are A- 0 to 3 percent, B- 3 to 8 percent, C- 8 to 15 percent, D- 15 to 25 percent, and E- >25 percent.

The soil survey comes with a set of matrixes describing the possible uses for the soil and the restrictions if any that the soil would have in a particular use. The tables include the use for wildlife habitat, the use for sanitary facilities and the building site development table describes what the conditions are for building on the different soil types.

The building site development table defines several categories of development that are appropriate and feasible for each type of soil. Those categories include

1. Shallow excavations
2. Dwellings without basements

3. Small commercial buildings
4. Local roads and streets

The categories for each soil have a rating of slight, moderate, and severe, describing restrictions on each soil type. For the purposes of this study the categories are all averaged for each soil type and that rating is assigned. This allows a composite rating of the soil.

Slope is a simpler rating. The soil survey defines 5 classes of soil (already described). Any soils over 15% slope are unsuited soils, below 15% are rated high, medium, and low suitability depending on their class. 0-3% rates high, 3-8% rates medium, and 8-15% rates low. This allows differentiation of slopes in later stages of the study.

#### 2.1.3.2 Landuse Data

The landuse data used in this study is the product of the University of Massachusetts Resource Mapping Center. The data is available for each town, and reports describing land use change are available for each county. The mapped data are the result of stereoscopic interpretation of aerial photos.

The photos are shot from an airplane and corrected to a size of approximately 1:24,000. They are then placed in the stereoscope

and magnified by 2.5 times. These are interpreted. The results are drawn onto a USGS 7.5 minute quadrangle sheets. This level of photographic interpretation is intended to have a minimum polygon size of approximately 1/4 acre. This combined with a spatial error of approximately 40 foot (in reality) makes this appropriate data for policy level decisions rather than data for smaller level studies.

The digital data comes with 21 different types of land use classifications. These land use classes include 2 types of agriculture, open space, 3 types of residential classification, commercial, industrial, and transportation landuse classes. For further investigation of these classes see the land use aggregation section of this report.

These data are available in digital format (ARC/INFO compressed) through the Executive Office of Environmental Affairs (MassGIS project). Their data were chosen because it has enough accuracy to be used at the regional/town level and are available at relatively low cost.



#### 2.1.3.3 Roads

The Road data is the result of converting USGS digital line graphs (DLGs) to ARC/INFO format. The conversion is done by MassGIS, the state GIS agency for Massachusetts, and the data is available at the USGS 7.5 min quad level. The major roads are abstracted from the road coverage and joined into a single coverage also available from MASSGIS called major roads. Major roads are interstate, state and federally designated highways.

The source manuscript for the original USGS DLGs was at 1:100,000. This was compared to the USGS 7.5 min quads at 1:25,000. There were no deletions due to the scale in the digital data. This "check-plotting" process, while not scientifically proving the accuracy of the data, tends to illustrate that the data has a reasonable amount of accuracy for this study.

The roads data comes in digital format with some attributes already attached to the graphic data. There is a distinction between the road classes. The interstates roads and the US highways and the state highways are distinguished. This distinction has allowed the study team to look at road size in reference to industrial suitability.

#### 2.1.3.4 Wetlands Supplementation (Forested)

National Wetland Inventory (NWI) maps were used to supplement the land use data. The land use data, previously described, only shows non-forested wetlands. These NWI wetlands are digitized from source manuscripts that have a 1:24,000 scale resolution. These maps are available at the USGS 7.5 minute quadrangle level. The wetlands are interpreted from aerial black and white photography, and are considered to have a spatial accuracy of approximately 40 foot. The minimum area for a wetland to appear on this map series is 1/2 acre.

Attribute information is available for the wetlands on the NWI maps. The wetlands are classified according to the Classification of Wetlands and Deep Water Habitats of the United States. This classification has 5 distinct systems of wetlands systems and several subsystems for each system. This study is primarily concerned that an area is considered a wetland since all wetlands are protected from development by both Federal and State law.

The NWI maps are overlaid on the zoning maps (plotted onto USGS 7.5 min quads) and the industrial zones are traced onto the NWI map. The wetlands within the industrial zone are then digitized.

#### 2.1.3.5 Aquifers

The aquifers data used in this project are another product of MassGIS. The aquifer coverage maps areas of high and medium yield. The boundaries for each panel of the coverage are the major watershed boundaries. Four of these panels affect our study area.

The aquifers were digitized from 1:48,000 hydrologic atlas maps. These maps were "fitted" to 1:24,000 USGS 7.5 min quads and then digitized. The resulting data layer is designed to show aquifer areas that are sensitive to development due to water quality. The source data is at a scale of 1:48,000. This sampling is of a larger scale than the other data layers used in the study. While this does not increase confidence in the process, the data has enough accuracy to represent aquifers at a study of the regional and town wide level. Caution should be exercised when looking at areas on the site level however.

The Aquifers data comes with attributes describing the yield, type and size of the Aquifer. This data varies from panel to panel, but have been standardized to show the yields of each aquifer relative to all the others represented.



#### 2.1.3.5 Protected Open Space

The open space data layer is available through MassGIS. This layer describes protected lands that are held by both Federal and State agencies, or by non-profit agencies such as Massachusetts Audubon Society. The different agencies have determined this land to be undevelopable for various reasons. The town owned lands and private trust lands are not mapped in this layer. The zoning maps for each town were surveyed to see if town or private trust open space existed in the areas under study, of which none was found.

The sources for this data are the agencies that own the land. The single largest paper manuscript is the USGS 7.5 min quadrangles 1:25,000 map series. The lands are surveyed and mapped onto this base. They are done at a scale and accuracy level that is within the limits of this study.

The protected open space data layer comes with a series of attributes describing the size, owner agency, and Statewide Comprehensive Outdoor Recreation Plan (SCORP) identification number. This attribute data is of little importance to this project. As in the wetlands coverage, being classified as undevelopable is the only detail of information required.

#### **2.1.3.6 Town Boundaries**

The Town Boundaries layer is constructed from USGS 7.5 min quadrangles. It simply contains the "footprint" of the state and the town boundaries. This coverage includes the entire state, and is the starting point for mapping on this project.

The source manuscripts are taken at 1:25,000 and are presented as having approximately 40 ft. spatial accuracy. This level of accuracy is useful at the level of either region or town wide.

This data layer also contains attributes describing each town. The attributes include the town name, population, and federal county code. This data layer was the selected basis from which the context maps were made and the boundaries for all of the maps produced in the study.

#### **2.1.3.7 Parcels**

The parcel data used in this study is used courtesy of the UMass Resource Mapping Unit and is formally credited as :

"Data produced by Resource Mapping- Land Information Systems, University of Massachusetts, Amherst in cooperation with EOEa MassGIS project.

The source manuscript for this data is from the Pioneer Valley Planning Commission. The parcel data was compiled onto a 1:12,000 base map and digitized.

The data has, at the time of this report, only one attribute describing it. The area in acres is that attribute. Future efforts with the data include land use and an ownership code. This parcel base is limited to only one town, Southampton.

#### **2.1.4 Physical/Environmental Suitability Methods**

This section of the report reviews two among the leading groups in the field of land use suitability modeling. Both groups, METLAND and Environmental Systems Research Institute, Inc. (ESRI), are led by Landscape Architects, and make use of computer technology for the applying of their assessment procedures. The METLAND model was followed closely in developing the industrial suitability model for this project.

##### **2.1.4.1 METLAND**

The METLAND approach to landscape/land use planning follows the traditional works of Frederick Law Olmstead, Charles Eliot, Henry Wright, and the later works of Ian McHarg. These men were all



proponents of Regional Planning with an emphasis on preserving our natural environments from misuse. Many of their studies, especially the later work of McHarg, dealt with the increasing growth of our urban areas on our rural landscapes, or the "urban fringe". The philosophy being to research and map the natural environment which will make apparent the areas most suitable for development and the areas to be left as open space. With the advent of computer technology and especially Geographic Information Systems, this approach to planning has gained momentum. Other reasons for the advance of this type of planning has been the increased concern over our environment in the last two decades with laws protecting environmentally sensitive areas, and our decision-making process has switched from one of representative democracy towards participatory democracy. This has increased the need for more information that can be altered quickly during the planning process (Fabos, Gross, "Resource Accountability in Landscape Planning: The METLAND Approach", Computer-Aided Land Use Planning and Management, p. 25, July 1984).

The METLAND approach to landscape/land use planning has been interdisciplinary in nature, guided by sound environmental/landscape planning principles. The five principles of METLAND are:

1. Development should be discouraged in areas of significant resource value.

2. Development should be discouraged in areas of natural and human-caused hazards.
3. The ecological "carrying capacity of the regional environment should not be exceeded.
4. Development should be encouraged in areas best suited for it.
5. Public service resource (e.g. infrastructure, education, recreation facilities, etc.) holding capacity should not be exceeded without appropriate expansion of such resources.

The premise of METLAND is if these five principles were adhered to in all land use decisions, we would have a much healthier, better living environment. These principles should be carried out in a three-phase procedure; assessment, plan formulation, and plan evaluation. METLAND's assessment techniques, it should be emphasized, are intended to serve as a town-wide or regional evaluation tool. It provides a "first cut" indication of the development limitations in a study area. Site specific evaluations will still be necessary. The following is the simplified framework of the METLAND model.

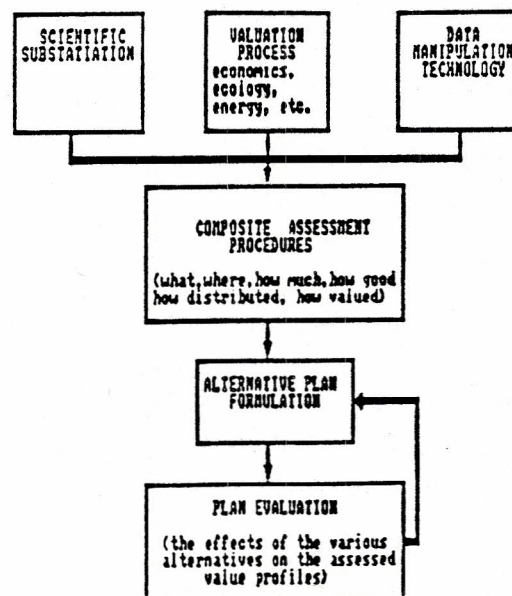


CHART # 2.1

## RESOURCE ASSESSMENT

The resource assessment phase looks at the various components of landscape resources. These can include hazards, a public resource, or a development suitability. These attributes are mapped with values attached to each landscape characteristic or attribute. The assessment looks at current land uses to judge their compatibility with the land's inherent productivity. As in the case of this study, if the land has residential use on it, or nearby, its value for industrial development is gone, or greatly reduced because of the inherent conflict between these two uses.

The assessment process also adds an economic valuation to landscape resources. Every dollar amount of the resource that is lost to development is calculated as a dollar lost to society. This adds in the social or external costs of development. The METLAND research team has spent over twenty years interpreting scientific data to determine the values for over twenty landscape and environmental factors. These would include sand and gravel deposits, viewsheds, micro-climates, and agricultural rating to name but a few.

The development suitability and public resource values procedures were developed to influence the location, the density, and the type of developments built in an area. The physical suitability assessment can help determine cost of development for a specific



area using type of soil, depth to bedrock, steepness of slope, and other physical factors associated with an area. Topoclimate characteristics assess an area's climatic comfort. Visual development suitability is calculated using view potential, vegetative setting, and compatibility of surrounding uses.

Public services, using the METLAND assessment procedure, are appraised from a resource perspective, the value of such resource based on the physical accessibility to these services. Different services are assessed depending on the type of study but include sanitary sewerage, municipal water supply, outdoor recreation, public protection, fire protection, and schools.

#### PLAN FORMULATION AND PLAN EVALUATION

Plan formulation is the procedure by which alternative plans are generated, with the evaluation phase eliminating those alternatives that are undesirable. This narrows the number of alternatives to a reasonable number that planners and decision makers are then able to evaluate in greater detail.

METLAND plan evaluation uses several procedures including "multi-objective planning". This combines the economic cost/benefit-loss and goal-oriented approaches to plan evaluation. The multi-objective approach is most appropriate for industrial site selection. In industrial siting, it is important to know the

economic advantages to a site in relation to the industry's and the community's goals. Both approaches can be used separately as well.

Plan evaluation is based on two types of output, computer generated maps and tabular information.

- The graphic mapped display shows the spatial patterns of new development or specified resource areas determined by "search" or "overlay" analytic functions.
- Tabular information that shows; the resource class and acreage of land's selected, and the aggregation of total resource dollar losses (Gross, et al, Landscape Planning and Evaluation: A combined Goal-Oriented and Benefit/Loss Approach, 1984, p. 11)

The evaluation and comparison of the different scenarios shows that in utilizing a GIS, planners and decision-makers can quickly analyze the effects of various land use goals. By using dollar values to represent the relative value of land resources, the economic tradeoffs inherent in land use decisions can be analyzed. Finally, by knowing the benefits of losses in land resources, new development can be encouraged in areas that respect community goals and minimize the loss in land resources (Gross, et al, 1984, p. 11).

#### 2.1.4.2 Environmental Systems Research Institute

Environmental Systems Research Institute, Inc. (ESRI), in addition to being the company that created ARC/INFO GIS, is in the business of applying their technology in the field. ESRI is divided into seven divisions. The **Applications & Consulting** division is in charge of creating databases and coverages to develop application systems to fit specific client needs. This includes site and development suitability analyses.

Their strategy for developing a suitability model is to generate several smaller models that determine the specific characteristics their client needs or will be relevant for the study. These could include the physical capability of the land, marketing or siting requirements, microclimate, and others. Discovering the types of models required is completed using a "needs analysis" which determines if something is relevant to the scope of study and if it is within their limits to study. Financial restrictions will affect the types of models used as well (Interview with Mark Sorensen, ESRI, March 1991).

The advantage ESRI has over this study is that they have a specific client with specific needs. Therefore the industry they are siting is already defined. Industries that hire the services of ESRI include the Caterpillar Company, Pennsylvania Electric (Plant Siting), Peabody Coal Holding Company (Environmental impact study),



and the the Airforce. The details of these studies could not be discussed because the information they are collecting is proprietary (Interview with Mark Sorensen, ESRI, March 1991).

Another project of ESRI was a development plan for hillside housing near Kyoto, Japan. Although this was not an industrial suitability study, the techniques used for their environmental assessment can be easily adapted for industrial siting.

Some of the analyses that have relevance for industrial siting include; hipsometric mapping (Allows planners to understand the general landform of the site), slope analysis, three-dimensional views, watershed/drainage development constraints, and accessibility analysis (Bucko, D., LaLUP and L.A. Computer News, Spring 1990, p. 42).

The significance of their analysis was "a model for developments situated on steep hillsides, demonstrating that through careful assessment and planning, it is possible to build new housing developments while preserving environmental integrity." (Bucko, D., LaLUP and L.A. Computer News, Spring 1990, p. 42).

### 2.1.5 Case Studies of Industrial Suitability

The following two case studies, The Blackstone River Valley and The City of Chicopee, were evaluated to get an understanding of the types of industrial suitability studies done previously in and around the Pioneer Valley. This provided information on the types of industrial lands available in the valley, and a basis for formulating the procedures to be used and factors to be studied.

#### 2.1.5.1 The Blackstone River Valley

Central Massachusetts Regional Planning Commission,  
"Blackstone Valley Industrially Zoned Land Survey and  
Analysis", Central Massachusetts Regional Planning  
Commission, Worcester MA., October 1982.

The importance of this report, in relation to our study of industrial suitability, is the process by which they evaluated their industrial lands within the Valley. To understand how the report was carried out, it is important to first understand their reasons for doing the report.

This report is a joint effort of the 11 towns that make up the Blackstone Valley Region. The study was designed to answer 5 fundamental questions regarding the valley:

1. What are the Blackstone Valley's most important assets for attracting new industry to the region?
2. Where and to what extent are these assets located?

3. Which towns have what combination of resources which prove effective attracting new industry?
4. What kinds of industry are suitable for locating in the Blackstone Valley?
5. What is the best course of action to pursue in attracting new industry and improving the tax base of Valley towns?

The study evaluated and ranked all industrially zoned lands within the valley that were of 25 net contiguous developable acres or more. Any industrial land less than this was not rated and dropped from further consideration. Developable acreage was defined as:

"[T]hat vacant land, within a parcel, devoid of identified floodplains, wetlands, groundwater supplies, grades in excess of 15 percent and vacant land with unknown ownership."(page II-2)

Lands were evaluated and ranked based on these five criteria, listed in order of importance.

1. Accessibility to major transportation networks.(6 pts max.)

Within 1 mile of interchange at I-90 or I-495 - 5 pts.

Adjacent to Route 146 - 4 pts.

Adjacent to Routes 122,122A, 140 and/or 16 - 3 pts.

Adjacent to local road - 1 pt.

Direct rail line service - 1 bonus pt.



2. Availability of large tracts of developable acreage.(5 pts max.)

More than 100 acres - 5 pts.

75 - 99 acres - 4 pts.

50 - 74 acres - 3 pts.

25 - 49 acres - 1 pt.

Less than 25 acres - Not considered.

3. Availability of utilities.(4 pts max.)

Public water within 1/4 mile - 2 pts.

Public sewer within 1/4 mile - 2 pts.

4. Land use compatibility.(2 pts max.)

Industrial and/or Commercial Pattern - 2 pts.

Vacant undeveloped - 1 pt.

Residential/Conservation Pattern - 0 pts.

5. Number of owners.(2 pts max.)

1 owner - 2 pts.

2-4 owners - 1 pt.

5 or more owners - 0 pts.

This report did not use any type of computerized mapping or GIS technology for assessing industrial suitability. There is also no explanation of how they measured the amount of industrially suited

land remaining after subtracting out the land that did not meet the requirement for "developable".

The base maps for each town, showing the industrial areas, was done using each town's zoning map with the parcel maps being verified using assessor plat maps. There is no description as to how these maps were actually produced. The data for the parcel maps, according to the report, are incomplete in many cases. The use of GIS for the mapping and assessment of the parcels for this study would seem to have greatly increased the accuracy of this report. The general descriptions of their criteria and vagueness with which they were applied lowers the validity of this report.

#### **2.1.5.1 The City of Chicopee**

Center for Economic Development, "An Analysis of Industrial Sites in the City of Chicopee", Center for Economic Development - University of Massachusetts, November, 1982.

This report was compiled for the Chicopee Development Corporation, consisting of a survey and evaluation of industrial sites in Chicopee. The report contains "an inventory of sites suitable for the spectrum of businesses and industries which will expand or locate in Chicopee in the years to come."

#### **The Evaluation Process**

Three sources were used to first identify industrial sites; the city's 1978 Atlas (scale 1" = 250'), a computerized list of all parcels and properties in the city, and a Planning department map (scale 1" = 100'). The Center developed maps to evaluate suitability based on natural factors and infrastructure improvements; soils (source: USDA Soil Survey of Hampden County), wetlands and floodplains (source: U.S. Dept. HUD Flood Insurance Rate Maps), major water lines and all sewer lines (source: appropriate city department). The actual procedure for producing the base and parcel maps is not specified.

Parcels were eliminated if:

- a) fully and successfully utilized for commerce or industry.
- b) parcels whose development constraints (very steep slopes, extremely remote location or proximity to dense residential development) were so severe that the site in question had no value for commerce or industry.

Underutilized parcels were not eliminated from the analysis.

Suitability was evaluated using four major criteria areas; natural factors, presence of utilities, quality and type of transportation access, size, and location issues affecting overall development potential. Using the four major criteria areas (a score of 1 to 3 for each criteria), each parcel was ranked on a scale of 4 - 12



(the sum of the criteria scores). Each parcel was then designated either highly suitable (12), adequately suitable (11,10), or limited suitability (less than 10).

Site suitability was determined with three types of industrial development in mind; general industry, warehouse and distribution, office and/or research. They ranked parcels based on the "preferred" type of development for each site. There is no explicit explanation of the criteria used to determine how one type of development was better suited to a site than another. They also developed action plans for each highly and adequately suited site.

Criteria not used for evaluating sites were; current zoning ( It was presumed the zoning could be re-evaluated for sites determined to be highly or adequately suitable for industrial development and was therefore not mapped), condition of buildings, and conformity with a Master Plan because such a document for Chicopee could not be found.

This report more clearly defined how the rating system was applied, yet it is not clear how they calculated remaining developable land after eliminating undevelopable lands. The dividing of the industrial land into three industry types adds validity to the analysis. The report is a definite aid to industrial development in the City of Chicopee.

## **2.2 Geographic Information Systems and Computer Technology**

This section addresses the use of GIS and computers in the landscape planning process. Several issues are discussed including the definition of GIS, an evaluation of several GIS's, and the implementation of GIS at different levels of government, and in private industry.

### **2.2.1 Definition of Geographic Information Systems**

Geographic information systems are defined as "...a powerful set of tools for collecting storing and retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes." (Burroughs 1986). In an age of technical revolution, this definition remains true regarding the current software available, but the tools Burroughs describes have become more complex. Geographic information systems are becoming increasingly integrated into the land use decision making process. This trend is expected to continue into the future as technological advances continue to be made in both hardware and software.

### 2.2.2 A Critical Evaluation of GIS

While the point of this project is not to look at geographic information systems and evaluate the usability of various systems, it is important to understand the reasons for choosing the system utilized. A procedure was developed for choosing the system that was employed on this project. This criteria evaluates the different types of systems that are available and provides a method for comparison with other systems. The software evaluated in this section does not constitute the entire inventory of GIS software available, but only attempts to look at several sections of the broad spectrum of available software. The systems studied are representative of most systems available.

The criteria for evaluation includes four basic categories:

1. The "user friendliness" of the system.
2. The data available for the system.
3. The presentation ability of the system.
4. The analytic ability of the system.

These four categories are used to look at the various aspects of a GIS. While each geographic information system must, to some extent, accommodate each principle mentioned above, different tasks present different requirements from a geographic information systems standpoint. Rating industrial suitability is a problem



that requires extensive use of the analytic ability of a system and its data availability. Therefore, the system chosen for this study needed strong analytic and data availability characteristics.

The following systems were evaluated using the criteria explained above:

#### **IDRISI**

This package was developed at Clark University primarily for the analysis and manipulation of data. IDRISI is considered a "tool box" of primitive functions that allow the user to develop the larger functions needed for more complex analyses. This allows a great deal of flexibility for the user, but hampers the systems ability to be used by novices. While IDRISI can quickly adapt to read different types of data (through conversion programs), There is no data base immediately available. This limits the usefulness of this system for the model used in this project.

#### **ATLAS MAPGRAFIX**

This package has been developed by a private company and is representative of packages available for about one to two thousand dollars. This package features the ability to present maps in a very easy to understand format, and is menu driven to increase user

friendliness. These systems have little analytic ability, and do little for the user in terms of database support. These systems are available on many computer platforms, and have an intuitive user interface. While these systems may be appealing for the purpose of rating industrial suitability it is doubtful that they either have the data base needed or the analysis ability to do such a task.

#### MAP (MAP ANALYSIS PACKAGE)

MAP is a direct descendant from some of the original geographic information systems that were developed. This package is remarkably analytical while remaining relatively simple to use. There is no established database for this software, but like IDRISI this software can be easily modified to read the needed data. MAP is ported to several different machines, but has a relatively coarse presentation ability. While this package can be made to use the data available and clearly has the ability to analyze, the poor presentation ability makes this package less than the ideal choice.

## ESRI's ARC/INFO

To many geographic information systems users ARC/INFO represents the culmination of all that geographic information systems should be. This package combines good analysis ability with a good presentation ability to create the package that is quickly becoming the standard of the industry. While the compromise for presentation has limited the analytic ability, ARC/INFO users have developed the user friendliness and the data availability to the point where ARC/INFO is truly a useful tool for land use planning. The sacrifices are hard however. While creating a slope analysis map in MAP would be simple, it is prohibitively difficult in ARC/INFO. The vector orientation of ARC/INFO makes analysis of this type difficult due to the way the information is stored. ARC/INFO release 6.0 for the workstation environment has the new GRID package which is a raster system and was developed to resolve this problem. The data availability and the presentation ability of ARC/INFO still make it the system of choice for this project.



## **MacDonnell- Douglas GDS**

Users of both ARC/INFO and GDS have commented on the similarity of the systems and the incredible power of GDS. This system has presentation ability comparable to ARC/INFO and analytic abilities like that of MAP. This package also features a very advanced (graphical) user interface, but fails when measured in the data availability category. GDS was only introduced recently and so lacks a sufficient database to be useful in this study.

## **Geographic Resources Analysis Support System (GRASS)**

GRASS is a raster based GIS designed to present data on line printers. GRASS was originally developed by the Army Corps of Engineers. While this raster system is public domain it is only a toolbox from which other more powerful functions can be built. Because of the modelling capabilities of GRASS, and the fact that it runs on many hardware platforms, makes this software very appealing. GRASS functions have been defined that allow GRASS to read and interpret remotely sensed (satellite) data from both Landsat and SPOT, but these levels of data may not be appropriate for the level of study being proposed. (GAO, 1990)

## **Environmental Planning and Programming Language (EPPL-7)**

EPPL-7 was developed by the state of Minnesota Land Management Information Center. It is the seventh version of GIS software that has been developed by this group and is available on a number of hardware platforms. EPPL-7 is a raster based system and the years and different versions make this software very well designed and extremely useful. EPPL-7 is available at very little cost (\$500 dollars for a single user site). The drawback to this software is that there is no direct link to the data that this study needs. This would require the study team to build a database from scratch, and therefore makes this software impractical for use in this study.

This section has attempted to relate the issues that the project team had to consider when contemplating which geographic information systems to choose. It was not the intent to review all the geographic information systems software available, but to show a sample of that software. While technical knowledge can supplement user friendliness problems, data availability, presentation ability and analysis ability can not be supplemented into a system without a lot of work. These issues contributed greatly to the selection of ARC/INFO for this project. ARC/INFO is a vector type GIS that has very good analytic abilities along with good presentation abilities. The strongest justification for choosing ARC/INFO is that MassGIS uses ARC/INFO for development of

their 12 layer database. ARC/INFO has also been determined to be the best GIS for this study.

### 2.2.3 Data Availability

The availability of digital data is perhaps the strongest factor in the choice of a GIS than any other factor (including the actual system costs). This is true because the data is the singularly most expensive part to the system. While there is not a great deal of "canned data" the availability of even some data strongly affects the choice of a system. The cost of acquiring the data if the study team were to build a database of its own would probably be prohibitively expensive.

The model of the Pioneer Valley that was constructed for this project was implemented with the intent of taking advantage of the digital geographic data available within this state. MASSGIS, part of the Executive Office of Environmental Affairs, has been constructing and maintaining a statewide data base which at present includes twelve different data layers. ESRI's ARC/INFO is being used as the standard. Since one of the objectives of the study is to create a transferable model for use statewide, it is necessary to take advantage of a system such as MASSGIS. The data layers provided by MASSGIS are integral to our study.



#### 2.2.4 Implementation of GIS

GIS has been available since the implementation of digital computers. These programs started as simple arrays of values like the raster systems used today, and have been developed to today's technology that combines raster and vector technology. Much of the development that has occurred in GIS technology has occurred as further needs were defined. This development, like computer technology has developed and trickled down in size as machines and software have become cheaper. GIS technology started at the larger levels of government and business and has come down to the level of smaller agencies as the affordability has increased. The next sections look at the implementation of GIS for agencies starting with the federal government and working down through the state level to the regional level.

##### 2.2.4.1 Federal Government GIS

Federal participation in GIS activities is a billion dollar business (GAO, 1990). The roots of GIS are in federal agency efforts to track land use activities. The earliest efforts in this type of programming were in the 1970's, mostly on mainframe computers. They created mostly dot and dash maps that defined the category in terms of a grid cell. While these efforts were good

for analyzing large areas, they required vast amounts of time and the technology made maps that were not very similar to conventional maps. Today 19 federal agencies use GIS of some type, on different sized computers, for vastly different reasons.

Federal agencies have built databases in GIS that include grid cell data from GRASS and other raster systems and vector database systems for programs such as ARC/INFO. These databases have become integral parts of the agencies that use them and are the cornerstone in current land use planning techniques.

The 1991 federal budgeting for GIS related activities reveals the importance that federal agencies are placing on spatial information. The Office of Management and Budget reported as of October 1988 that GIS related activities would cost nearly 165 million dollars annually (GAO, 1990). The federal budget supports this interest in GIS by funding the different types of GIS within the various federal agencies.

Yet the nature of these systems is consistent at this level. While the systems these agencies use are not identical, there is a certain amount of standardization that indicates some ability for inter-agency communication. For instance, nearly all of the federal agencies using GIS have GRASS in some form or another. GRASS provides a standard basis for communication. While the individual agency may have other GIS needs and other GIS software,

GRASS provides an excellent area for mutual use and standard database and software development.

#### 2.2.4.2 State Level GIS - Two Case Studies

With the advent of better hardware and software, the states began getting into the GIS market for land use analysis and planning. One of the leading states in this area was Minnesota. Minnesota began developing its Environmental Planning and Programming Language (EPPL) in 1972. EPPL-1 was implemented on a mainframe and now the latest version, EPPL-7, is available at the PC level (MLMIC 1990). This is a clear example of how technology has moved from large centralized machines into small de-centralized ones. This program has been developed and is marketed for resale by the State of Minnesota Planning Agency. The actual software was reviewed earlier in this document.

EPPL-7 is the center piece of the Minnesota experience, but not the only focal point. In addition to pioneering software development, this state as a whole has done a tremendous amount in terms of data collection and development of data standards. Minnesota has formed the Natural Resource Geographic Information System Consortium. The consortium consists of subcommittees for database development which include committees devoted to Hydrology, Wildlife, Transportation, Soils, Land Use/Land Cover, Land Net and



Forestry. Each subcommittee works to develop their data layer and to insure consistency with the other subcommittees. In addition there are two technical subcommittees. One is devoted entirely to data exchange and the other to GIS standards (NR-GIS 1989).

Another accomplishment of the Minnesota State Planning Agency is its Datanet Plus software. This relatively simple and inexpensive software package is a mapping package with built-in data for use by nearly anyone. The package is largely for mapping of prepackaged data sets, but again, it illustrates Minnesota's commitment to understanding and supplying spatial information (Hanson, 1990).

The Minnesota experience is largely that of a state which has built their own tools for spatial information processing. In addition however, Minnesota is also leading the way in database standards development in an attempt to create an efficient up-to-date model of their state.

The Massachusetts experience is somewhat different than the Minnesota experience. Massachusetts has created a data base using a standard software package. The data base consists of twelve data layers, and while the work is largely a product of a single agency, the Executive Office of Environmental Affairs (EOEA), great care has been taken to assure standards and reasonable accuracy are achieved.

Like Minnesota, the data layers in Massachusetts are largely natural resource related, consisting of the following information: Land Use/Land Cover, Roads, Railroads, Aquifers, Ponds, Streams, etc. These data layers represent the interests of the host office, EOEa, but remain very helpful for use in many fields. Many public and private agencies use the data available through the Massachusetts GIS project. These agencies seem to have followed EOEa in adopting ARC/INFO as their software standard. The data provided by EOEa and MASSGIS is usable on the PC version of ARC/INFO up to the Mainframe version. This flexibility, along with the number of functions or tools available in ARC/INFO, have contributed to the decision to use ARC/INFO in this state.

MassGIS is also a consulting and cartographic services unit. The project team has used consulting as a method to supplement the cost of building the data base. This allows the state agencies and town governments in Massachusetts to perform analysis on GIS without actually purchasing the system and hiring the staff.

MassGIS also serves as a training center for GIS. Using ARC/INFO and their own database, MassGIS provides these training services teaching both technical and management issues involving GIS. These programs are available to anybody and are provide at a nominal fee.

#### 2.2.4.3 Regional Level GIS

The major user of GIS at the regional level in the state of Massachusetts is the Cape Cod Planning Commission. The commission is a PC ARC/INFO user with a single complete workstation. The commission has worked towards developing a regional database and has a fairly complete database for two towns. The common elements of that database are:

- Assessor
- Zoning
- Wetlands
- Species Habitat

These data layers supplement the data available from MASSGIS and while they are only available for two of the commissions dozen towns, this represents a significant effort in producing data for use at the regional level. The commission has recently been given a permanent funding source and has been authorized by the people of Cape Cod to participate in land use policy making. This should further the development of their data and software.

Another useful spatial information system at the regional level is the Massachusetts Water Resources Authority (MWRA). This authority is responsible for the delivery of drinking water and the disposal of waste water for forty four cities and towns in Massachusetts. In addition to this, MWRA has an active role in cleaning up Boston Harbor. MWRA has a Digital Equipment Company VAX 6000. MWRA has



ESRI's ARC/INFO software as well as other software for spatial analysis. By using ARC/INFO, MWRA is able to take advantage of the statewide database available to them from MASSGIS. The decision to use ARC/INFO is difficult for MWRA, because the package does not have some of the engineering capabilities of other packages, the supplemented database was a large part of MWRA's decision to go with ARC/INFO.

#### 2.2.4.4 GIS In The Private Sector

There is an increasing trend towards the use of GIS in private industry. According to a 1990 customer survey, 34% of the GIS that was sold was to private firms. This trend is said to be the result of the emerging workstation environment and of the decreased price of computing in general (Hamilton, interview 1991).

Several other factors have contributed to the increase of Privatized GIS's. These factors include the increased availability of digital data such as TIGER files, the increased use of consulting firms for GIS related tasks, and the increased use of GIS for private tasks. Private tasks may include the siting of a shopping mall or the private search for waste sites.

Many land use planning consultants have embraced GIS technology. The use of GIS has replaced older modeling techniques and has

served as a focal point for developing new ones. Models in land use planning have been constructed that were considered unfeasible before the use of GIS. Software developers and consultants are not only using GIS to improve the old modeling techniques, but are developing models that take advantage of GIS.

Camp, Dresser and McKee (CDM), an international civil engineering and land use planning group, is one private firm that is embracing the use of GIS technology. Recently CDM was contracted by the South Essex Sewer District to help with the siting of a new sewage treatment plant. They performed a site search using GIS, a process that would have taken a tremendous amount of time without the use of a GIS, which revealed 7 sights with potential.

In addition to a normal site search, CDM performed an economic analysis based on costs of transportation, infrastructure and conflicts. This analysis used the GIS to find the additional costs associated with each of the 7 sites. By using a triangular irregular network, which processed the spatial data, the consultants were able to establish "cost lines". These cost lines were then used to rank each sight. The results allowed CDM to narrow the focus even further. This part of the model would have been virtually impossible to complete without the use of a GIS (Interview with April Nichols, CDM GIS Manager, May 1991).

### 2.3 Conclusion

This chapter had two purposes essential for the completion of this report. The first was to gather data necessary for the development and calibration of the suitability model. The second purpose was to provide information on the recent trends in industrial development and zoning to assist towns revising their current zoning and trying to attract industry to their community.

The review and assessment of the data layers available from MassGIS made it apparent that the creation of a suitability model utilizing existing state-wide data was possible. The data layers needed for such an assessment including land use, roads, and aquifers was available and at a scale and accuracy that made it useful for the model. The additional data necessary, most important slope and soils, was assessed and found useable. The realization from analyzing this data source was the time constraint involved with digitizing the soils data. Because of this information the application of the second phase of the model will now have to be limited to two towns.

The understanding of the METLAND model and the use of it as the basis for developing the Industrial Suitability Model will increase the validity of the model's results. The METLAND Research Group has been rating land suitability for 20 years, so many of the METLAND suitability models have been thoroughly tested.



The review of the two case studies, The Blackstone River Valley and the City of Chicopee, have proved valuable in two ways. The first is the use of some of their factors for assessing industrial land such as ownership and proximity to transportation systems. The other value gained was in seeing how limiting their techniques for assessment were because the assessments did not involve the use of sufficient spatial information or the use of currently available data bases. The reports did not explain how the acreage remaining after unsuitable lands were eliminated was calculated, nor did they have the ability to produce maps as found in this report.

The evaluation and review of several Geographic Information Systems and their application is both a source of information for communities looking toward GIS for their town and to evaluate the best system to use for this study. ARC/INFO's analytical and presentation abilities, along with the data available for this system has made it the obvious choice for this study.

Geographic Information Systems are a growing trend, and the application of this new technology in the field of Planning and land use decision making is still in its infancy. It is obvious from this research that this technology can and needs to be applied to the assessment of industrial lands. What is also apparent is towns need to be proactive in attracting industry to their

community. The application of GIS technology can provide the information towns need to attract industry to their community.

Indeed, this State of the Art provides the study team with a sufficient basis for the development of a useful process to assess the suitability of existing lands zoned for industry. The process advocated by this study can even more appropriately be used to find future industrial land prior to zoning it. This way the land zoned industrial would be much more suitable for industry than those which are zoned without such suitability assessment

### 3. METHODS

This chapter describes the methods by which the study was accomplished. Data Development, Section 3.1, describes how specific data layers were developed that were not readily available from MassGIS. The two main priorities in developing these data layers was to use sources and techniques that were as accurate as possible and to create this digital information in an economical and timely manner.

These two priorities are often at opposite ends of the spectrum since often using the quick approach to data development is the most inaccurate. This was why the research from Chapter 2 was so important in developing these data layers. Without understanding the accuracy of the source data, how it was developed, and understanding the accuracy limits of the source data, any results that were derived from data would be highly questionable.

The Industrial Suitability Model, Section 3.2, describes how the model was developed and operates. The model consists of two phases, with each phase following specific steps by which it assesses the data. Maps and data are produced in both phases



during several different steps. Phase One, Identify is a five step procedure and Phase Two, Suitability, is four part procedure with each part following a specified number of steps.

The information gathered from Chapter 2 was essential for creating and calibrating the model. The METLAND "cookbook" approach for assessing land was followed closely, its procedure having passed the test of time. The two case studies provided information as to the types of criteria to use for evaluating industrial lands. The study of industrial trends helped determine the final suitability categories, *Suited for All Industry*, *Suited for Light Industry*, and *Not Suited For Industry*.

The uniqueness of this approach, compared to the two case studies from Chapter 2, is the utilization of a Geographic Information System. What also makes this model unique is the use of readily available data for that system. This was done to allow the model to be run statewide, and make the development and operation of the system economically feasible and possible. This model, data development and all, was designed, developed, and functioning in four months. Without utilizing existing data, this would have been impossible. The use of a GIS was essential for producing the type of information presented in Chapter 4.

### 3.1 Data Development

Although much of the data used for this study was obtained from MassGIS as discussed in Section 2.1.3, several data layers had to be created and/or interpreted from other sources. The two most complex data layers to manage were the slope and parcel data. Slope because of the interpretation necessary to derive a slope and parcel data because of the enormous time constraints involved in digitizing individual parcels. Obtaining slope data offers several alternatives. Those alternatives are described below followed by a description of the two methods for obtaining the parcel information and the process used for digitizing the industrial zoning.

#### 3.1.1 Zoning

The zoning data layer is composed of data digitized by the project team. The source data is comprised of zoning maps of each town. Each town with formal industrial zones is digitized. The digitizing process is three phased. Phase one is to select the town with zoning to be digitized out of the town boundaries file. The next phase is to add tic registration points to the town boundaries and digitize the zoning. The third phase is to look at the digitized zoning and to create a checkplot. The checkplot is matched against the original source map to determine its accuracy.

Since only the industrial zones need to be digitized, the attributes for the zoning are fairly simple to assign. Any zone that is industrial in its by right use is simply indicated with an 'IND.' in the ZONETYPE data field. Those areas in a town that are not industrial are simply indicated with a blank in the ZONETYPE data field.

### 3.1.2 Slope

In the process of constructing a suitable model several methods of finding slope were attempted. The process was to investigate different procedures for interpreting slope and to decide upon the proper slope calculation method.

One of the major factors rating land suitability is the study and classification of slope. Slope is the ratio of the change in elevation over a given distance of land. This ratio is written as rise over run (rise/run). The difficulty of creating a slope map is that the slope categories must be interpreted to a ratio based on the distance between elevation contours. There are a number of methods for interpreting elevation contours for designating the slope of an area. The study team investigated several possible methods and the results are reported below.



The first method considered was the use of USGS digital elevation models (DEMs). The USGS is in the process of creating these models for all lands they have coverages for. The DEM can be easily interpreted to a slope map, and are accurate enough to be useful for this study. Currently they have only selected areas available. Unfortunately our study area has not been completed by USGS.

The second method is to attempt to create a DEM by taking X,Y and Z coordinates from certain points in the area and interpolating this into a contour map. Then a slope map can be interpreted from that. This method is very viable except that it requires a great degree of accuracy on the part of the X,Y and Z coordinates. This type of accuracy would require a great deal of field work that is not feasible for this study. This requirement for field work eliminates this option.

The third method attempted was to create a slope map by interpreting a USGS quad map into a slope map using a mechanical "slope jig". A slope jig is a measuring scale with the calculated slope ratio on it. The difficulty is in the application of the jig. On a standard 1:25000 scale USGS map with 10 foot elevation contours, a 3 percent slope is approximately 1/10th of an inch apart, and the greater slopes are even closer together. Attempting to interpret slope at this scale is highly inaccurate, the reliability and validity of the results being highly questionable.

The fourth option is to use the slope classification found in the Soil Conservation Service soil surveys. While there are known inaccuracies in this method, this option appears to be the only viable option for this study given time, scale, technological, and financial constraints. Future methods of slope classification will revolutionize the methods used by industry and this study, however until those methods become available the interpretation of slope from soil surveys is our only viable and feasible option for this project.

#### 3.1.3 Parcels

The parcel data is difficult to obtain because it is available only at the town level and is broken down onto several, sometimes dozens of maps. They are usually at a very large scale of 1" = 40' or 1:4,800. This, combined with the fact that these maps are usually difficult to obtain, make digitizing the parcels an arduous task. Time constraints alone making digitizing the parcel infeasible for this study. Since the parcels have an RF of 1:4800 this data layer will have a much finer resolution than the rest of the study and may contribute to a belief in the accuracy of the study that is simply not supported by the other data.

It is for these reasons that the parcels have been viewed in two different ways. First by utilizing digitized parcels, and second

by simply counting the amount of parcels in the industrial zone and producing an average parcel size estimate for the entire industrial zone.

The source rectification, digitization procedure was estimated to take approximately 10 hrs time for a 300 acre industrial zone. This is considerably longer than the .5 hour that it took to actually count the parcels in the zone and divide by the overall acreage of the industrial zone.

The difference between the two types of parcel information used by the study is in the rating of the zone regarding its parcel size. By digitizing the parcels an actual median can be calculated. The other method of counting the parcels and calculating an average can be considered less accurate as it does not account for the character of the parcels only the number in the industrial zone.

Comparing the two methods of measurement reveals that there is some difference between the systems. For example using the entire town of Southampton as a basis, experiments to find the average parcel size and the median parcel size were conducted. For the entire town of Southampton the average parcel size is 7.6 acres, however the median parcel size is 1.2 acres. Further examination of the parcels reveals that the amount of land consumed over the median is 95%. This in conjunction with the fact that the largest parcel in the town is 1842.5 acres indicates that there are a number of



large parcels in the sample, and that the parcel index for the entire town should be high, meaning large parcels.

Examining the industrial zone in Southampton reveals that there are similar characteristics. The median parcel size is 1.08 acres, The average parcel size is 6.35 acres. and the largest parcel is 66.721 acres. The amount of land consumed by parcels larger than the median is 96% while the amount of land consumed by parcels larger than the average is 82%. These numbers combined with the presence of the 66 acre parcel indicates that this industrial zone should have a high overall parcel rating. This indicates a favorable ownership pattern. Less owners of an area of land make consolidating that land easier.

The final method of parcel rating is the simple counting technique. By finding the approximate number of parcels in the study area and calculating the percent of land in terms of a parcel land use pattern, an estimate can be made about the number of owners within the area. Using average parcel size, by dividing the total area by the number of parcels counted, instead of using the mean parcel size (digitized parcel data is needed to determine mean), an ownership rating can be determined.

While the counting technique is not as accurate as the digitizing and parcel index technique, the time differentiation, no parcel

digitization is necessary, may make the difference with which technique is used.

Methods for finding slopes and parcels have been discussed in this section. As there are numerous methods for finding each, and different accuracy issues that come with each, the study has focused on finding the appropriate one for each. This study used the parcel counting technique for evaluating ownership and interpreted slopes from the SCS soils data. The research in this section presents alternative methods that may be used for other purposes.

### 3.2 The Industrial Suitability Model

The suitability model developed for this project has several key aspects. It uses readily available data which is produced for the entire state. This enables the transfer of this model to the state level in a relatively simple operation. The model is done in two phases with each phase and intermediate parts producing specific results (See Chart # 3.1). Phase One is Identify and Phase Two is Suitability. This two phased process allows for added interpretation of the results and to understand at what level land becomes unsuitable for industrial development.

# INDUSTRIAL SUITABILITY MODEL

## OVERVIEW OF MODEL

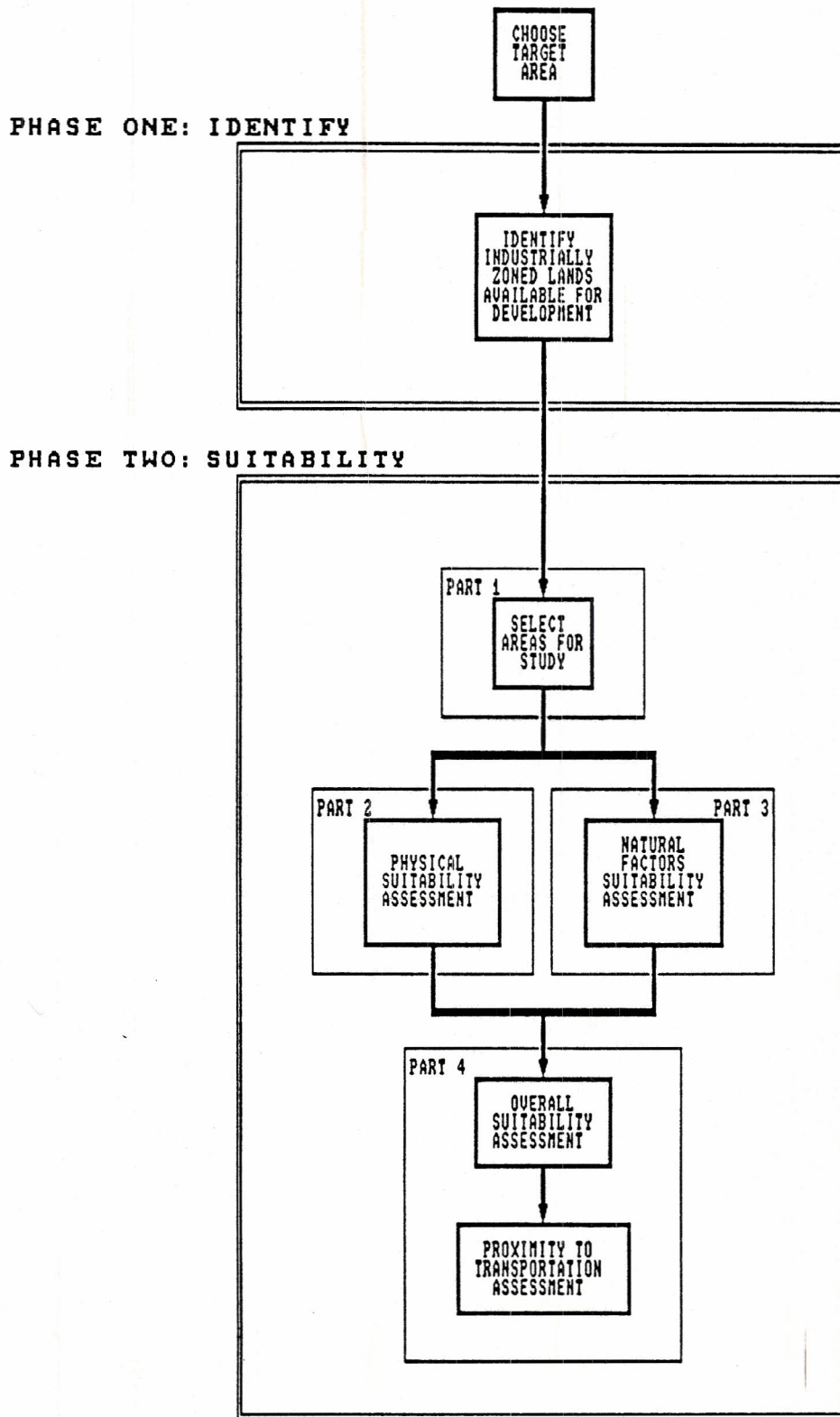


CHART # 3.1



This model is designed to be carried out at the regional level. Therefore the information produced should not be used to determine an individual sites specific suitability for sevelopment. The information is for towns to assess their current industrial zoning and for assessing large areas of land as to their general suitability. The following sections describe how the suitability model is carried out.

### 3.2.1 Phase One: Identify

The purpose of this phase is to examine the entire study area, find the formal industrial zones, and then to assess the information in the industrial zones as to their land use, size, and proximity to transportation networks to identify lands available for industrial development that are zoned industrial. The results of this phase are carried out in 5 steps.

- STEP 1: Survey Towns
- STEP 2: Digitize Industrial Zoning
- STEP 3: Identify and Aggregate Land Uses
- STEP 4: Mapping Data
- STEP 5: Proximity to Transportation Corridors

Steps 1 to 3 create the study area for Phase Two by ruling out the majority of land unavailable for industrial development and further focusing the study to specific areas based on availability and size of the are. Steps 4 and 5 provide statistical information for the whole study area. The region is assessed looking at the acreage of land for each aggregated land use type within the industrially

zoned lands of the Pioneer Valley (see Chapter 3 on land use aggregation). These statistics are compiled for the entire region and each town within the study area. Further study is then done to determine the amount of land within 1,000 feet of existing rail lines and within 1 mile of existing major roads. Chart # 3.2, located at the end of this section, diagrams this procedure.

#### **STEP 1: Survey Towns**

Step 1 in the Identify Phase is to survey the towns within the study area looking for formal industrial zones. This step is done by surveying the local and regional planning agencies. The information requested for each town included :

1. Does the town have industrial zones ?
2. Does the town have a zoning map showing the industrial zones?
3. What is the scale, date and source of the zoning map?
4. Can a copy of the zoning map be obtained ?

The product from the survey is a collection of town maps that have industrial zones. These maps can then be used as source maps for digitizing the zoning.

#### **STEP 2: Digitize Industrial Zoning**

The survey of towns yields an inventory of towns with industrial zones. The survey also yields a stack of maps, that can be digitized. The digitizing process, when complete, allows a reading

of both area and perimeter for each industrial zone. The zoning data is constructed for each town and then compiled to give a measured number of industrially zoned acres for the entire study area. The zoning is digitized into a town boundary coverage from MassGIS. The source for these boundaries is from USGS quad sheets (See Section 2.1.3.6 of this report) so the projection for the zoning is corrected to State Plane Coordinates.

### **STEP 3: Identify and Aggregate Land Uses**

Working from the town by town zoning, the industrial zones can be examined for their 1985 land uses. The land uses are available for the state and are surveyed from aerial photographs. The 21 land use classes can be aggregated into broader categories for use.

The Land Use/Land Cover data available from The University of Massachusetts Resource Mapping unit is divided into 21 different categories. Those categories reflect different land use types as interpreted from stereo aerial photo pairs. These are categorized in the following table.



### UMASS Resource Mapping Land Use Categories

1	Intensive Agriculture	12	Medium Residential
2	Extensive Agriculture	13	Light Residential
3	Forest	14	Salt Wetlands
4	Fresh Wetlands	15	Commercial
5	Mining	16	Industrial
6	Open Lands	17	Open and Public Space
7	Participation Recreation	18	Transportation
8	Spectator Recreation	19	Waste Disposal
9	Water based Recreation	20	Water
10	Multi-Family Residential	21	Woody Perrenials
11	Dense Residential		

TABLE # 3.1

These 21 categories are to be aggregated into 5 categories. These five categories are designed to describe land use as it specifically addresses an industrial zone. Those aggregated categories are:

### Aggregated Land Use Categories

1	Proper Use	(existing industrial land use in an industrial zone)
2	Conflicting Use	(existing non-industrial use in the zone)
3	Wetlands and Water	
4	Available	(land use types that could be developed )
5	Commercial	(existing)

TABLE # 3.2

The complete aggregation was determined by assigning each of the land use types to one of the aggregated uses. The following table illustrates the aggregation.

### Land Use by Aggregation

#### Aggregate Category

#### Land Use Category

1 Proper use	Industrial
2 Conflicting use	Mining, Participation Recreation, Spectator Recreation, Water based Recreation, Multi-Family Residential, Dense Residential, Medium Residential, Light Residential, Waste Disposal
3 Wetlands and Water	Fresh Wetlands, Salt Wetlands, Water
4 Available	Intensive Agriculture, Extensive Agriculture, Forest, Open Lands, Woody Perennials
5 Commercial	Commercial

TABLE # 3.3

These aggregated uses fulfill the needs of this study. By eliminating the land that is already in use, the study can focus on only those areas still available for development. Commercial is separated out in the aggregation because it is postulated that this area could more easily be converted back to industrial use at a future time than could residential. Non-forested wetlands and water features are eliminated from the study at this point as well.

Grouping agricultural uses in the study area does not constitute a value judgment. It simply acknowledges the development trends of the past and the ease with which agricultural land can be developed to a more intense use.

#### **STEP 4: Mapping Data**

An identification map is made for each town based on its zoning map and the land use data. This map shows the town's industrial zones, and the relation of those zones to the town boundaries, major roads, and railroads within the town. The map is shaded to reflect the five aggregated land use classes; Proper use, Conflicting use, Water or Wetlands, Commercial use, and Available. The map is completed with text describing the acreage of the aggregated land uses in the industrial zones, and the percentage of that use. The graphs following each map show the relationship between the amount of industrially zoned land currently being used for industry compared to the other aggregated land uses.

After the town level work is done, the aggregated industrial land uses are compiled for the entire study area. This process allows the entire study area to be mapped and analyzed. This map is presented in a similar format to the town level maps with all five categories being graphically depicted, and the amount of land in each category presented in a table on the map. This map is difficult to present at the report size, and is replicated in a large format (36" X 48" map). This map further illustrates the land use relationship within industrial lands in the context of the entire valley.

Finally available lands can be identified by their size, and grouped into three categories. Available lands that have a



contiguous size of less than 50 acres are aggregated into one category, land areas greater than 50 acres but less than 100 acres are grouped into another category and available land areas greater than 100 contiguous acres are identified as a third category. The map also textually conveys the amount of land that is in each size classification.

#### **STEP 5: Proximity to Transportation Corridors**

Additionally at the regional level, the "available" lands can be counted in terms of the land masses relation to the existing transportation. This map shows the "available" lands, the railroad buffer at 1000 feet around existing rails, and the major roads buffer at 1 mile. Text describes the amount of available land within the rail buffer, the amount of available land within the major road buffers and the amount of available land outside both buffers. This map is used to illustrate the proximity of the industrial lands to existing transportation systems.

The Identify Phase of the study is designed to eliminate from further analysis industrial lands that are not available for development. The steps of the Identify phase have helped the selection process by identifying lands to rate in terms of their industrial suitability. This phase has also provided useful information as to how lands zoned industrial in the Pioneer Valley are being used.

# PHASE ONE: IDENTIFY

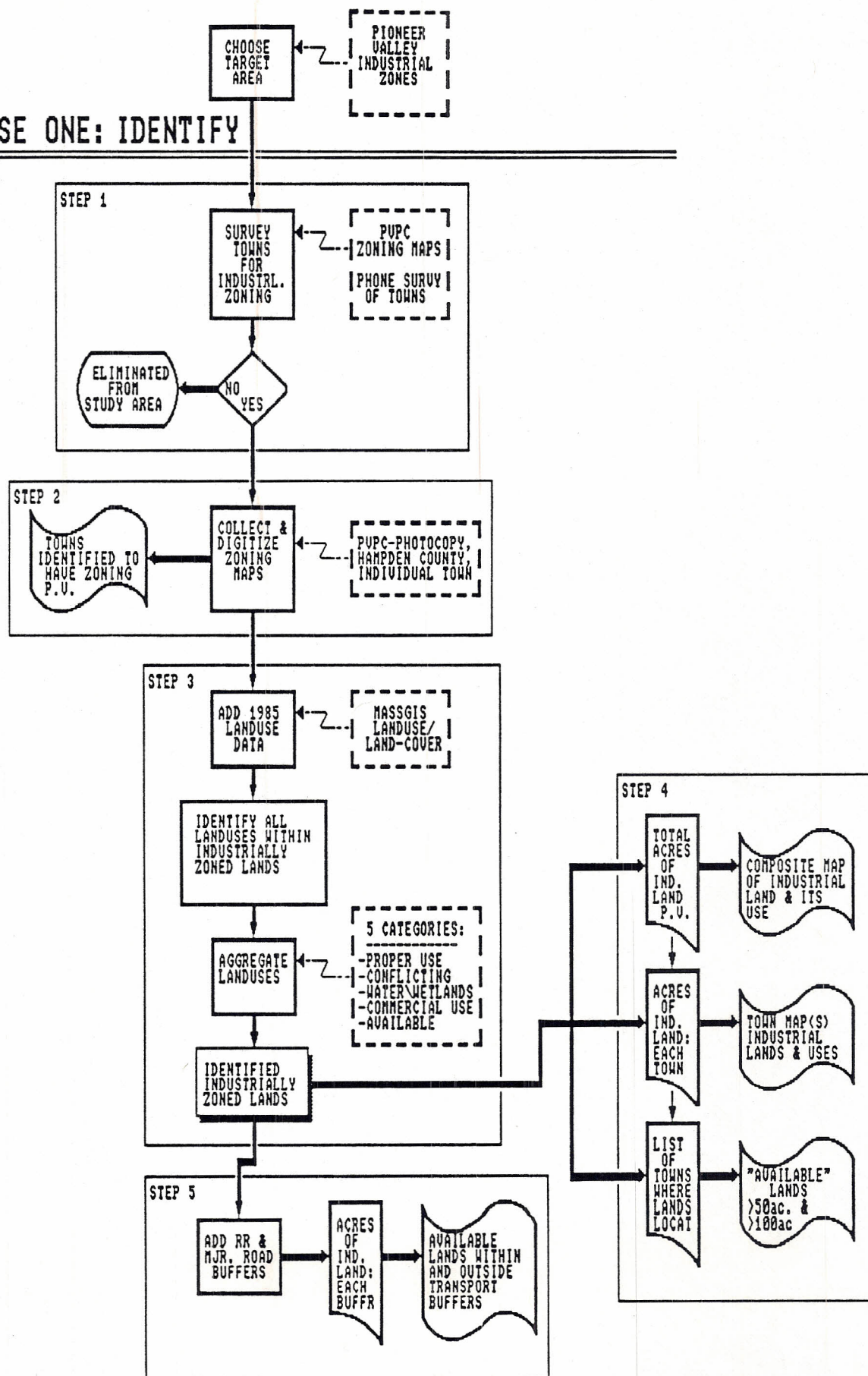


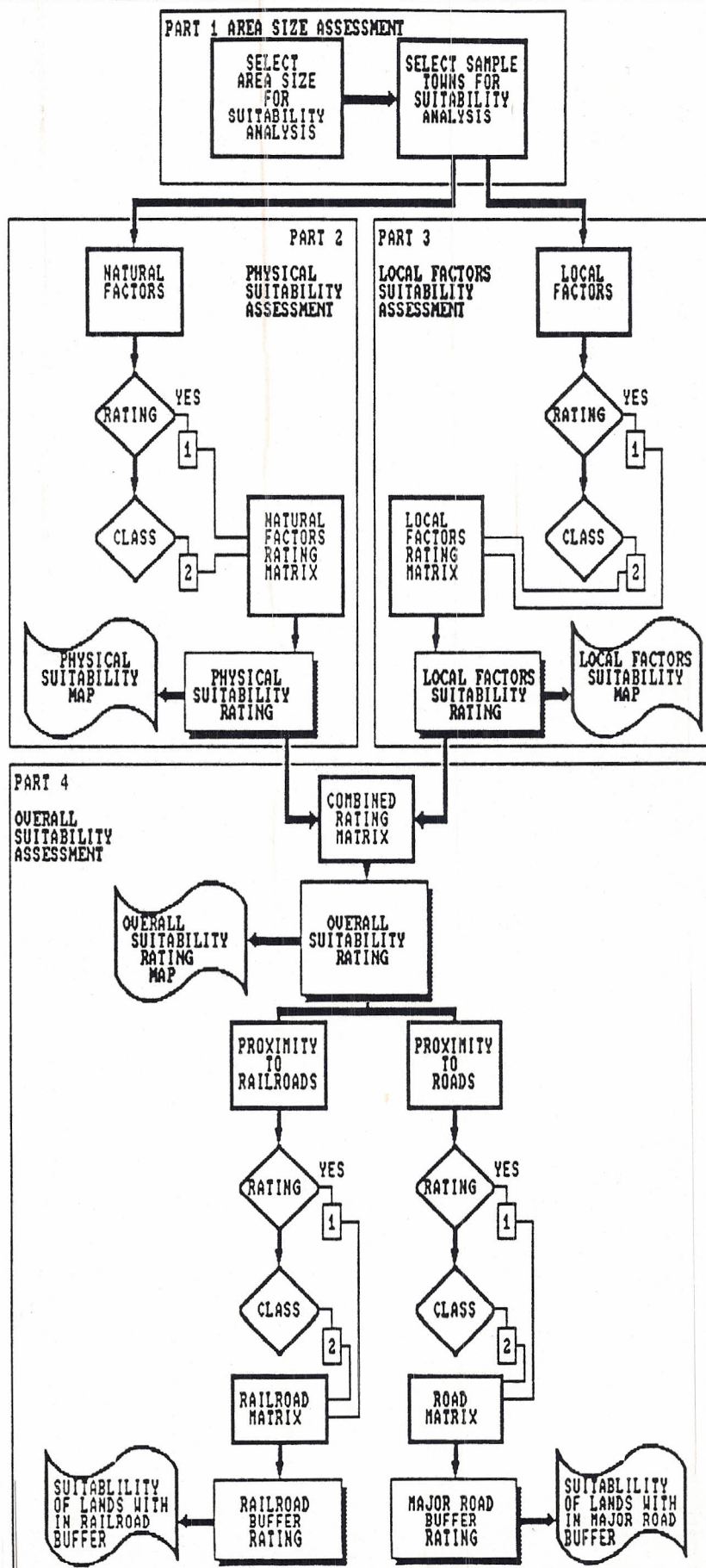
CHART # 3.2

### 3.2.2 Phase Two: Suitability Assessment

The Identify Phase located the lands in the Pioneer Valley that were zoned industrial and were "available" for development. That is vacant industrially zoned land. The Suitability Phase assesses only identified available lands, categorizing it into three different suitability classes; *Suitable for All Industry*, *Suitable for Light Industry*, and *Not Suitable for Industry*. . This four-part assessment consists of Part 1; selecting the appropriate minimum size for an area in order for it to be assessed, Part 2; rating the natural factors, Part 3; rating factors within local control, and Part 4; an overall proximity assessment and assesment to both major roads and railroads on the land determined to be suitable for development. The following flow chart, Chart # 3.3, illustrates this procedure. The following sections describe in greater detail how the three suitability ratings were carried out.



# PHASE TWO: SUITABILITY



KEY :

[DESCRIPTION BOX]

PROCESS

NEW COVERAGE CREATED

MAP COMPOSITION

AGG. DATA FROM MAPS

CHART # 3.3

### 3.2.2.1 Part 1: Area Size Assessment

#### STEP 1: Select Area Size

First the "Identified Industrially Zoned" lands are categorized into three mutually exclusive classes based on their contiguous acreage, over 100 acres, between 50 and 100 acres, and the less than 50 acres. The assumption is that industrial land less than 50 acres is not enough land mass to economically develop for industry and the preferred size is at least 100 acres. The case studies and experts interviewed support this classification (See Chapter 2 of this report).

#### STEP 2: Select Towns

The project team chose two areas over 100 acres as the test sites for running the suitability model. The Southampton site was chosen because the added digital data needed for this phase already existed. The University of Massachusetts Resource Mapping Unit had complete data layers for the entire town that were easily utilized in our assessment. Belchertown was the other site chosen. The Belchertown site fit the requirements and was suitable for comparison with the Southampton site. The following chart illustrates this procedure.

# PHASE TWO: SUITABILITY

## PART 1: AREA SIZE ASSESSMENT

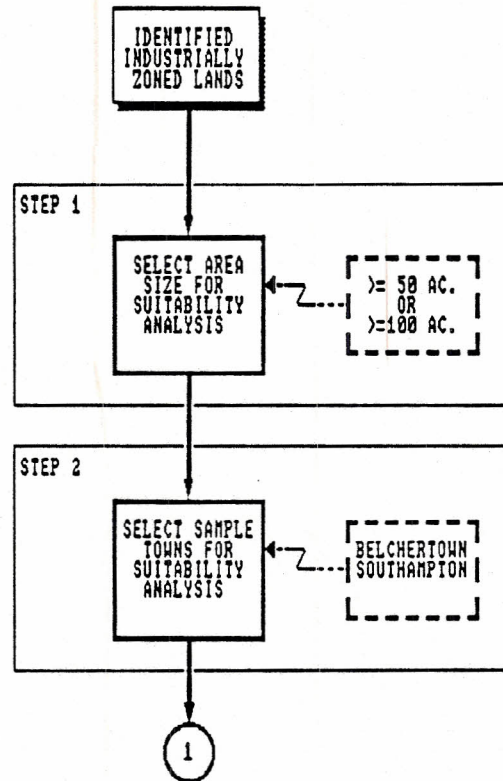


CHART # 3.4



#### 3.2.2.1 Part 2: Physical Suitability

Part 2, Physical Suitability looks at the following natural factors: Slope Classification, Soil Engineering Ratings, Aquifer Recharge Areas, Non-Forested Wetlands, and Open Space. These factors are entered into the database as different layers. The different factors are then segregated into different classes based on standard suitability ratings and knowledge gained through our state-of-the-art research. The results are then mapped, showing the rated areas and their acreage. Chart # 3.5 on the next page shows how each of the six steps are carried out.

# PHASE TWO: SUITABILITY

## PART 2: PHYSICAL SUITABILITY

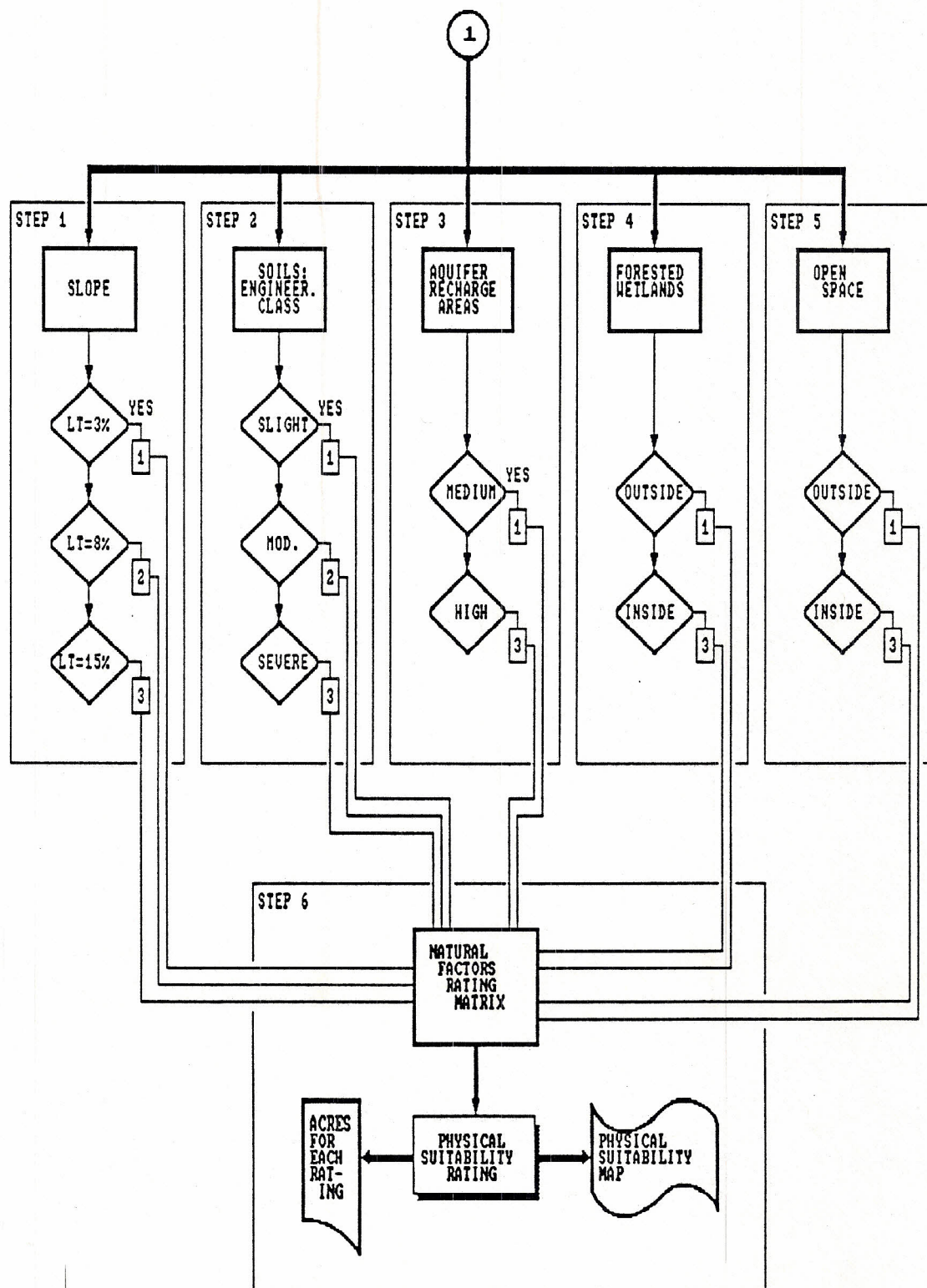


CHART # 3.5

#### **STEP 1: Slope Classification**

The slope is classified into four categories, less than 3%, 3-8%, 8-15%, and greater than 15%. Slopes over 15% are considered too costly to build on and are eliminated from analysis. Slopes less than 3% are significant in that they are suitable for rail access. Trains cannot travel on slopes greater than 3%. A 3% slope is also ideal for large warehouse or manufacturing/assembling facilities. Modern factories are horizontal in nature. It is less expensive to move materials on one level, therefore a large building footprint is required. The more grading that is necessary to level a site, the more expensive the plant is to build. This is why the lower slope categories receive the higher suitability rating. Light and smaller industries do not fit this trend so the slope rating is not as critical a factor.

#### **STEP 2: Soil Classification**

The soil engineering classes are broken down per the Soil Survey rating, slight, moderate, and severe. This is discussed in section 2.1.3.1.

#### **STEP 3: Aquifer Recharge Classification**

#### **STEP 4: Forested Wetlands Classification**

#### **STEP 5: Open Space Classification**

The last three factors, Aquifer Recharge, Forested Wetlands, and Open Space, are rated in an "all or none" fashion. The aquifer coverage is either in a high or medium recharge area. Land within a high recharge area is considered unsuitable for development



because industrial development within these areas is seen as too great of a threat to the ground water. The other two factors are classified in the same manner. If the area is a forested wetland or public open space, it is designated not available for development.

#### **STEP 6: Rating of Natural Factors**

The first two factors, Slope and Soils, are now combined in the first stage of the two stage *Natural Factors Rating Matrix*, Table 3.4. Soils designated severe and slopes over 15% are considered unsuitable for development. The remaining classifications are put into the second stage of the *Natural Factors Rating Matrix* which combines all the factors to come up with a Physical Suitability Rating. The matrix shows this graphically. The final physical suitability rating is then mapped, with the acreages displayed for each rating category.

## PART 2: PHYSICAL SUITABILITY

### NATURAL FACTORS RATING MATRIX

#### STEP 6

- 1 = Suitable for All Industry
- 2 = Suitable for Light Industry
- 3 = Not Suitable for Industry

#### STAGE 1

		SOIL ENGINEERING CLASS		
		SLIGHT	MOD.	SEVERE
SLOPE	0 - 3%	1	1	2
	3 - 8%	1	2	2
	8 - 15%	2	2	3
	< 15%	3	3	3

#### STAGE 2

		STAGE 1 RATINGS		
		1	2	3
AQUIFER RECHARGE	MOD.			
FOREST WETLANDS	OUTSIDE	1	2	3
OPEN SPACE	OUTSIDE			
AQUIFER RECHARGE	SEVERE			
FOREST WETLANDS	INSIDE	3	3	3
OPEN SPACE	INSIDE			

TABLE # 3.4

### 3.2.2.3 Part 3: Local Factors Suitability

The local factors are classified much the same way as the physical suitability, although analyzing the data and placing it into the various classifications requires statistical interpretation of the information. The three "local" factors examined were Conflict with Neighbors, Ownership, and Sewers. Chart # 3.6 on the next page illustrates this procedure. The following describes in greater detail how the statistical process for determining the factor classifications was carried out.

#### STEP 1: Determination of Land Use Conflicts

The same process that was used to aggregate the land use categories in the Identify Phase was repeated to aggregate the land uses into conflict rating classifications. Here again are the 21 original land use categories:

#### UMASS Resource Mapping Land Use Categories

1	Intensive Agriculture	12	Medium Residential
2	Extensive Agriculture	13	Light Residential
3	Forest	14	Salt Wetlands
4	Fresh Wetlands	15	Commercial
5	Mining	16	Industrial
6	Open Lands	17	Open and Public Space
7	Participation Recreation	18	Transportation
8	Spectator Recreation	19	Waste Disposal
9	Water based Recreation	20	Water
10	Multi-Family Residential	21	Woody Perrenials
11	Dense Residential		

TABLE # 3.5



# PHASE TWO: SUITABILITY

## PART 3: LOCAL FACTORS SUITABILITY

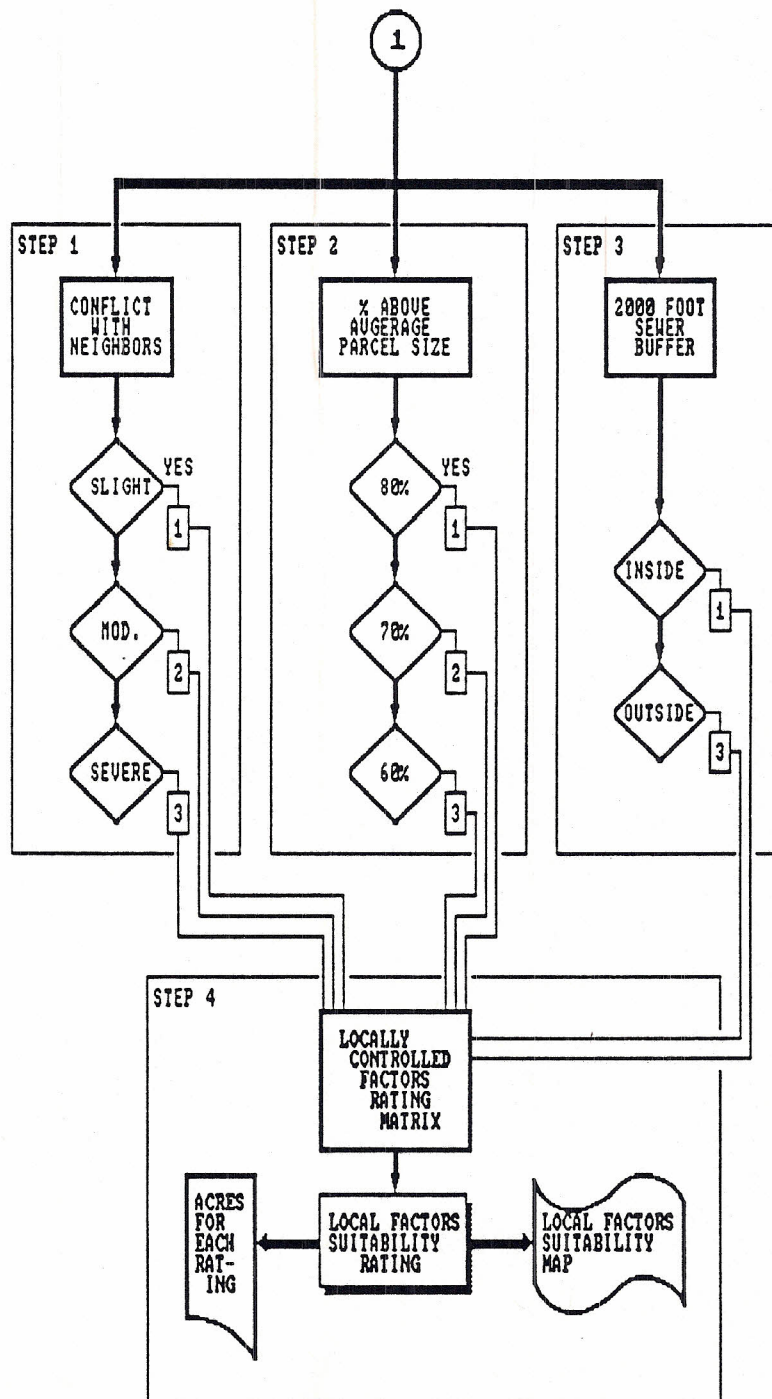


CHART # 3.6

Given these 21 categories, the study team then looked at each land use in terms of its potential for conflict, or hostility towards industrial development within the zone. The irony of the situation is apparent. Land uses that are in conflict with the actual zoning on the land (Industrial) can prevent industry from building through political pressure and other means.

By buffering the industrial zone to 1,000' and looking at the land uses, three types of conflict were determined. They are as follows:

1. **Low Conflict:** Land uses with little or no conflict towards industrial development.
2. **Moderate Conflict:** Land uses that would not produce actively hostile neighbors, but are not complementary to an industrial use.
3. **High conflict:** Land uses that are likely to produce hostile neighbors and are inherently incompatible with an industrial use.

#### Conflict Categories

<u>Conflict rating</u>	<u>Land use category</u>
Low conflict:	Commercial, Transportation, Mining, Waste Disposal
Moderate conflict:	Intensive Agriculture, Extensive Agriculture, Forest, Open Lands, Woody Perennials
High conflict:	Fresh Wetlands, Participation Recreation, Spectator Recreation, Water based Recreation, Multi-Family Residential, Dense Residential, Medium Residential, Light Residential, Salt Wetlands, Open and Public Space, Water

TABLE # 3.6

The result of this system looks similar to a donut. The available land under study is encircled by the buffered land uses surrounding the industrial zone. These are the areas analyzed as to their potential conflict. The final step to be created is a conflict "index" for the entire industrial zone.

The determination of a conflict "index" is to simply take the acreage of each type of conflict and determine the percentage of the entire area each conflict classification represents. Simple rules have been determined to define the overall parcel index. They are as follows:

If more than 33 percent of the area surrounding an industrial zone is rated "high" then the overall parcel index is "High".

If more than 50 percent of the area surrounding an industrial zone is rated "low" then the overall parcel index is "Low".

"Moderate" is assigned to any area not fulfilling one of the two first categories.

If both high and low are determined to be appropriate then high is assigned to the overall parcel index.

The reason for applying the "High" rating is that if more than a third of the surrounding area has the potential to be actively opposed to industrial development, then the area is likely to be of a high conflict potential.



The reasoning for the "Low" rating is that if 50 percent of an area is already of low industrial conflict, then the area is likely to allow added industrial development.

#### **STEP 2: Classification of Ownership Rating**

Ownership was the second factor considered. The purpose for looking at ownership is the premise that the greater the number of owners of a particular area, the more difficult it is to assemble the land for development (Section 2.1.4.1 The Blackstone River Valley).

The ownership rating was estimated from a count of the parcels contained within the available industrial area being studied. The total acreage of the industrial area being studied was divided by the parcel count to get an average parcel size. Looking at the percentage of parcels above the average parcel size then gave the project team an estimation of the number of parcels within the area relative to their size. It is assumed that having a few large parcels within an area will make land assembly easier (Section 2.1.4.1 The Blackstone River Valley). Therefore this process gives a more accurate estimate of the ownership difficulty than going by a straight parcel count. The 80, 70, 60 percent ownership classifications were chosen to represent the difference in parcel sizes and their relative difficulty for assembly. The process for acquiring and analyzing this data, and its accuracy relative to other techniques, is discussed in Section 3.1.1 Data Input.

Using the average parcel size the team needed only to count the number of parcels within the area. This accomplished two objectives. It decreased the time needed for data gathering by an estimated 95% (Digitizing of the parcel map is not necessary), allowing this factor to be evaluated, and it increased the ability of this process to be implemented on a state wide basis. Again, the process for acquiring and analyzing this data, and its accuracy relative to other techniques, is discussed in Section 3.1.1 Data Input.

Time constraints also prevented the project team from actually checking the ownership names from the assessors list for repetitious owners. As this process is only to get an estimation of the potential conflict, and the process is designed to be readily implemented at the state level, the time savings relative to the accuracy lost is reasonable.

### **STEP 3: Proximity to Sewer**

The sewer rating is similar to the transportation ratings. The sewers were digitized as a coverage and a 2,000 foot buffer was placed around the line. Land was then evaluated as either inside or outside the buffer. Land inside the buffer was given the higher rating because the cost for hooking into the sewer system would be less. It is assumed that any industry developing in the valley will have to use a sewer system to avoid breaching any

environmental laws or regulations. Sewer systems are generally required for any type of industrial development.

#### **STEP 4: Rating of Local Factors**

The different ratings for each of the local factors are then compiled in a rating's matrix as was used in Suitability 1. This "Locally Controlled Factors Rating Matrix" is shown in Table # 3.7. The resulting ratings classifications are mapped listing the acreage for each rating.



PART 3: LOCAL RAT. MATRIX TABLE # 3.7

#### 3.2.2.4 Part 4: Overall Suitability Rating

The Overall Suitability Rating combines the ratings from Part's 2 and 3 creating a composite suitability assessment. This rating is then evaluated as to its proximity to the rail and major road networks in the valley. This is illustrated in Chart # 3.7.

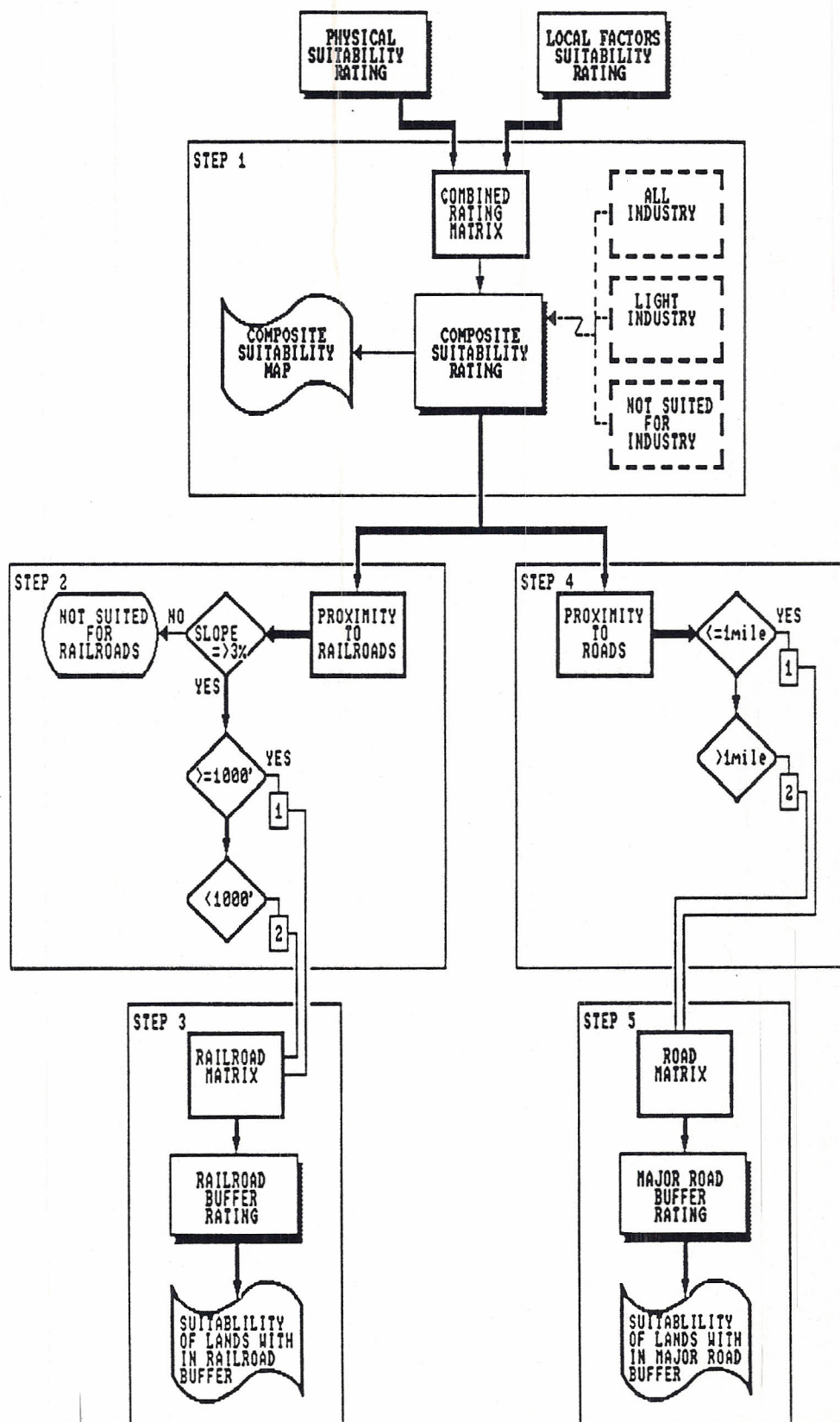
##### STEP 1: Combined Suitability Rating

The overall suitability is a simple process of combining the two previous rating categories in a "Combined Rating Matrix" (Table # 3.8). The resulting rating categories, *Suitable for All Industry*, *Suitable for Light Industry*, and *Not Suited for Industry*, are mapped with their resulting acreage figures.

The three classifications designate lands with few restrictions for development, those lands with characteristics that prevent certain industries from developing, and lands that are unsuited for development. The broad categories are used because this study is not intended to pinpoint lands for specific industries, but to locate areas with the potential for development. The specific characteristics of each of these categories can be determined by examining the three ratings matrices that were used to assemble the ratings into the three categories.

# PHASE TWO: SUITABILITY

## PART 4: OVERALL SUITABILITY RATING





All Industry would include any type of industry, specifically heavy industry or large warehouse/distribution development that requires large flat land, buildable soils, limited environmental restrictions, and a low "Conflict with Neighbors" rating. Light Industry would include smaller industrial parks or industry that can utilize vertical space such as high tech or the assembly of lightweight merchandise. They produce less noise and pollution compared to heavy manufacturing or shipping and so generally have a lower conflict with neighbors as well. They may also have less need for rail access. Rails are the most economical when shipping heavy materials or products.

#### **STEP 2: Classification of Railroads**

The Overall Rating Classification is then evaluated first against its proximity to rails. The railroads are buffered by 1,000' and all suitable lands with a slope of less than 3% are assessed to see if they fit within the rail buffer.

#### **STEP 3: Rating of Railroads**

The results of Step 2 are placed into a railroad matrix creating a railroad buffer rating. Land is rated either inside or outside the buffer. The results of this coverage are then mapped.

#### **STEP 4: Classification of Major Roads**

The major roads are buffered at a mile distance on either side and assessed the same way but without the slope criteria since trucks

are not restricted by slope as severely as trains. The upper limit for trucks are generally slopes of 15%.

#### **STEP 5: Rating of Major Roads**

The results of Step 4 are then placed in the roads matrix defining land as either inside or outside the buffer. The major roads buffer coverage is then created along with a map displaying these results.

The four-part process of the Suitability Phase of this model produces five separate suitability maps that categorize the land into three categories; Suitable for All Industry, Suitable for Light Industry, and Not Suitable for industry. The five products are a suitability map and figures based on natural factors, another based on locally controlled factors, a composite suitability map, and rails and roads proximity maps using the composite suitability map as its base.

The advantage of producing the different suitability maps is in being able to see where and what has the greatest impact to impeding development within these industrial zones. These results can directly benefit policy makers in their decision making process.

### PART 3: LOCAL FACTORS SUITABILITY

#### LOCAL FACTORS RATING MATRIX

##### STEP 4

- 1 = Suitable for All Industry
- 2 = Suitable for Light Industry
- 3 = Not Suitable for Industry

##### STAGE 1

		CONFLICT WITH NEIGHBORS		
		SLIGHT	MOD.	SEVERE
% AREA ABOVE	80%	1	2	3
AVERAGE	70%	2	2	3
PARCEL SIZE	60%	3	3	3

##### STAGE 2

		STAGE 1 RATINGS		
		1	2	3
2000'	INSIDE	1	2	3
SEWER BUFFER	OUTSIDE	3	3	3

TABLE # 3.7



## 4. APPLICATION

The Suitability Model, after being developed, was tested on the Pioneer Valley. The Identify Phase was carried out on the entire valley while the four-part Suitability Phase was tested on two towns in the Valley. Only two towns were used for Phase Two: Suitability, because of the time constraint involved with digitizing the additional data needed for this phase. The results from this assessment are discussed below.

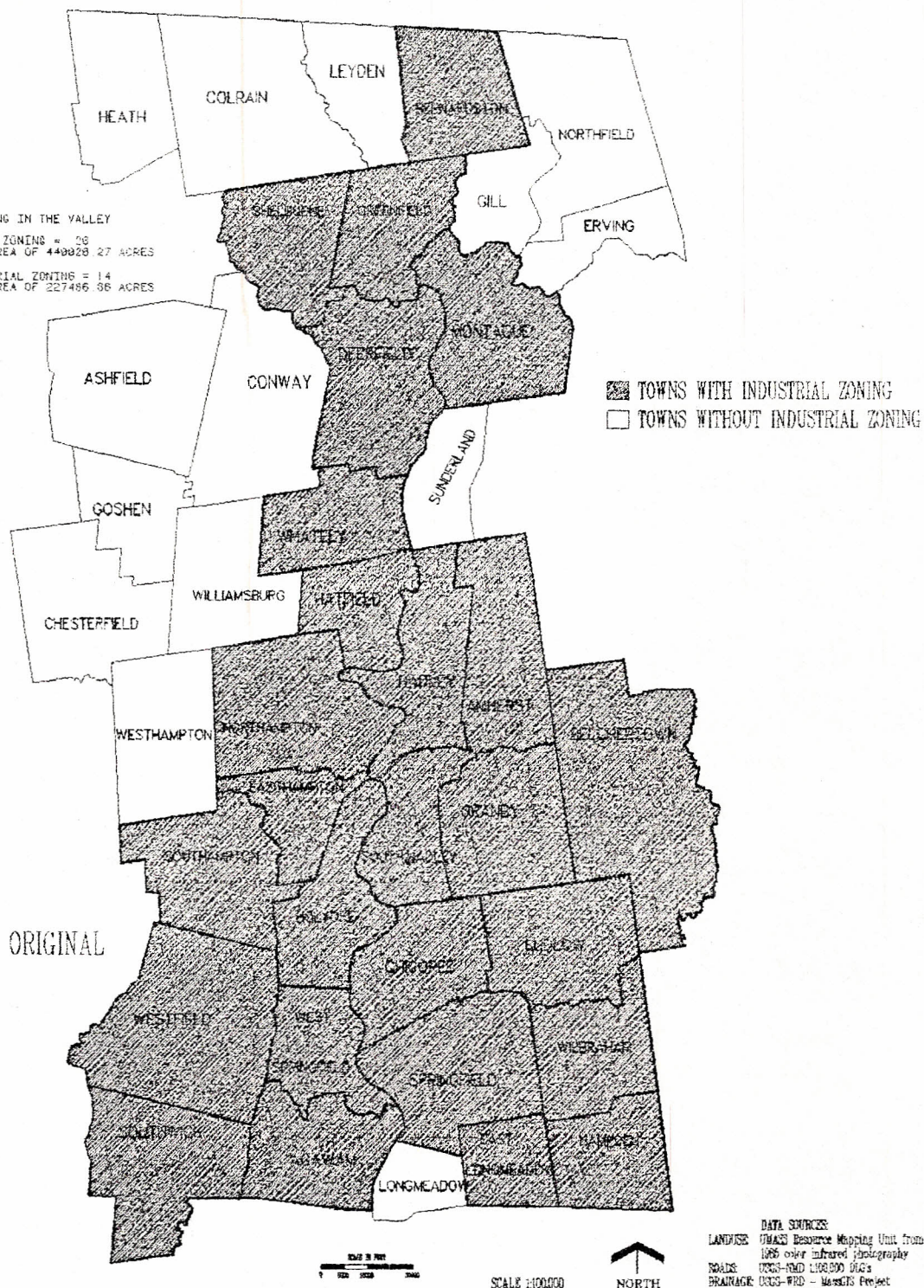
### 4.1 Application of Phase One: Identify

#### STEP 1: Survey Towns

The first criteria of the study is that only industrially zoned lands are being studied. The original study area consisted of 40 town within the Pioneer Valley. After surveying the towns for industrial zoning, 26 remained in the study area. Most of the towns within the Valley that do not have formal industrial zones are small hill towns that do not have land suitable industrial land. Map # 4.1 displays the towns that made this first cut. This means that 14 towns, or 35 percent of the towns comprising most of the Pioneer Valley are without formal industrial zoning. This calculates out to be 227,466.86 acres, or 34 percent of the land area. Only the remaining 26 towns and their land area was used for the remaining steps.

# TOWNS WITH INDUSTRIAL ZONING IN THE STUDY AREA

TOWNS WITH INDUSTRIAL ZONING IN THE VALLEY  
 # OF TOWNS WITH INDUSTRIAL ZONING = 36  
 THOSE TOWNS HAVE A TOTAL AREA OF 449928.27 ACRES  
 # OF TOWNS WITHOUT INDUSTRIAL ZONING = 14  
 THOSE TOWNS HAVE A TOTAL AREA OF 227486.86 ACRES



CENTER FOR ECONOMIC DEVELOPMENT  
 LANDS ZONED AND SUITABLE FOR INDUSTRY

STUDY AREA WITHIN PIONEER VALLEY



Produced by the METLAND Research Group  
 Dept. of Land, Arch. and Reg. Planning  
 University of Massachusetts, Amherst



## **STEP 2: Digitize Industrial Zoning**

The zoning that was digitized for this project was taken from a variety of source maps. The maps ranged from 1" : 800' to 1" : 1500' in scale and ranged from 1971 to 1990 in date. While this meant a great range of information had to be compiled and standardized, this comprised the basis of the work for the study area. The digital copy of the zoning data is a close copy of the original, but the varied source maps and age may contribute to some error in the zoning data. Corrections and updates were made to the data whenever possible.

The digitizing of only the industrial zones was a decision based on time constraints and the needs of this study. The full zoning for each town would have been a tremendous asset as a database, but was not useful for this study since only industrial zones were being analyzed for their suitability for development. The time saved digitizing only industrial zones could be estimated at a range of between 3 to 10 hours per town.

## **STEP 3: Identify and Aggregate Land Uses**

The industrial zoning of these towns was then measured and the acreage for the aggregated land uses was summed. The land uses were aggregated into five categories as described in the Methods Chapter. The results of this process are mapped on Map # 4.2 at the end of this section. As was predicted, only 58 percent of the total acreage within the industrial zones for all of the Pioneer



Valley is still available for development, although this does not include the 15 percent of land being used for industry at present. Chart # 4.1 at the end of this section displays the results of this aggregation.

General zoning principles maintain that towns should have at least 10 percent of their land area zoned industrial in order to maintain a sound tax base. Calculating the land area within the 26 town study area, only 6 percent of the land is zoned industrial with only 15 percent of that area being used at present for industry. This means only 0.9 percent of the total land in the study area is being used for industry. Adding the land zoned and available for industrial development totals only 4.5 percent of the total land in the study area. At only this level of the study, the Pioneer Valley has less than half the land area needed for industrial development.

#### **STEP 4: Mapping Data**

This step consisted mainly of creating maps based on the information collected in the previous step. The individual town maps, along with their ensuing charts provide information on each towns industrial land. The maps follow this section to provide a more fluent reading of this assessment step. This base information collected was also used to explore the data, which is the purpose for using GIS technology in this study.

A major factor in developing industrial land is the total contiguous acreage available to assemble and develop in any given area. The general industry standard (and the client's request) is that at least 100 contiguous acres are needed to interest development of industry in any area. It was decided to evaluate areas between 50 and 100 acres as a comparison. Map # 4.3 shows the location of the 50 and 100 acre zoned industrial land areas. Found in the study area were 33 areas over 100 acres adding up to 11,848 acres. A total of 1,411 acres in 55 areas were found within land areas between 50 and 100 acres. This eliminates an additional 2,511 acres that can be labeled as available for development. An additional 1,411 acres are eliminated when the 100 acre minimum is used. Comparing this figure with the entire Pioneer Valley, only 2.6 percent of the lands comprising the valley have the potential for industrial development based on the 100 acre minimum requirement for development. *This cuts almost in half the land left available for development following step 2.* The following table describes the distribution of these lands throughout the valley.

TOWNS WITH INDUSTRIAL AREAS OVER 50 AND 100 ACRES

Town/City	Number of Parcels:	
	50 - 100 ac.	over 100 ac.
Agawam	4	3
Amherst	1	0
Belchertown	1	1
Bernardston	1	1
Chicopee	5	0
Deerfield	3	2
Easthampton	2	1
E. Longmeadow	1	1
Granby	1	1
Greenfield	2	1
Hadley	4	3
Hampden	1	1
Hatfield	2	1
Holyoke	1	1
Ludlow	4	2
Montague	2	2
Northampton	0	0
Shelburne	0	0
South Hadley	2	2
Southampton	1	1
Southwick	2	2
Springfield	4	1
West Springfield	1	0
Westfield	5	4
Whately	2	1
Wilbraham	1	1
<b>TOTAL</b>	<b>53</b>	<b>33</b>

TABLE # 4.1

There is a good distribution of 100 acre or greater industrial lands throughout the valley. Montague contains the greatest acreage (2,437ac.), this site having originally been considered for a nuclear power plant.



#### PART 4: OVERALL SUITABILITY RATING

##### COMBINED RATING MATRIX

###### STEP 1

- 1 = Suitable for All Industry
- 2 = Suitable for Light Industry
- 3 = Not Suitable for Industry

##### COMPOSITE SUITABILITY

##### LOCAL FACTORS SUITABILITY RATING

		1	2	3
PHYSICAL	1	1	2	3
SUITABILITY	2	2	2	3
RATING	3	3	3	3

TABLE # 3.8

#### **STEP 5: Proximity to Transportation Corridors**

The industrial lands found available for development were then evaluated as to their proximity to the two transportation networks studied. Only 4,798 acres of the available zoned industrial lands were within the 1000 foot railroad buffer and an additional 8,483 acres were within the 1 mile major roads buffer. As access to transportation is a very important factor in choosing industrial land, these figures demonstrate the premise that there is not enough "true" industrial land in the valley. Only 1.1 percent of the total land area in the study area is available for industrial development, zoned industrial, and within the 1,000 foot railroad buffer. Three percent of this same area is within the major roads buffer. Map # 4.4 located at the end of this section shows the lands within proximity to the transportation buffers.

#### **Summary of Phase One**

The end result of the first phase of the Industrial Suitability Model shows the original hypothesis to be true. The original hypothesis stated that a significant portion of the land zoned industrial in the Pioneer Valley is not suitable for development (1. INTRODUCTION, p.1). The results show that there is not enough land zoned industrial in the Pioneer Valley. Only 6 percent of the total land in the Valley is zoned industrial and almost half of that land is not available for industrial development because it is not within a close enough proximity to any transportation network.

Factoring in contiguous land area and transportation proximity reduces the amount of useable industrial land even more. Three percent of the available land is within proximity to a transportation buffer and also only 2.7 percent of the available industrial land is of a size greater than 100 contiguous acres. Each of these two percentages are not mutually inclusive, that is the areas comprising these two categories are not necessarily the same land area. Therefore, the amount of land that is both within proximity to transportation and over 100 acres in size is only a portion of both percentages.

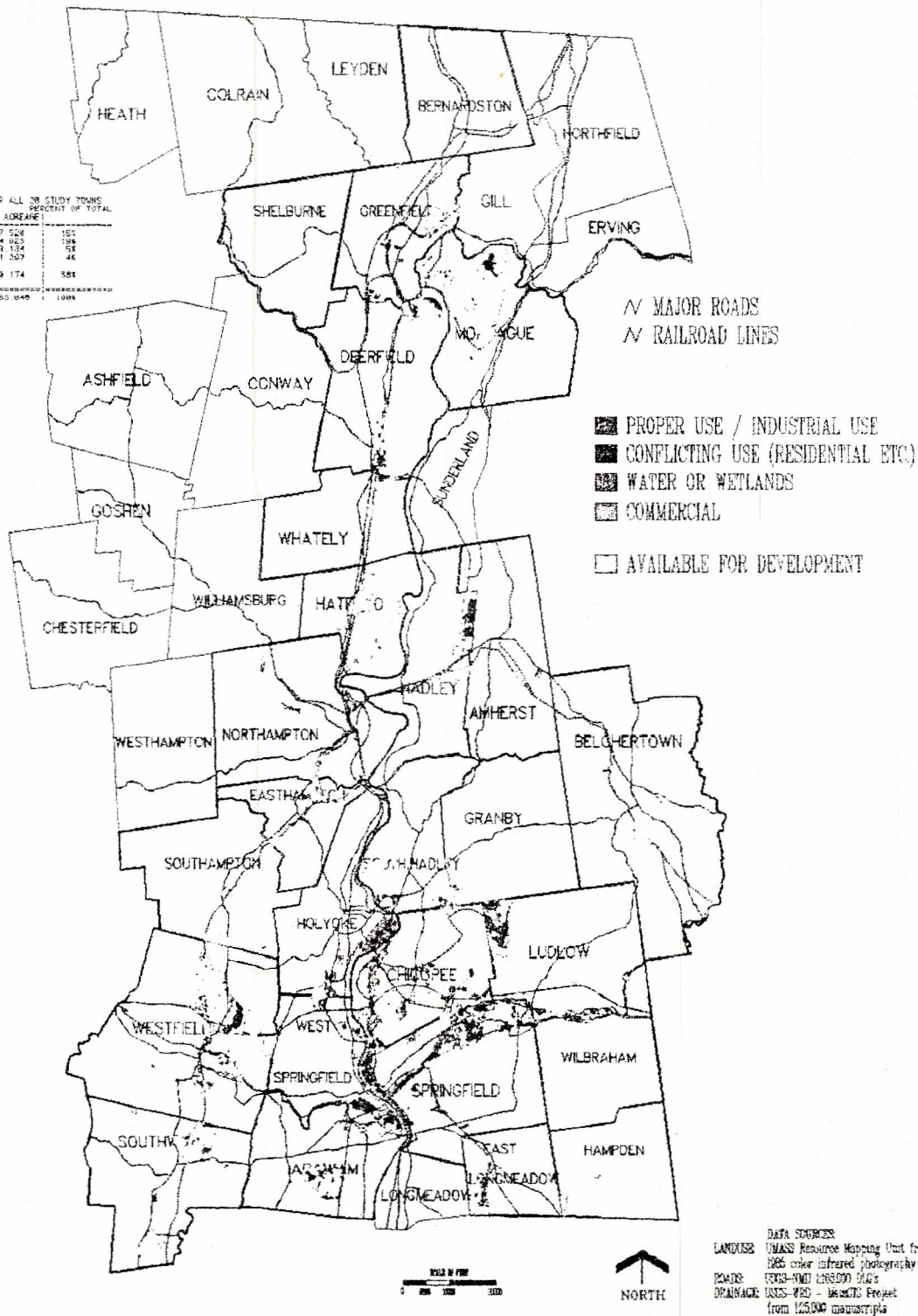
These lands identified as available for industrial development, which total less than 3 percent of the total land area for the Pioneer Valley, have not even been assessed as to their suitability for development. The second phase of the model addresses this, which will further reduce the percentage of lands in the Valley available and suitable for development. The following maps and charts produced in Step 4 of the Identify Phase give a more detailed and visual picture of the available industrial lands in the Pioneer Valley.



# AGGREGATED LAND USES WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE STATISTICS FOR ALL 38 STUDY TOWNS  
FREQUENCY OF OCCURRENCE PERCENT OF TOTAL

AGGREGATED LAND USE	TOTAL ACREAGE	PERCENT OF TOTAL
PROPER USE	4047 526	15%
CONFLICTING USE	3144 963	12%
WATER OR WETLANDS	1200 134	5%
COMMERCIAL USE	751 307	3%
AVAILABLE	15778 174	58%
TOTAL	28963 049	100%



DATA SOURCES  
LAND USE: MASS Resource Mapping Unit from 1985 color infrared photography  
ROADS: 1:50,000 1:250,000 maps  
DRAINAGE: USGS-250,000 Project from 1:250,000 maps

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

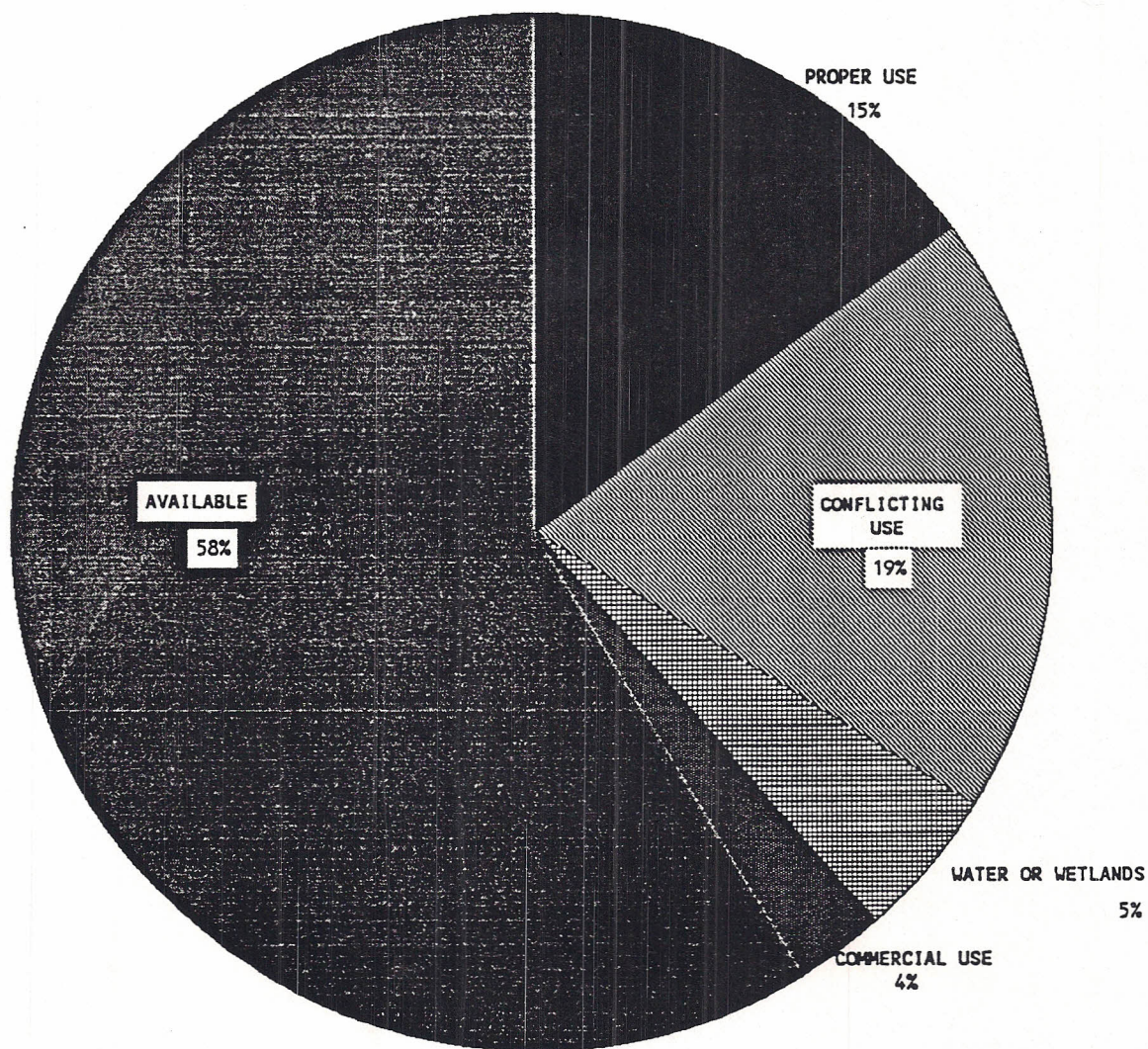
STUDY AREA WITHIN PIONEER VALLEY



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University of Massachusetts, Amherst



PERCENTAGE OF AGGREGATED LAND USES  
WITHIN INDUSTRIAL ZONES:  
COMPOSITE TOTAL

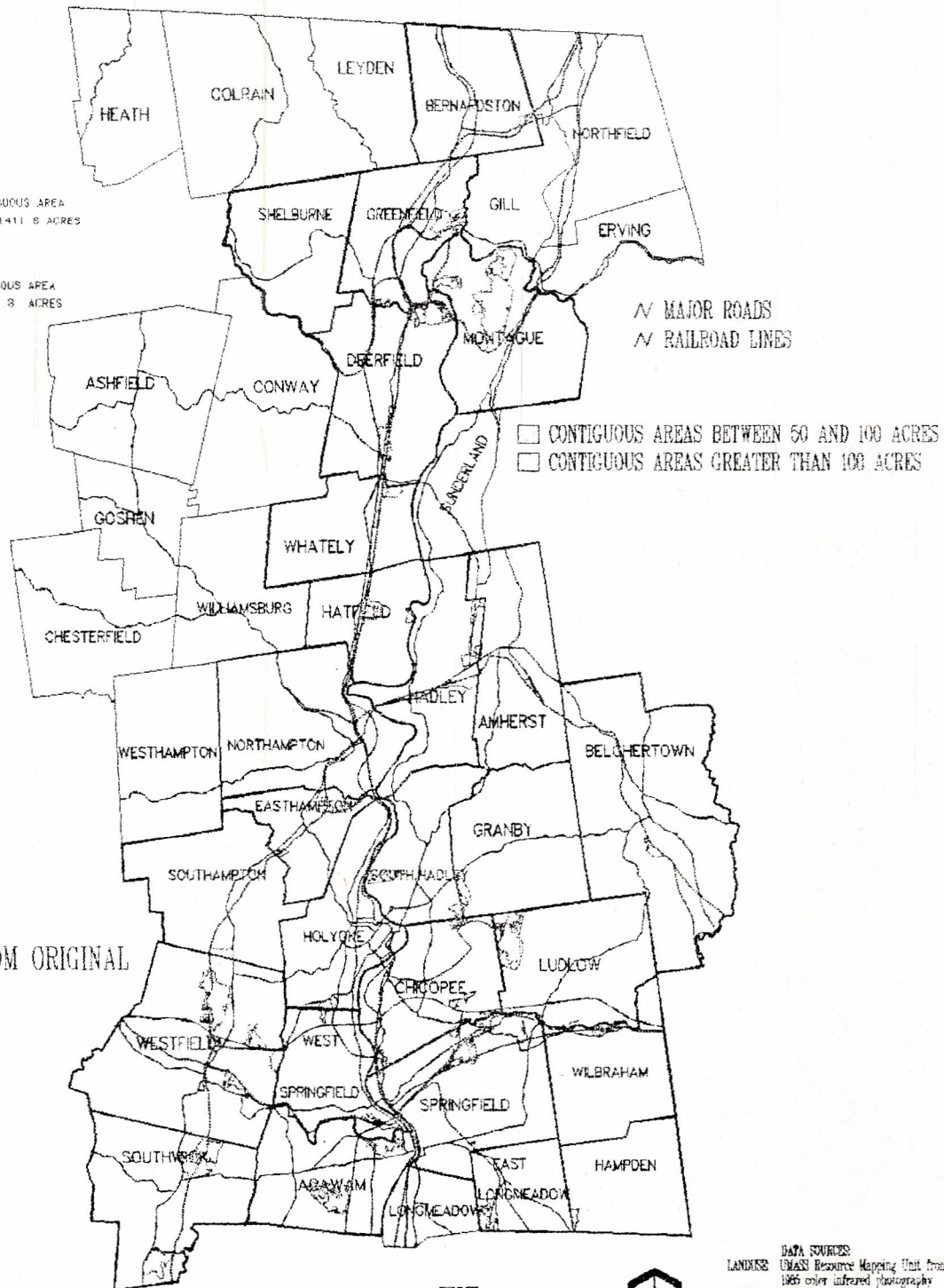




# CONTIGUOUS "AVAILABLE" LANDS BY SIZE

AVAILABLE LANDS WITH CONTIGUOUS AREA  
BETWEEN 50 AND 100 ACRES 1411.6 ACRES

AVAILABLE LANDS WITH CONTIGUOUS AREA  
GREATER THAN 100 ACRES 11847.3 ACRES



REDUCTION FROM ORIGINAL

SCALE IN FEET  
0 100 200 300



DATA SOURCES  
LANDS: UMass Resource Mapping Unit from 1965 color infrared photography  
ROADS: 1965-1966 1:50,000 scale  
DRAINAGE: 1965-1966 - MassGIS Project from 1:25,000 manuscripts

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STUDY AREA WITHIN PIONEER VALLEY



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# PROXIMITY OF AVAILABLE LANDS TO TRANSPORTATION

AVAILABLE LAND WITHIN 1000' RAILROAD BUFFER 4705 378

AVAILABLE LAND OUTSIDE 1000' OF RAILROAD  
BUT WITHIN 1 MILE MAJOR ROAD BUFFER 8492 955

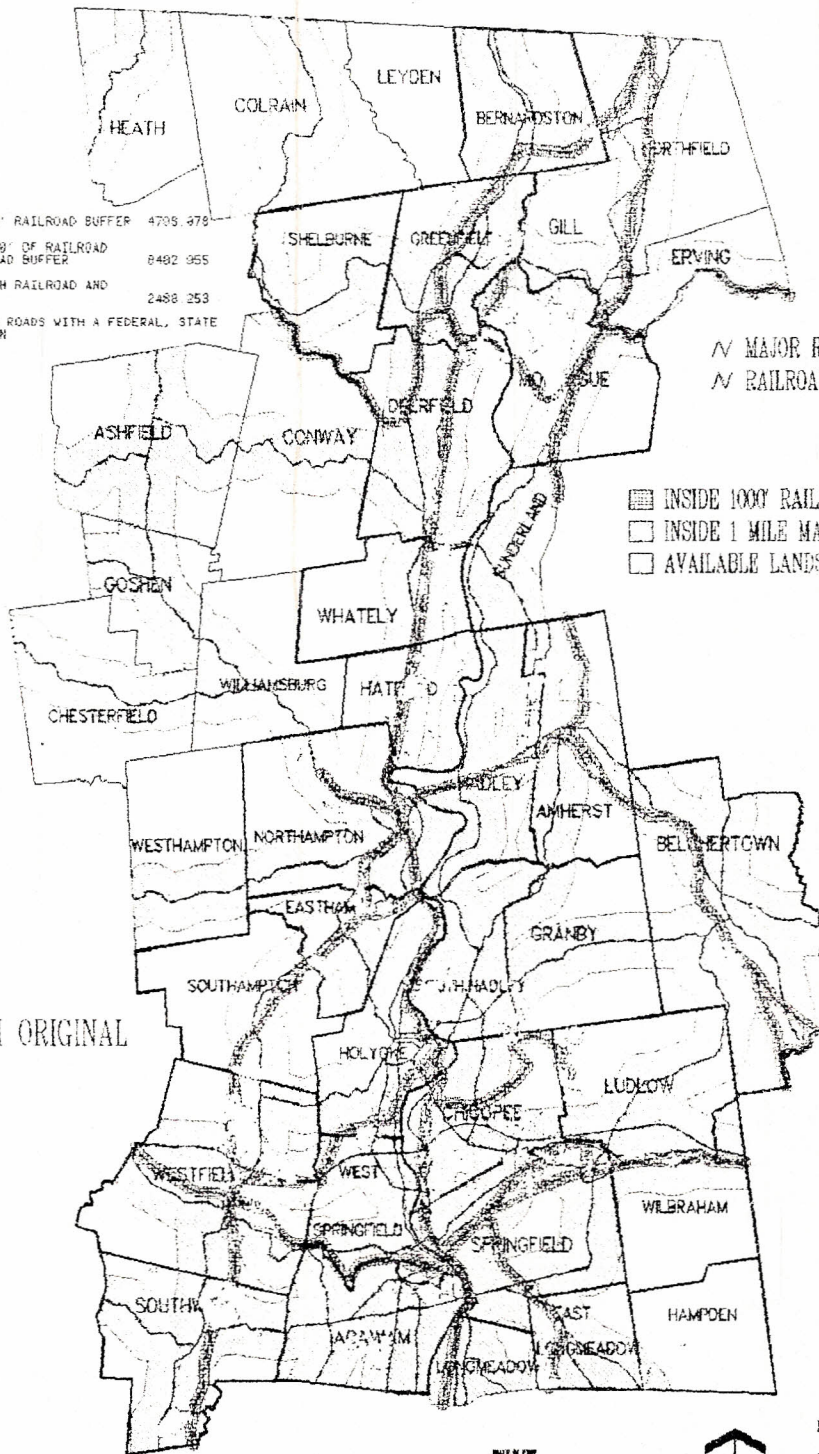
AVAILABLE LAND OUTSIDE BOTH RAILROAD AND  
MAJOR ROAD BUFFERS 2488 253

MAJOR ROADS ARE DEFINED AS ROADS WITH A FEDERAL, STATE  
OR U.S. HIGHWAY DESIGNATION

~ MAJOR ROADS  
~ RAILROAD LINES

■ INSIDE 1000' RAILROAD BUFFER  
□ INSIDE 1 MILE MAJOR ROAD BUFFER  
□ AVAILABLE LANDS (INDUSTRIALLY ZONED)

REDUCTION FROM ORIGINAL



DATA SOURCES:  
LANDUSE: UMMS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS AND 1:50,000 D.C.  
DRAINAGE: USGS-PCD - MassGIS Project  
from 1:25,000 manuscripts

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STUDY AREA WITHIN PIONEER VALLEY



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
AGAWAM

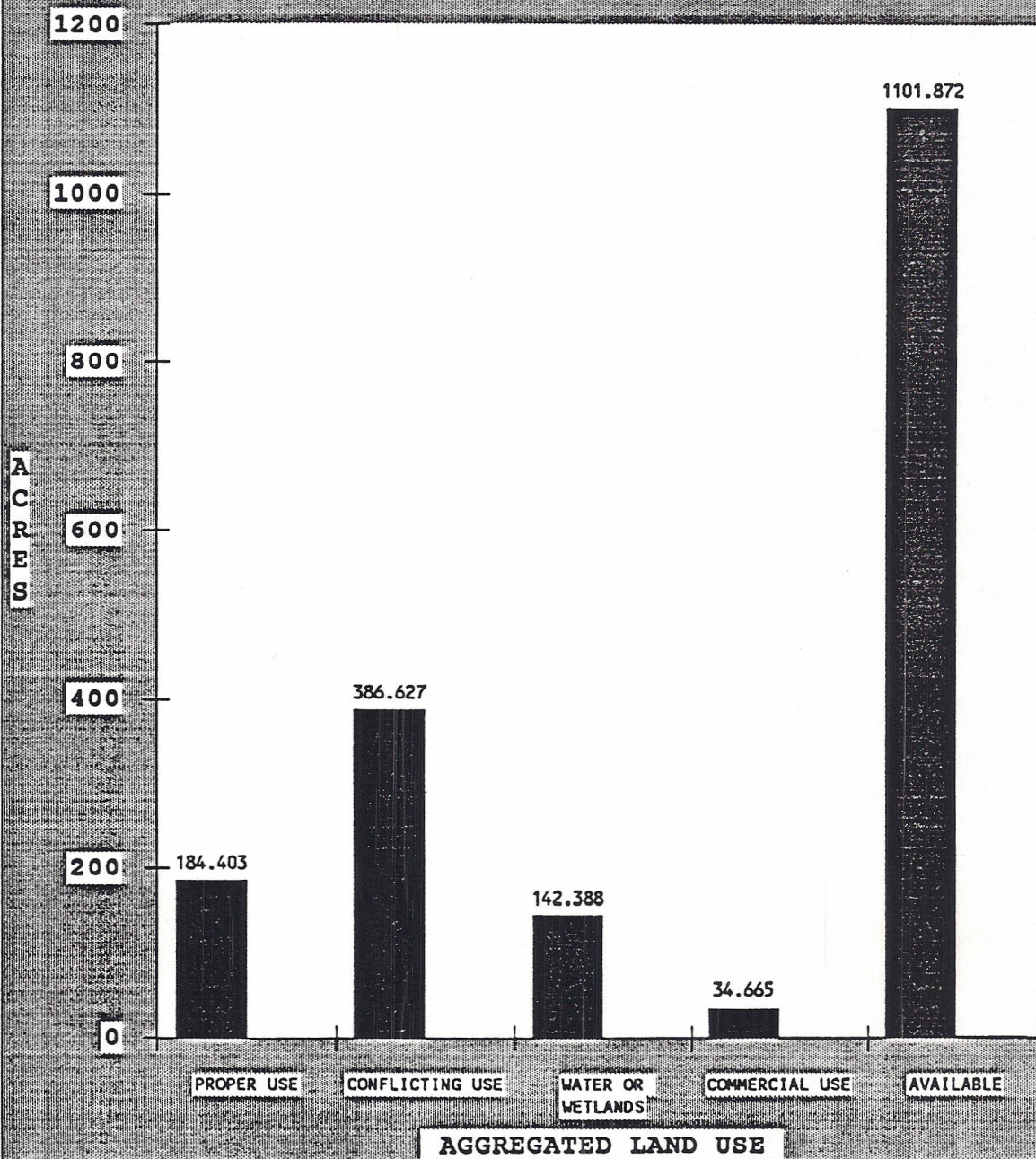
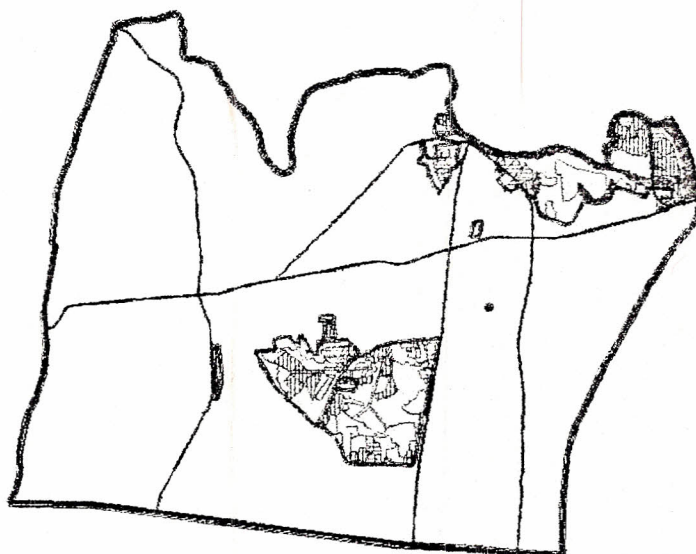







CHART # 4.2

# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	AGAWAM	
	AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	184 403	10%
CONFLICTING USE	386 627	21%
WATER OR WETLANDS	142 388	8%
COMMERCIAL USE	34 665	3%
AVAILABLE	1101 972	59%
TOTAL	1849 960	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
LANDUSE: UMMS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS AND 1:50,000 DGS  
DRAINAGE: USGS-750 - MASHS Project  
from 125,000 manuscripts

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

AGAWAM



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
AMHERST

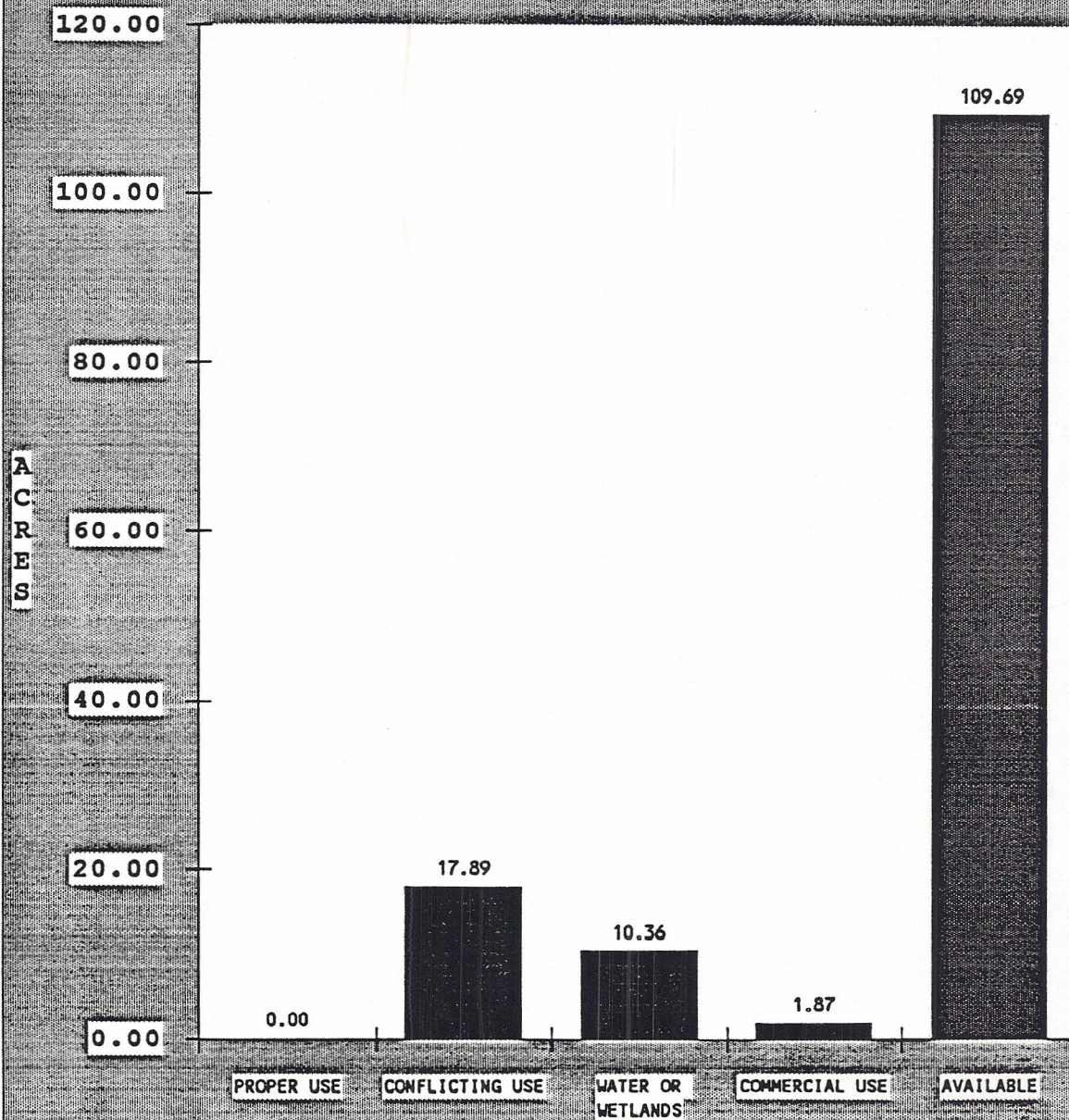
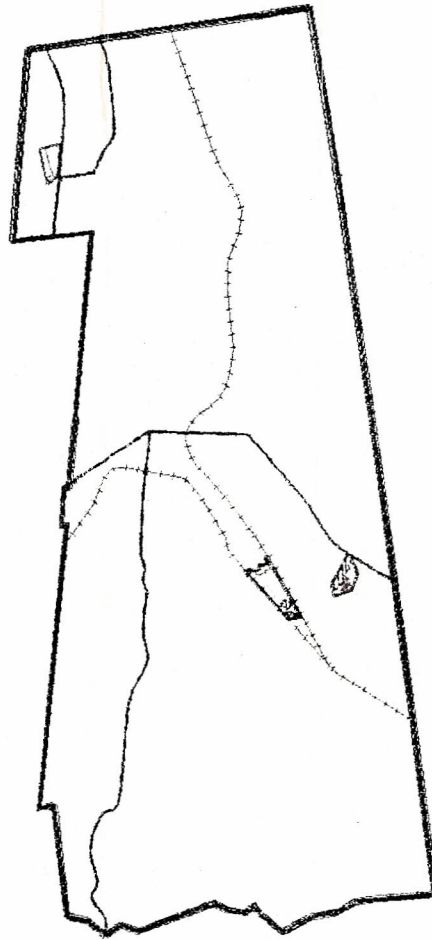







CHART 4.3

# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AMHERST		
AGGREGATED LAND USE	AREA IN ACRES	PERCENT OF TOTAL
CONFLICTING USE	17 888	13%
WATER OR WETLANDS	10 359	7%
COMMERCIAL USE	1 874	2%
AVAILABLE	109 692	78%
TOTAL	139 812	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
LANDUSE: UNACIS Resource Mapping Unit from  
1955 color infrared photography  
BOUND: 1955-1960 USGS 1:25000 maps  
DRAINAGE: 1955-1960 USGS 1:25000 maps  
from 1:25,000 manuscripts

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AMHERST



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**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
BELCHERTOWN**

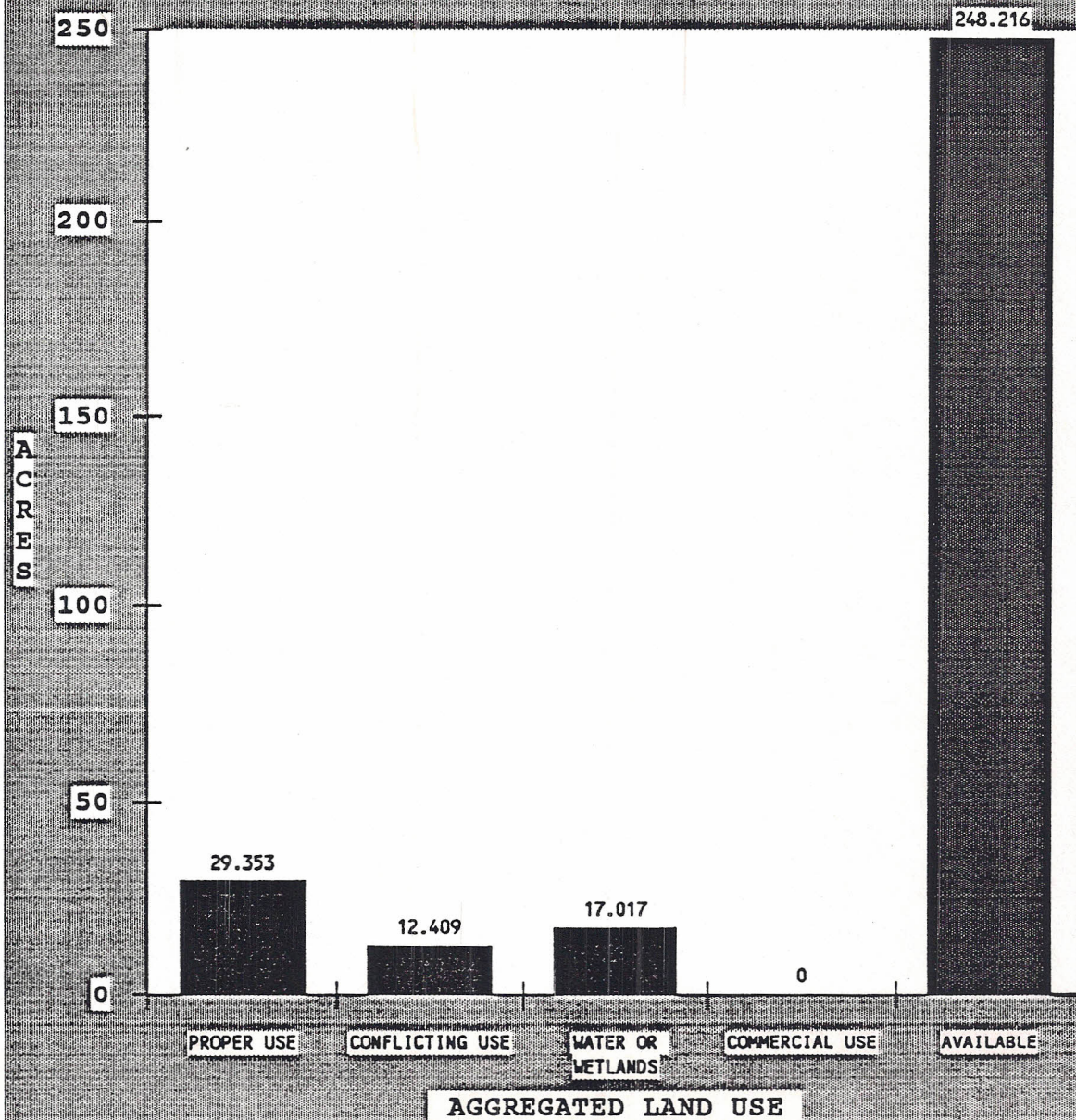
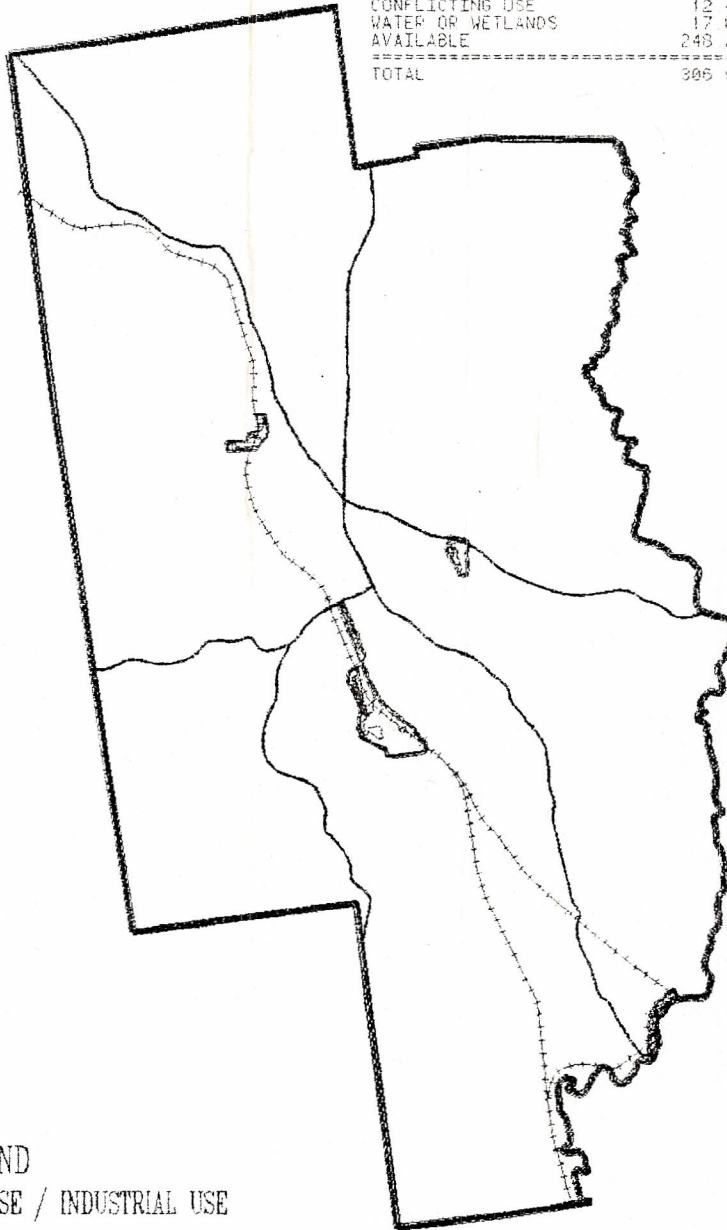


CHART # 4.4








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	BELCHERTOWN AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	29 353	10%
CONFLICTING USE	12 409	4%
WATER OR WETLANDS	17 017	6%
AVAILABLE	248 216	80%
TOTAL	306 992	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCE:  
LANDUSE: UMMS Resource Mapping Unit from  
1986 color infrared photography  
ROADS: USGS-NHD 1:50,000 DLS  
DRAINAGE: USGS-WBD - MASSGIS Project  
from 1:25,000 manuscripts

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

BELCHERTOWN



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
BERNARDSTON

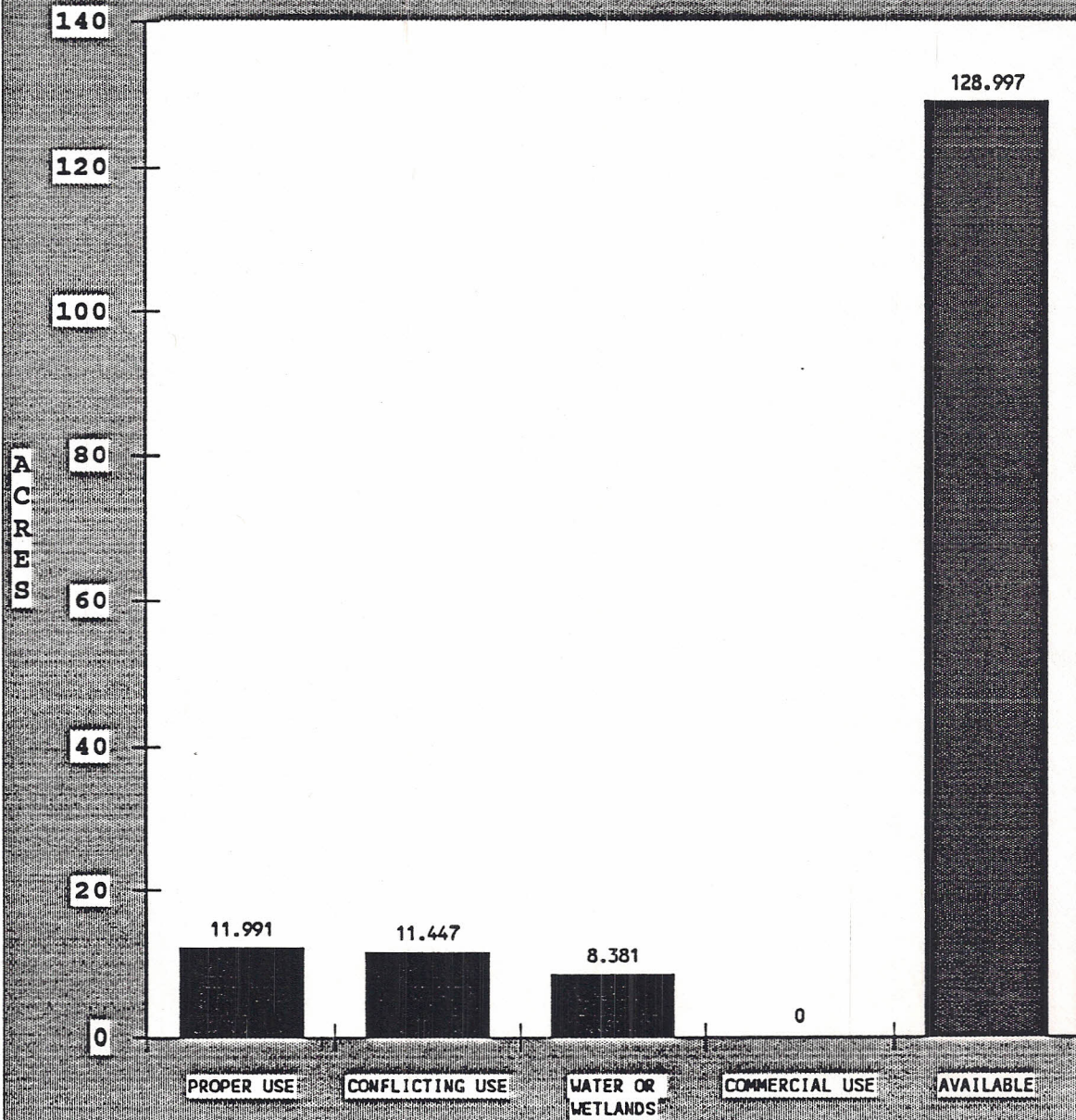
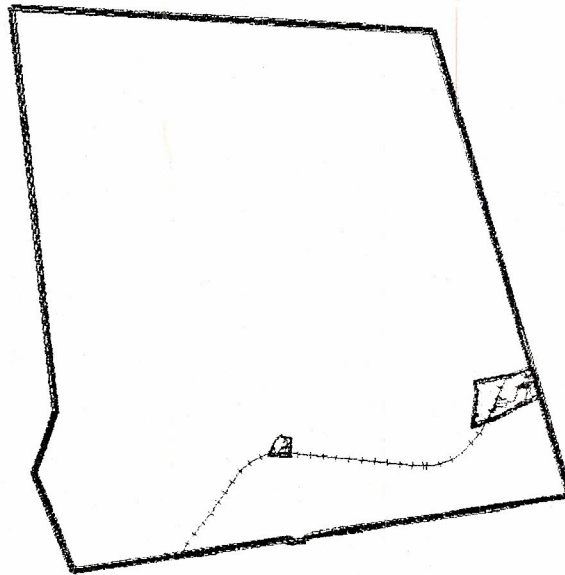


CHART # 4.5








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	BERNARDSTON AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	11 991	7%
CONFLICTING USE	11 447	7%
WATER OR WETLANDS	8 381	5%
AVAILABLE	126 997	81%
TOTAL	160 815	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES:  
LANDUSE: UMASS Resource Mapping Unit from  
1986 color infrared photography  
ROADS: USGS-NOI 1:50,000 MGA  
DRAINAGE: USGS-NOI - Watershed Project  
from 1:25,000 manuscript

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LANDS ZONED AND SUITABLE FOR INDUSTRY

BERNARDSTON



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
CHICOPEE

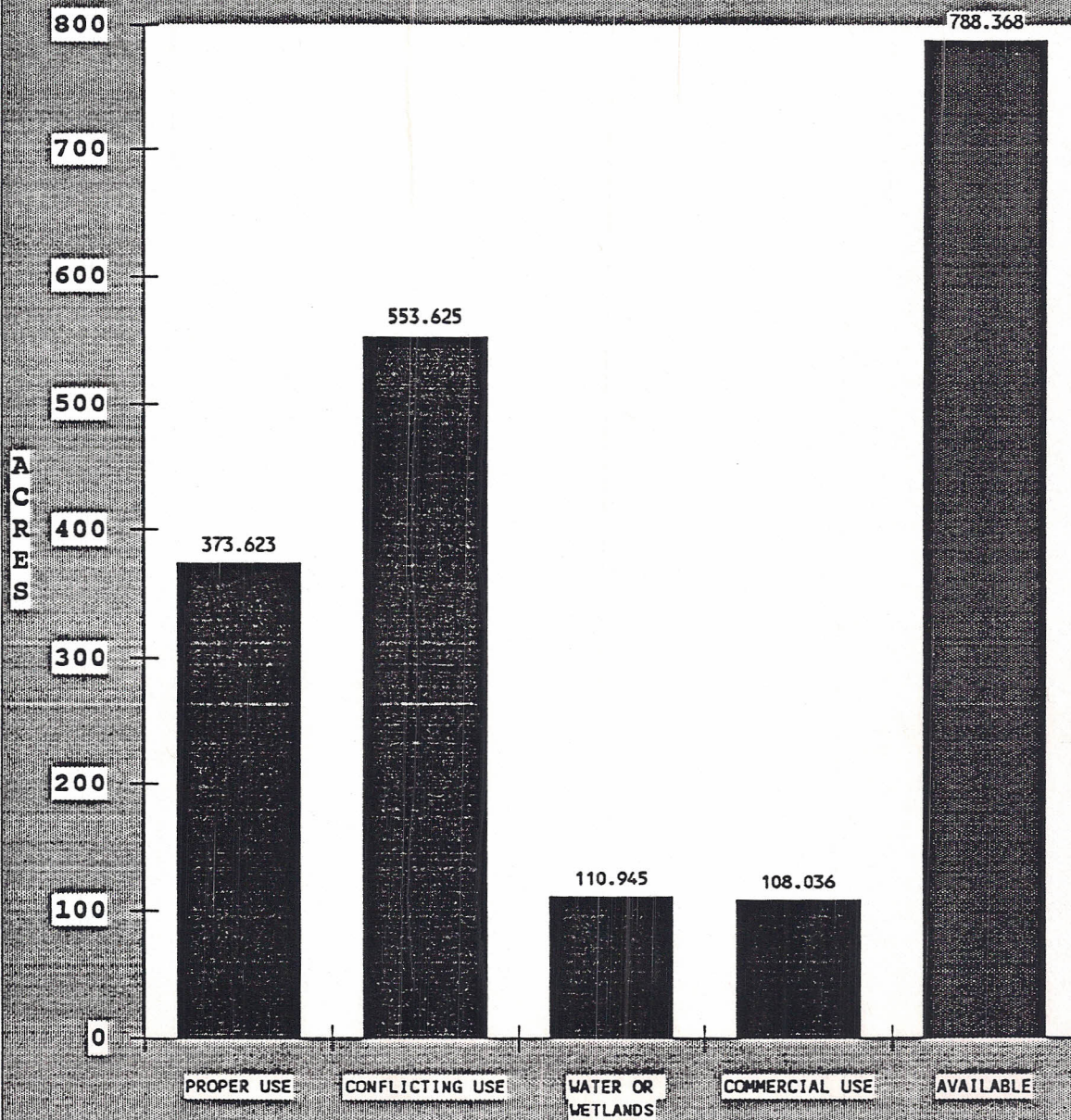
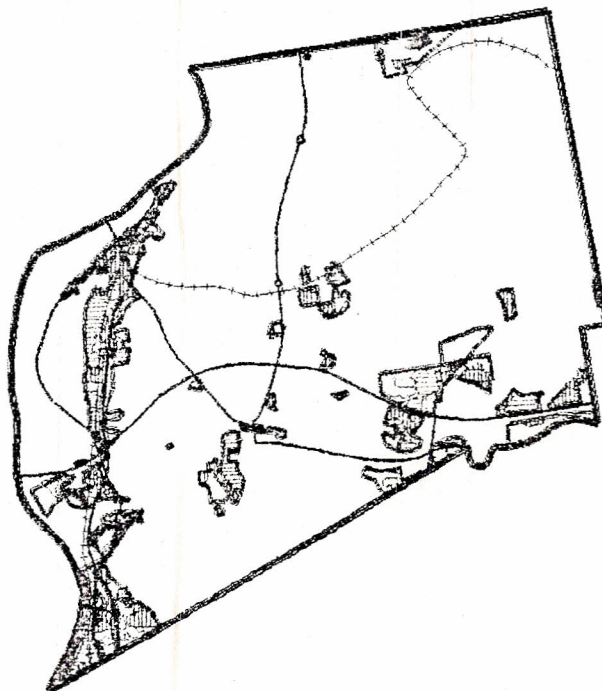


CHART # 4.6








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	CHICOPEE AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	373 623	19%
CONFLICTING USE	553 625	29%
WATER OR WETLANDS	119 645	6%
COMMERCIAL USE	103 036	5%
AVAILABLE	788 368	41%
TOTAL	1934 596	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
LANDUSE: UNASIS Resource Mapping Unit from  
1965 color infrared photography  
ROADS: USGS-NOI 1:50,000 DGS  
DRAINAGE: USGS-NOI - Watershed Project  
from 1:50,000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

CHICOPEE



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
DEERFIELD

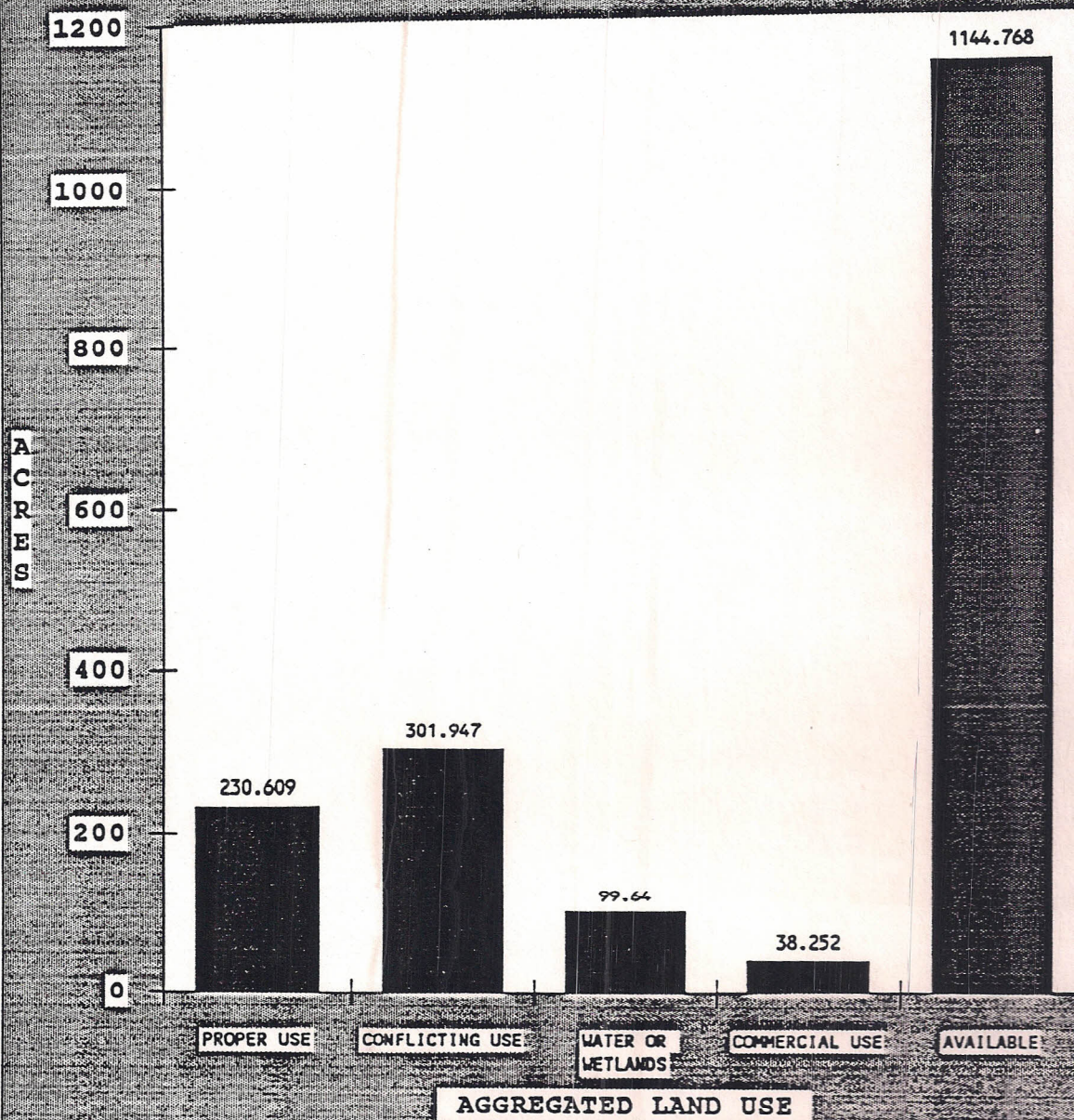
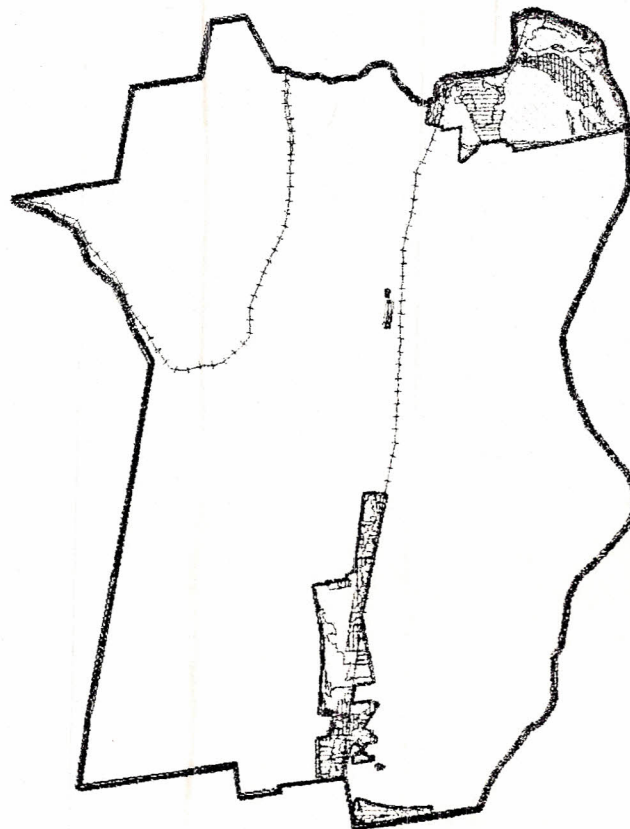


CHART # 4.7








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	DEERFIELD AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	230 609	13%
CONFLICTING USE	301 947	17%
WATER OR WETLANDS	99 640	5%
COMMERCIAL USE	38 252	2%
AVAILABLE	1144 768	63%
TOTAL	1815 213	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
LAND USE: UMMS Resource Mapping Unit from  
1966 color infrared photography  
ROADS: USGS-NHD 1:50,000 1960s  
DRAINAGE: USGS-RD - MassGIS Project  
from 1:25000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

DEERFIELD



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**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
EASTHAMPTON**

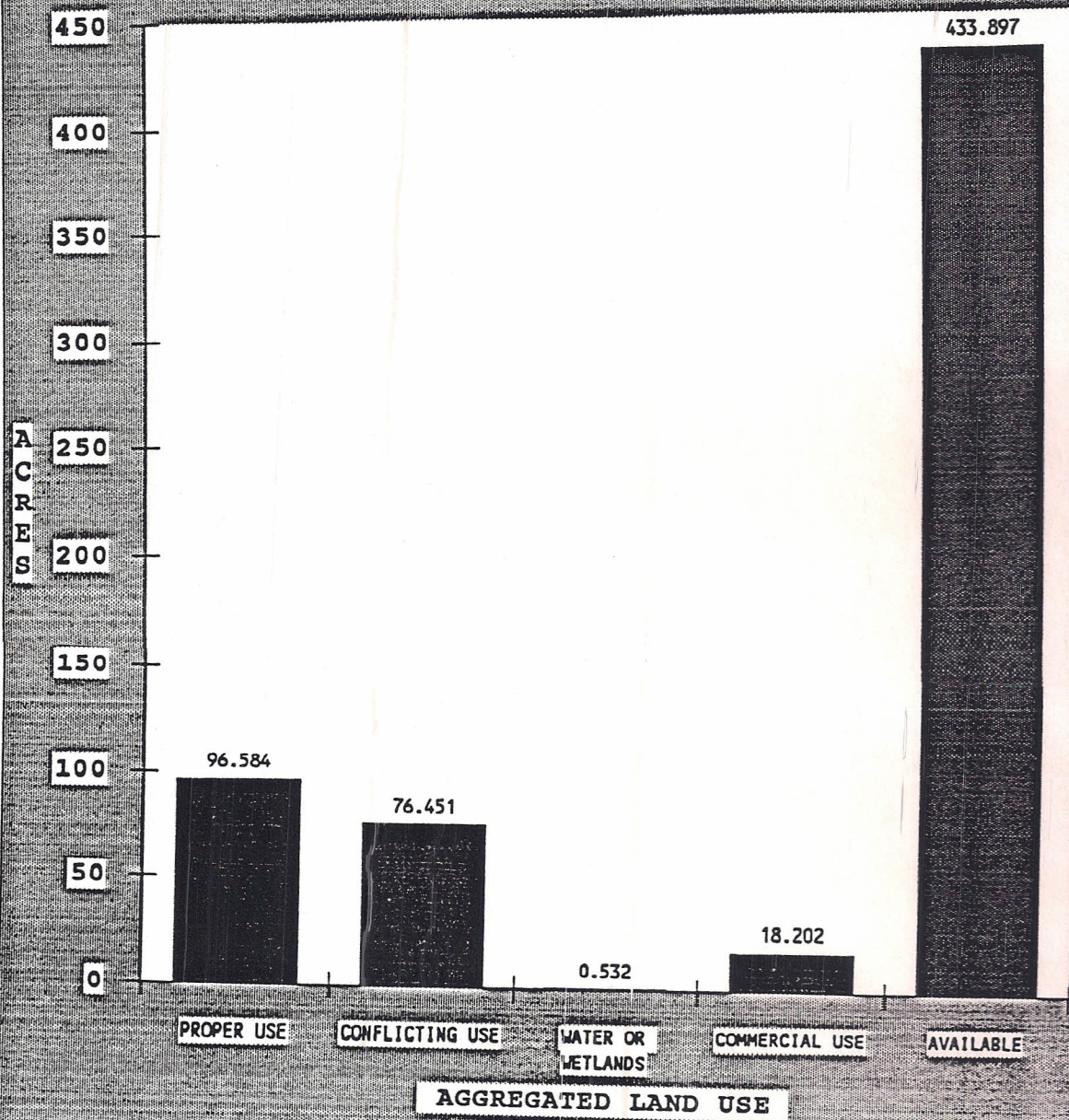
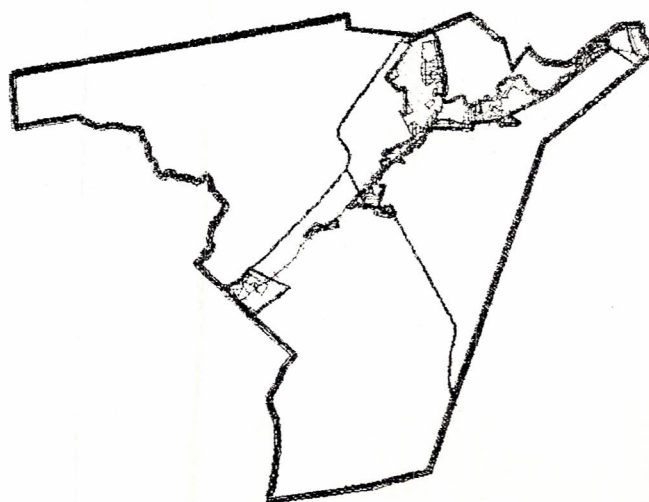


CHART # 4.8








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	EASTHAMPTON AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	96 584	15%
CONFLICTING USE	76 451	13%
WATER OR WETLANDS	0 532	0%
COMMERCIAL USE	18 202	3%
AVAILABLE	433 897	69%
TOTAL	625 665	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES:  
LANDUSE: UNAS Resource Mapping Unit from  
1965 color infrared photography  
BOUND: USGS-NOI 1:50,000 DGS  
DRAINAGE: USGS-NOI - MassGIS Project  
from 1:50,000 manuscripts

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EASTHAMPTON



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**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
EAST LONGMEADOW**

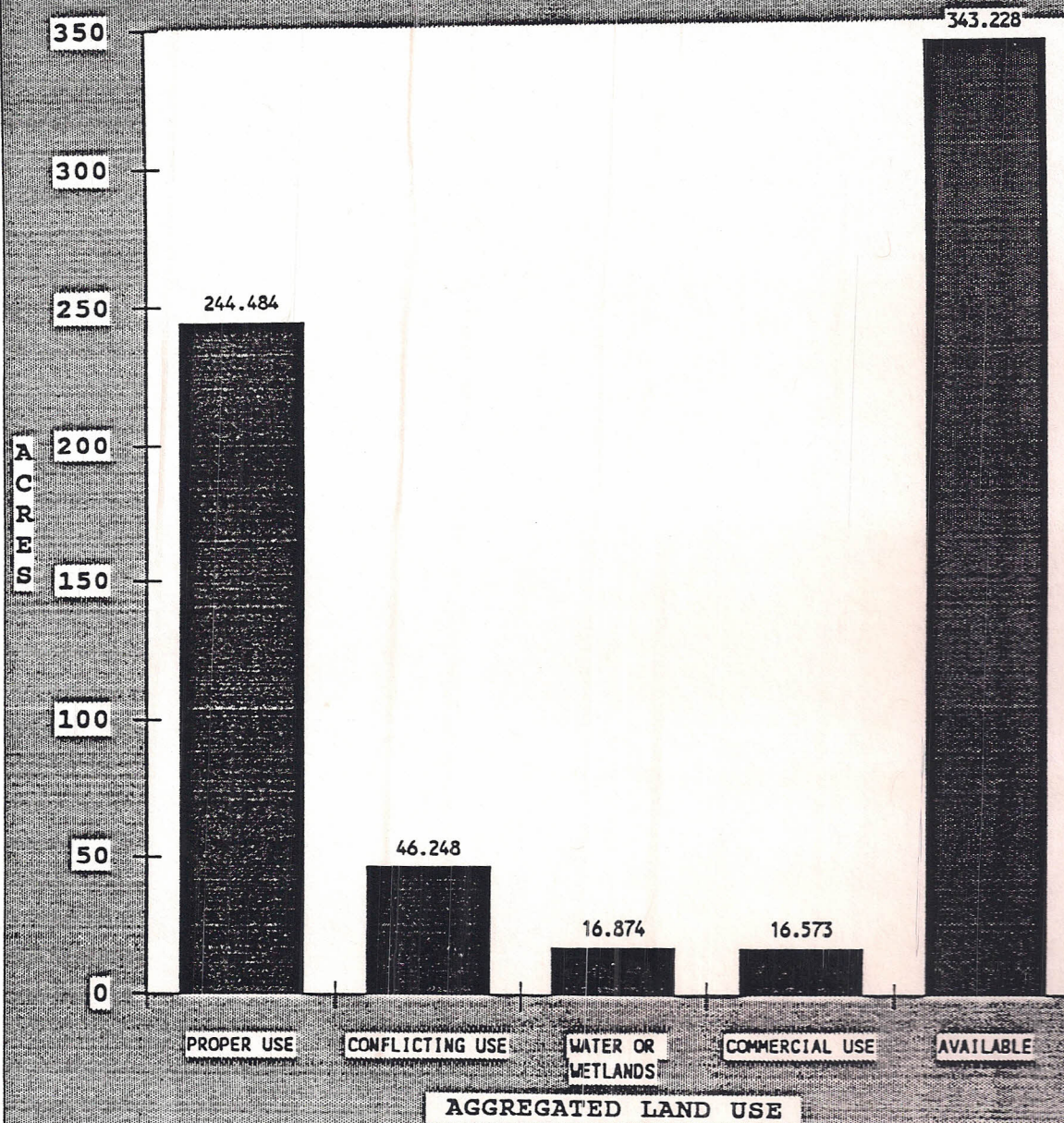
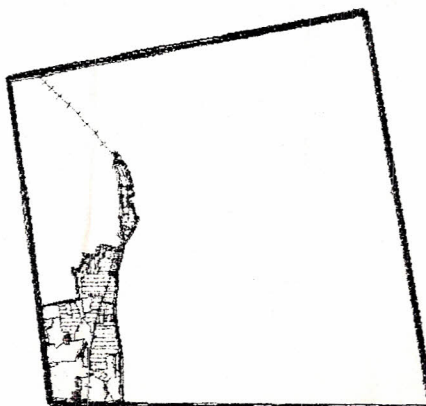


CHART # 4.9








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	EAST LONGMEADOW AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	244 484	37%
CONFLICTING USE	46 248	7%
WATER OR WETLANDS	18 374	3%
COMMERCIAL USE	16 573	2%
AVAILABLE	343 228	51%
	667 467	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES:  
LANDUSE: UMMS Resource Mapping Unit from  
USGS color infrared photography  
ROADS: UMMS-UMMS 1:25000 Data  
DRAINAGE: USGS FPD - UMMS Project  
from 1:25000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

EAST LONGMEADOW



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
GRANBY

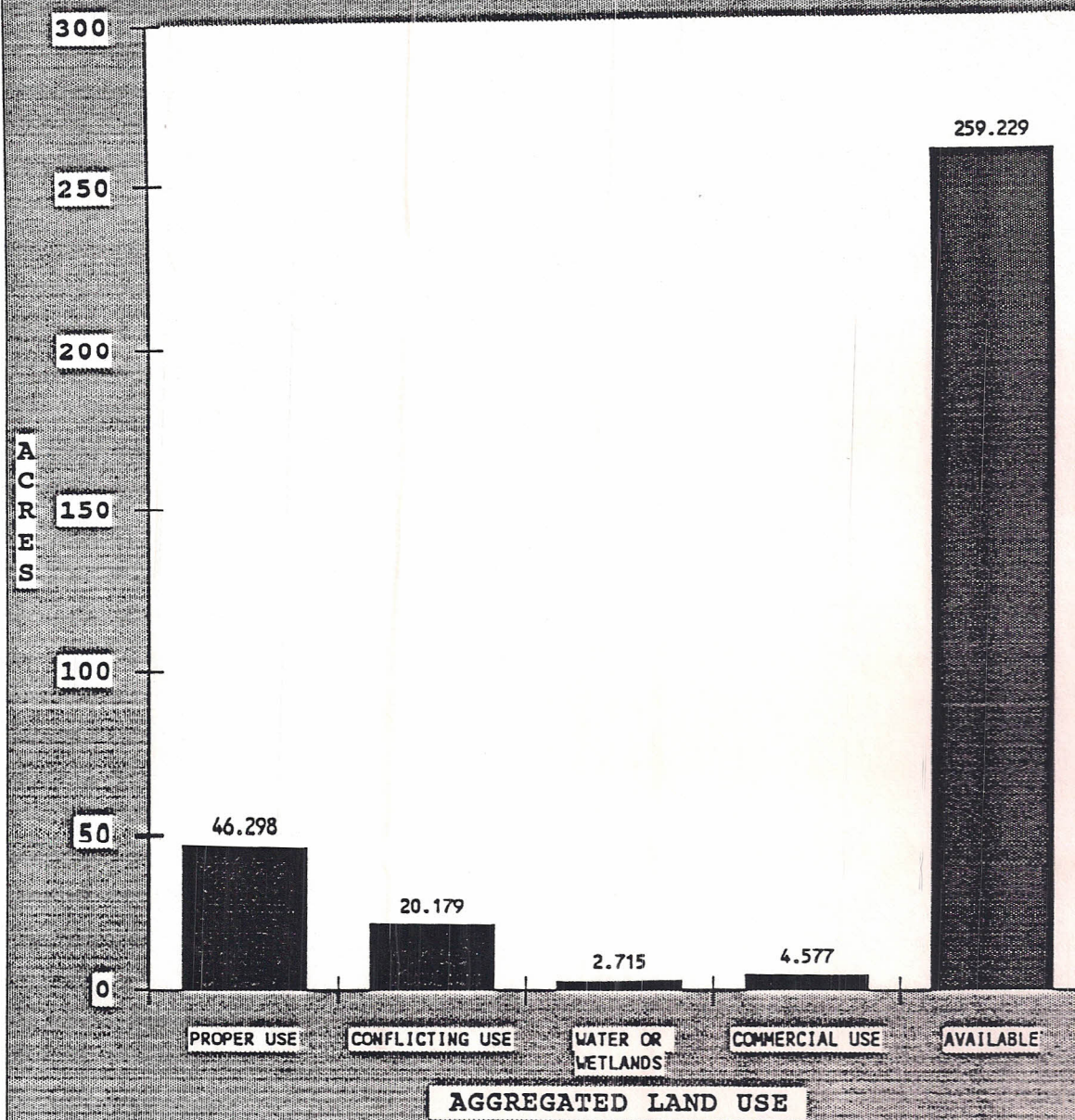
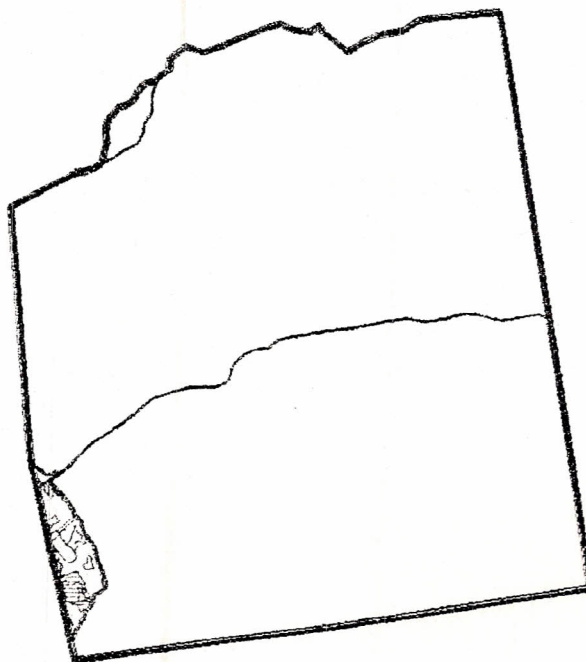


CHART # 4.10








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

GRANBY		
AGGREGATED LAND USE	AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	46 295	14%
CONFLICTING USE	20 179	6%
WATER OR WETLANDS	2 712	1%
COMMERCIAL USE	1 577	2%
AVAILABLE	259 229	78%
TOTAL	332 992	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES:  
LANDUSE: UNASIS Resource Mapping Unit from  
1986 color infrared photography  
BOUND: 1963-1964 1:25000 DGS  
DRAINAGE: 1963-1964 - 1:25000 Project  
from 1:25000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

GRANBY



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**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
GREENFIELD**

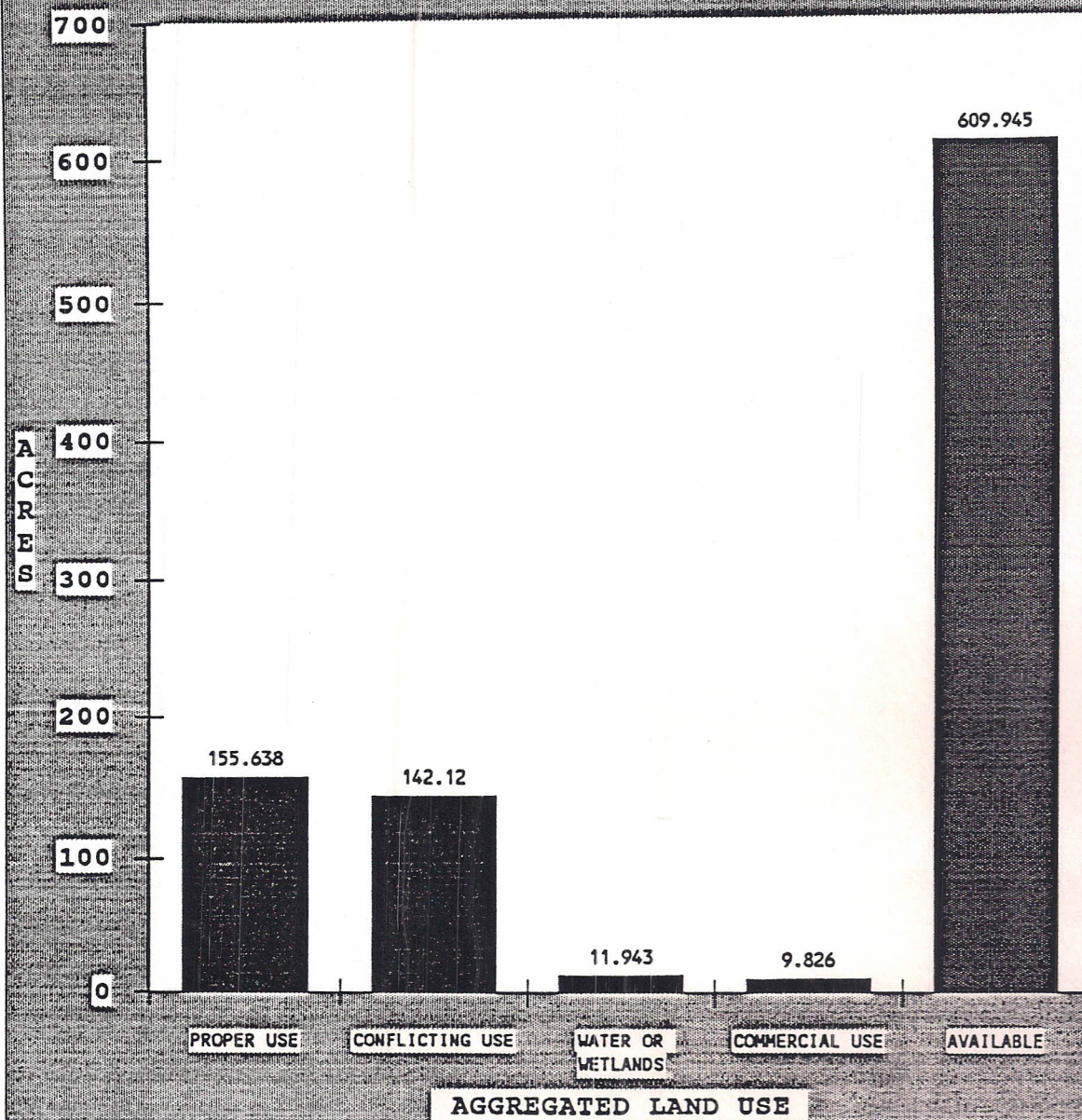
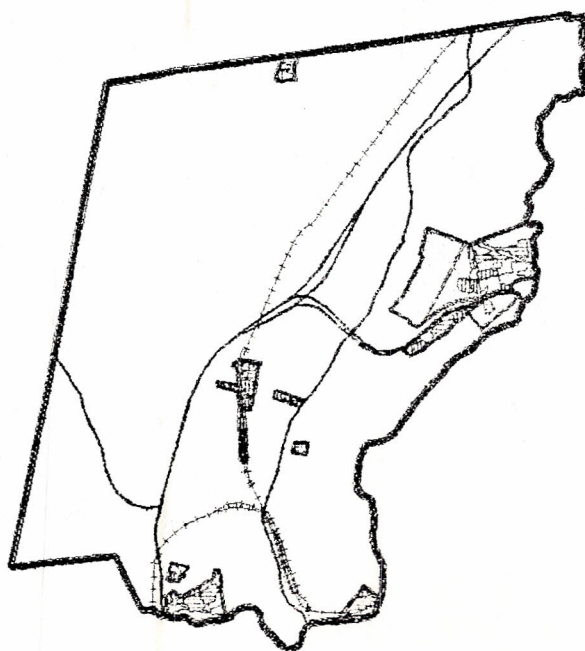


CHART # 4.11








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	GREENFIELD AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	155 838	17%
CONFLICTING USE	142 120	15%
WATER OR WETLANDS	11 943	1%
COMMERCIAL USE	9 826	1%
AVAILABLE	609 945	66%
TOTAL	929 476	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCE:  
LANDUSE: UMMS Resource Mapping Unit from  
1986 color infrared photography  
BOUND: USGS-NHD 1:50,000 DGS  
DRAINAGE: USGS-FRD - 1:50,000 Project  
from 1:25,000 manuscripts

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

GREENFIELD



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
HADLEY

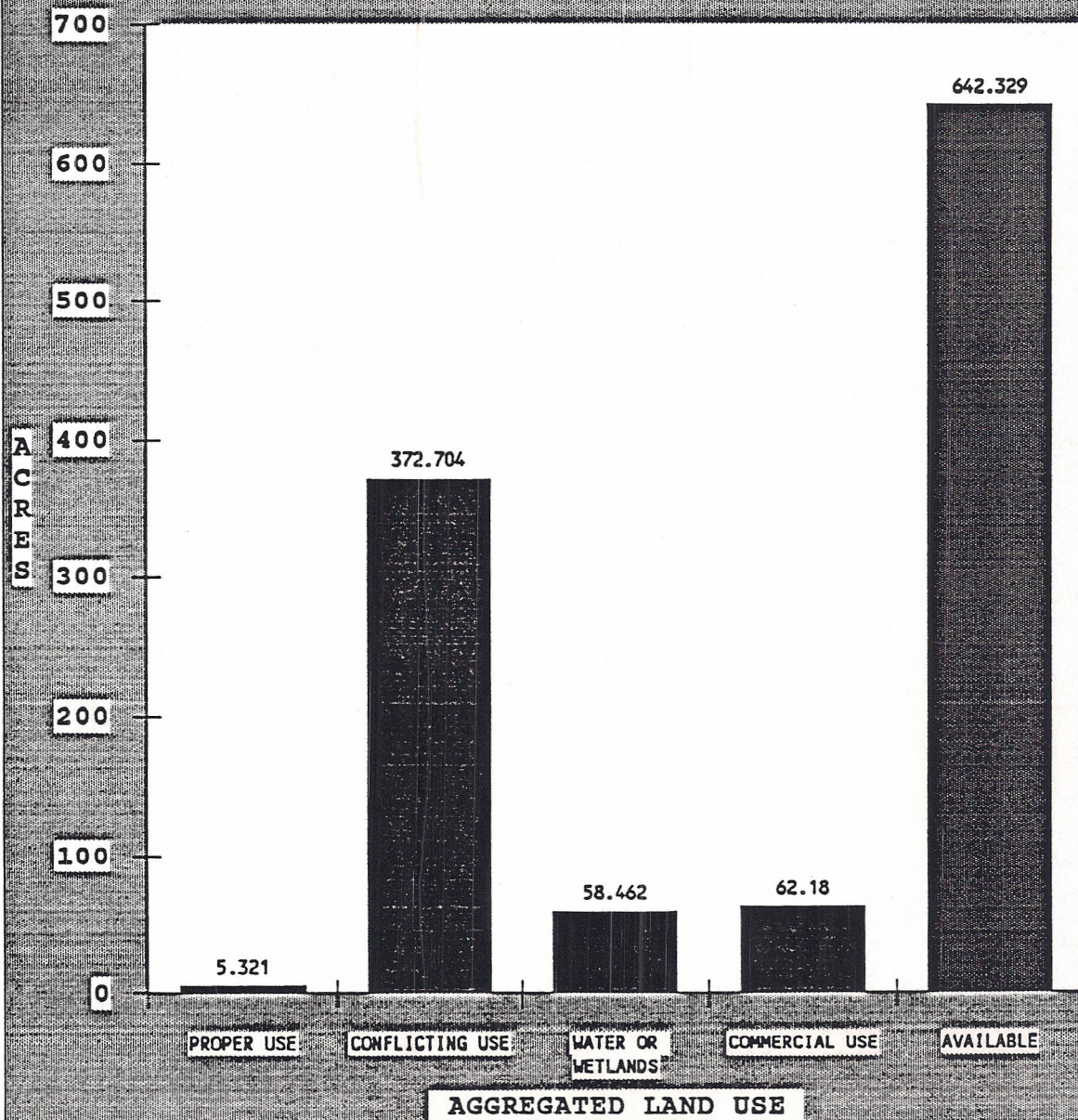
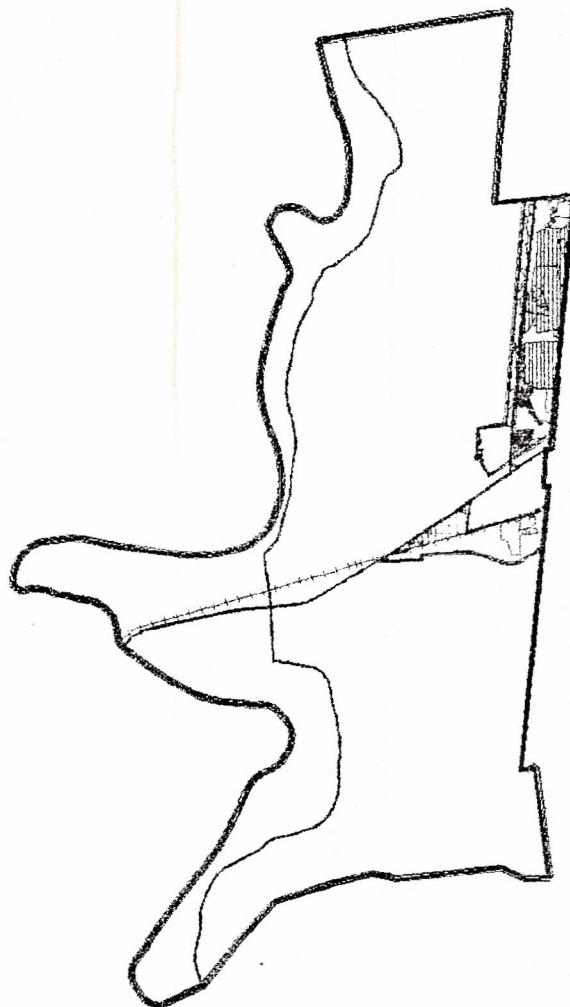


CHART # 4.12








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

HADLEY		
AGGREGATED LAND USE	AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	5 321	1%
CONFLICTING USE	372 704	33%
WATER OR WETLANDS	58 462	5%
COMMERCIAL USE	62 180	5%
AVAILABLE	642 329	56%
TOTAL	1140 997	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES:  
LANDUSE: UMASS Resource Mapping Unit from 1986 color infrared photography  
ROADS: USGS-AND 1:50,000 DRS  
DRAINAGE: USGS-FED - MORGAN Project from 1950-60 manuscripts

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

HADLEY



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
HAMPTON

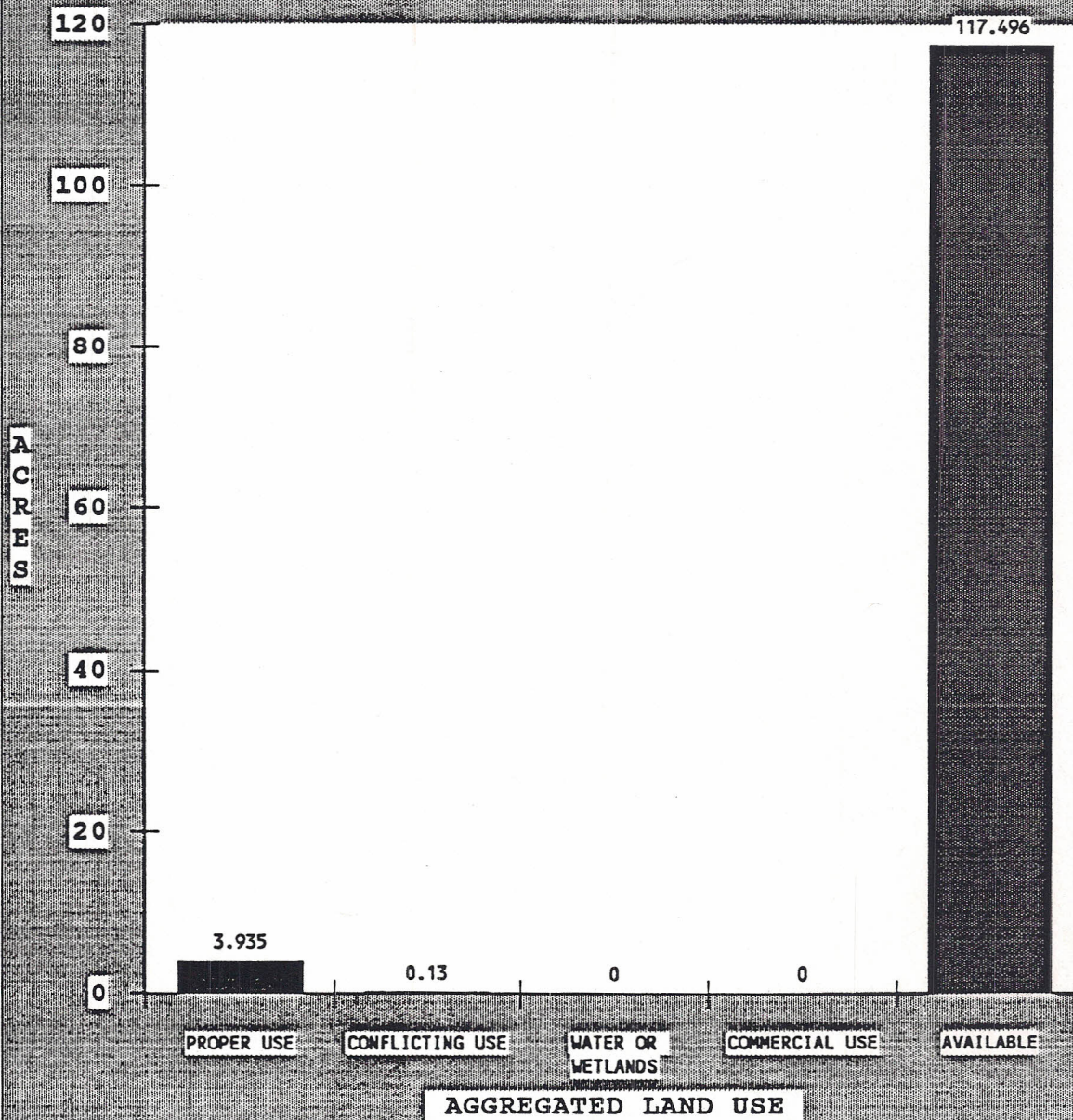
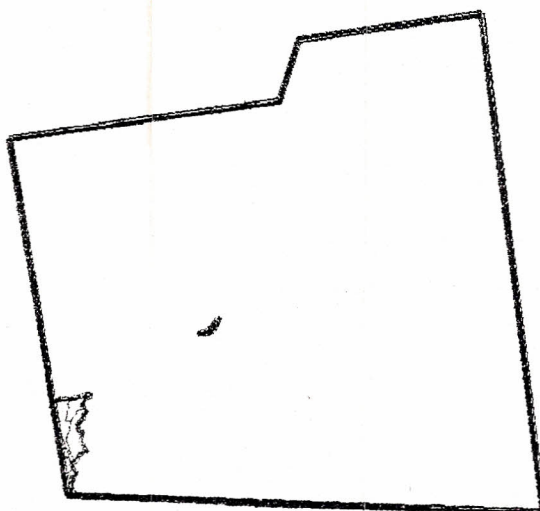


CHART # 4.13








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	HAMPDEN AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	3 935	3%
CONFLICTING USE	0 130	0%
AVAILABLE	117 496	97%
TOTAL	121 561	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
 LANGUAGE: UM&S Resource Mapping Unit from  
 1985 color infrared photography  
 ROADS: USGS-ND 1:50,000 DGS  
 DRAINAGE: USGS-WD - MassGIS Project  
 from 1:25,000 manuscripts

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 LANDS ZONED AND SUITABLE FOR INDUSTRY

HAMPTON



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
HATFIELD

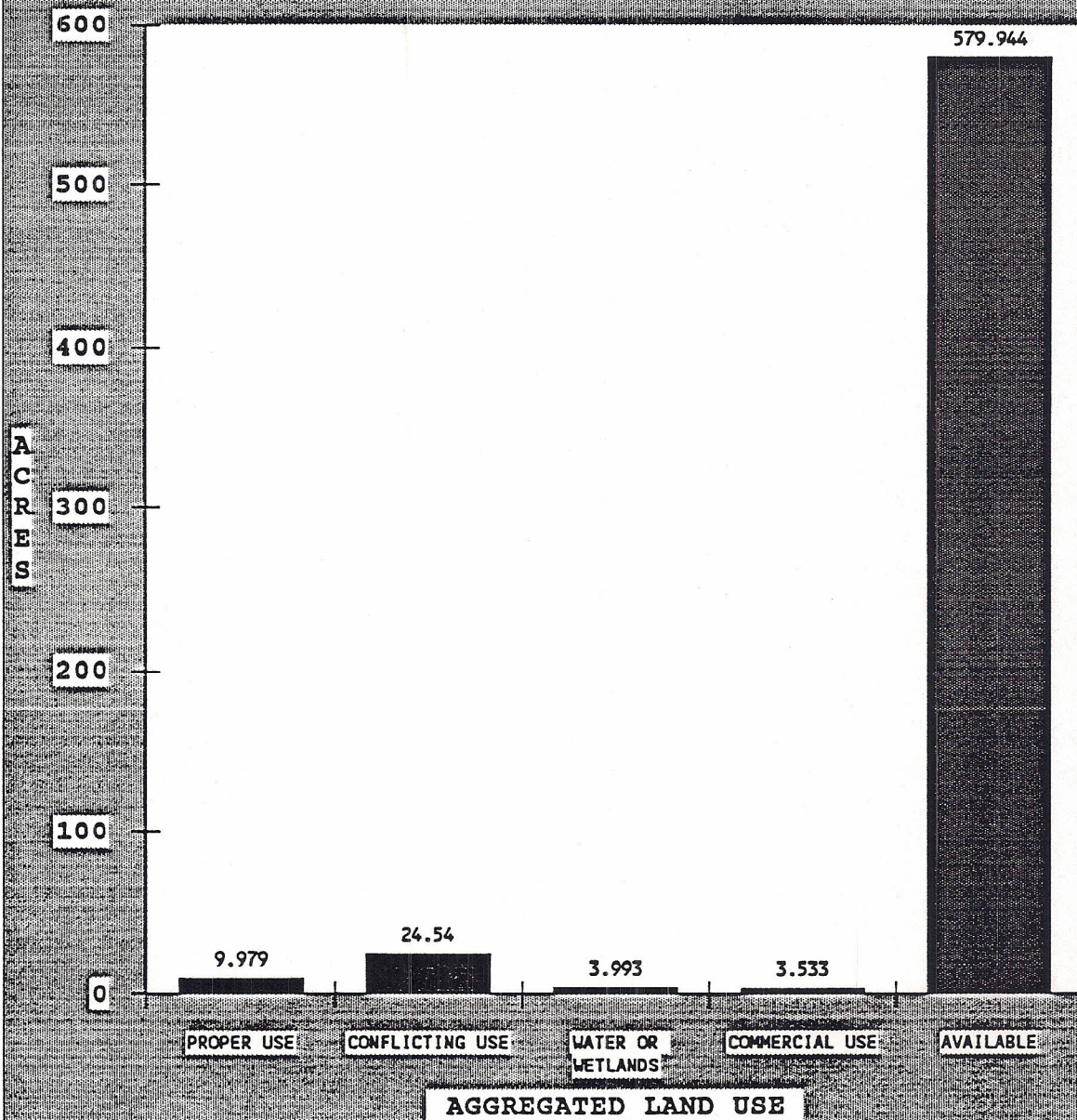
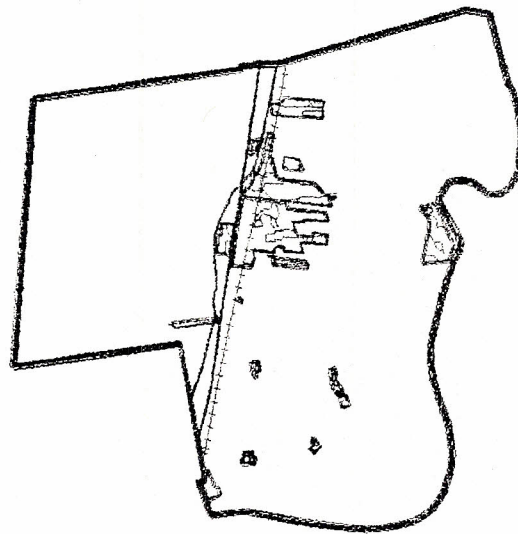


CHART # 4.14








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

HATFIELD		
AGGREGATED LAND USE	AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	9 979	2%
CONFLICTING USE	24 540	3%
WATER OR WETLANDS	3 993	1%
COMMERCIAL USE	3 533	1%
AVAILABLE	579 944	93%
TOTAL	621 991	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES:  
LANDUSE: UMASH Resource Mapping Unit from  
1965 color infrared photography  
ROADS: USGS-ND 1:50,000 DLS  
DRAINAGE: USGS-WFD - MassGIS Project  
from 195,000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

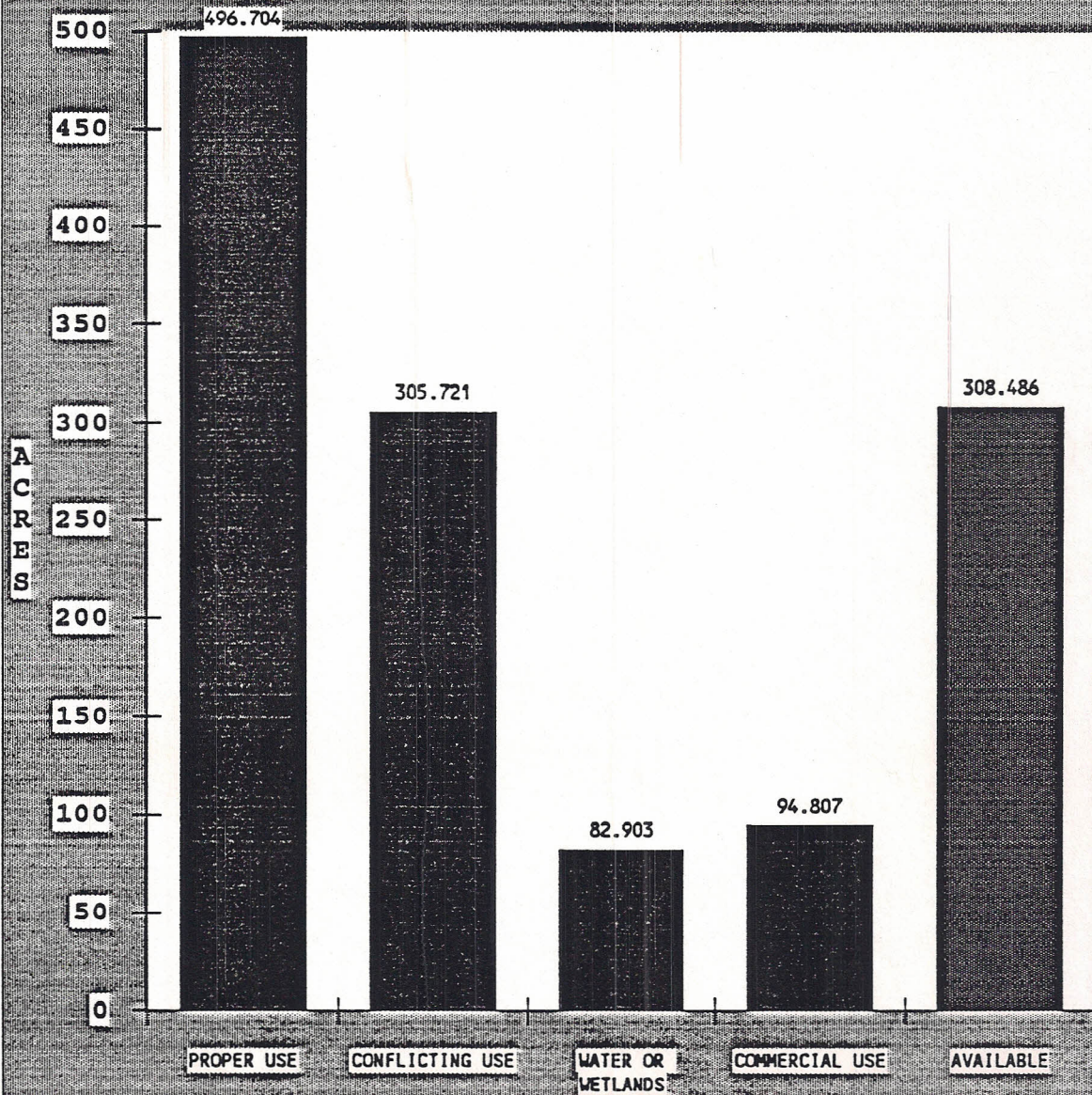
HATFIELD



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
HOLYOKE



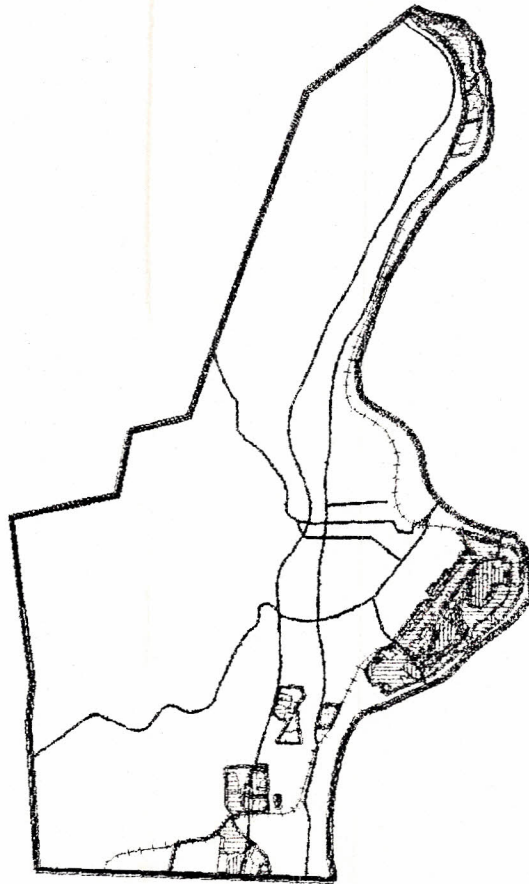
AGGREGATED LAND USE

CHART # 4.15








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	HOLYOKE AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	498 704	39%
CONFLICTING USE	305 721	24%
WATER OR WETLANDS	22 903	5%
COMMERCIAL USE	94 807	7%
AVAILABLE	308 466	24%
TOTAL	1268 620	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCE:  
LANDUSE: UNAS Resource Mapping Unit from  
1965 color infrared photography  
ROADS: 1:25000 and 1:50000 files  
DRAINAGE: 1:25000 - 1:50000 files  
from 125,000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

HOLYOKE



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
LUDLOW

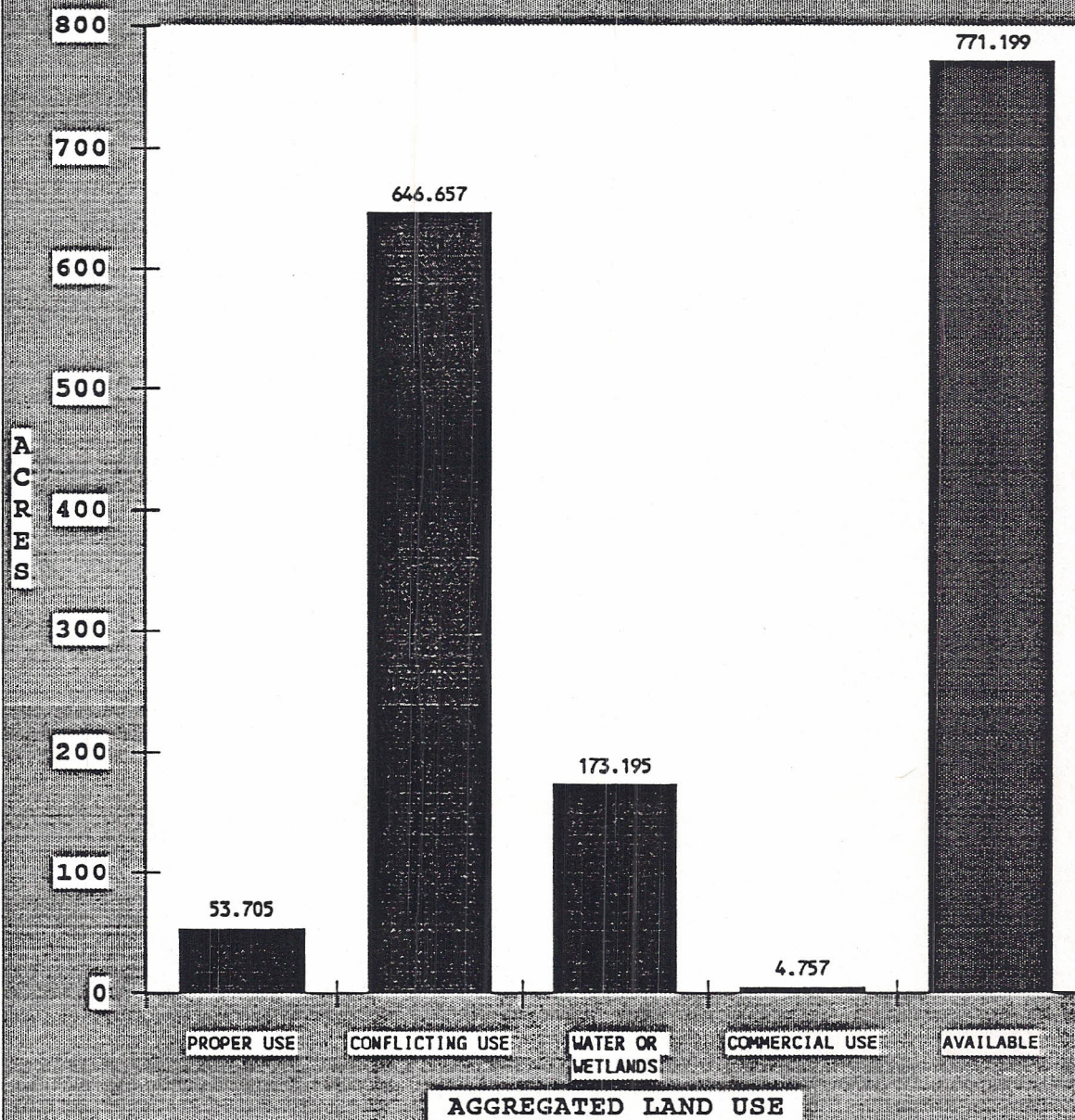
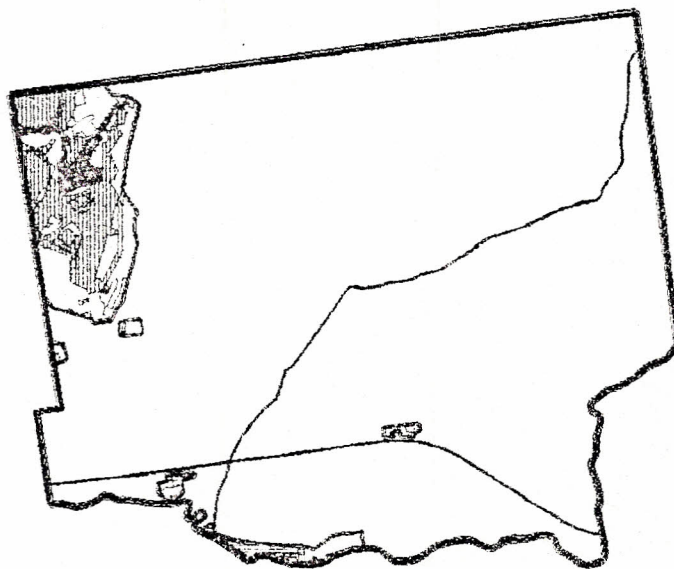


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



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

LUDLOW		
AGGREGATED LAND USE	AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	53 705	4%
CONFLICTING USE	646 657	59%
WATER OR WETLANDS	173 195	16%
COMMERCIAL USE	4 757	1%
AVAILABLE	771 199	46%
TOTAL	1049 510	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES:  
LANDUSE: UMMS Resource Mapping Unit from 1965 color infrared photography  
ROADS: USGS-ND 1:50,000 DGS  
DRAINAGE: USGS-WFO - MasGIS Project from 125,000 manuscripts

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LUDLOW



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**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
MONTAGUE**

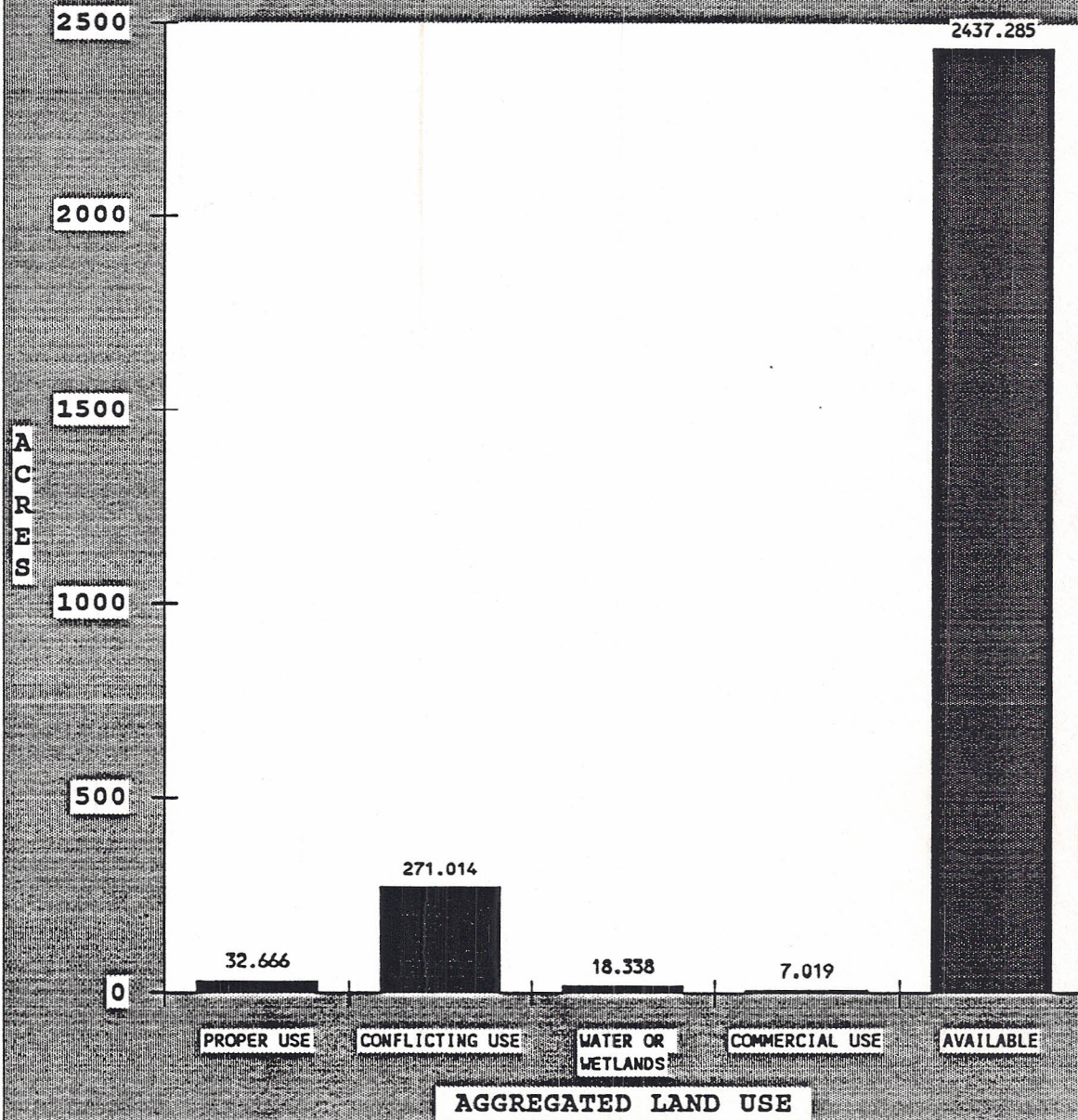


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


# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	MONTAGUE AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	32.686	1%
CONFLICTING USE	271.814	10%
WATER OR WETLANDS	13.338	1%
COMMERCIAL USE	7.819	0%
AVAILABLE	2437.285	88%
TOTAL	2786.921	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES  
LANDUSE: UMMS Resource Mapping Unit from  
1985 color infrared photography  
BOUND: USGS-AND 1:250,000 DGS  
DRAINAGE: USGS-WBD - Montague Project  
from 1:25,000 manuscripts

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MONTAGUE



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
NORTHAMPTON

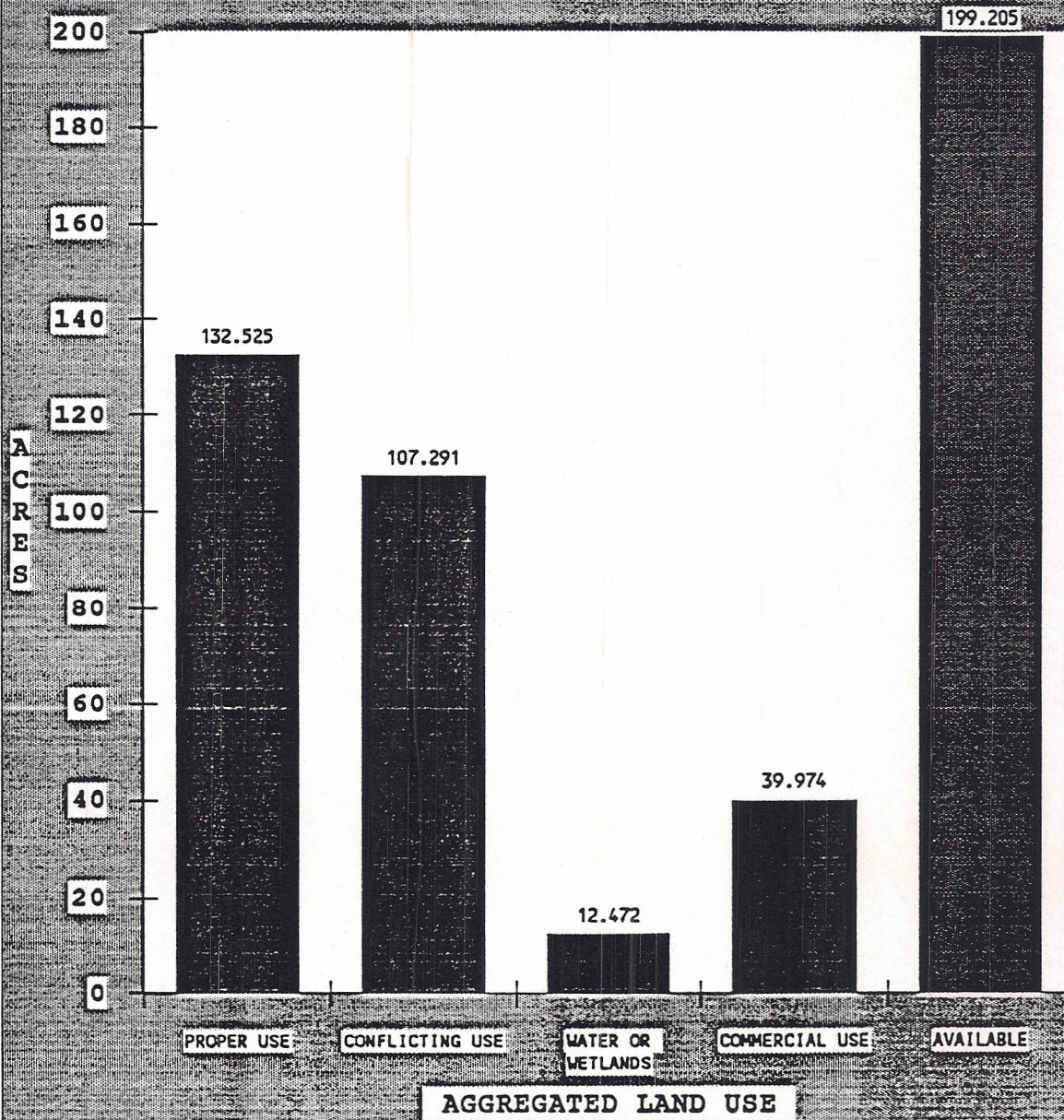
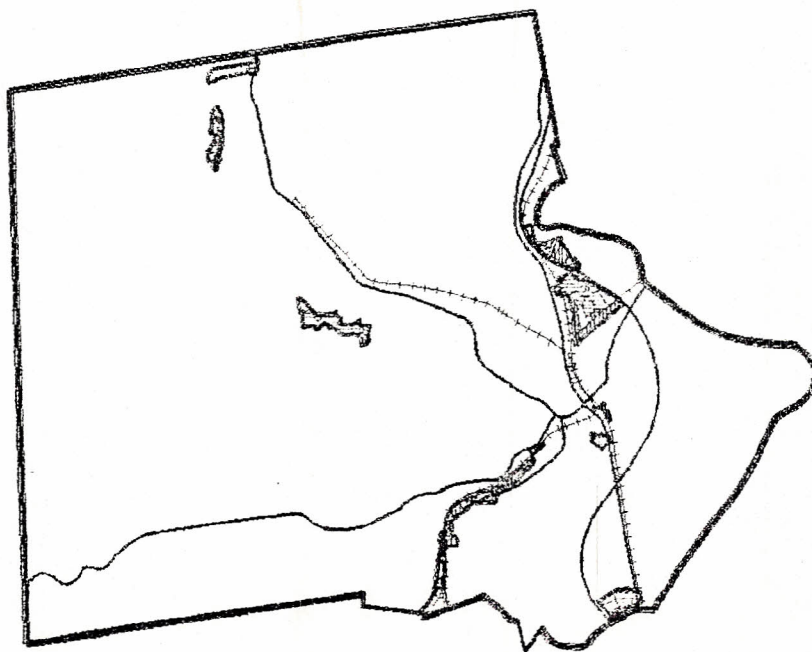


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


# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	NORTHAMPTON AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	132 525	27%
CONFLICTING USE	107 291	22%
WATER OR WETLANDS	12 472	2%
COMMERCIAL USE	39 974	8%
AVAILABLE	199 205	41%
TOTAL	491 460	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES:  
LANDS: UNASS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS-ND 1:50,000 DGS  
DRAINAGE: USGS-VTD - MassGIS Project  
from 125,000 manuscripts

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NORTHAMPTON



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
SOUTHAMPTON

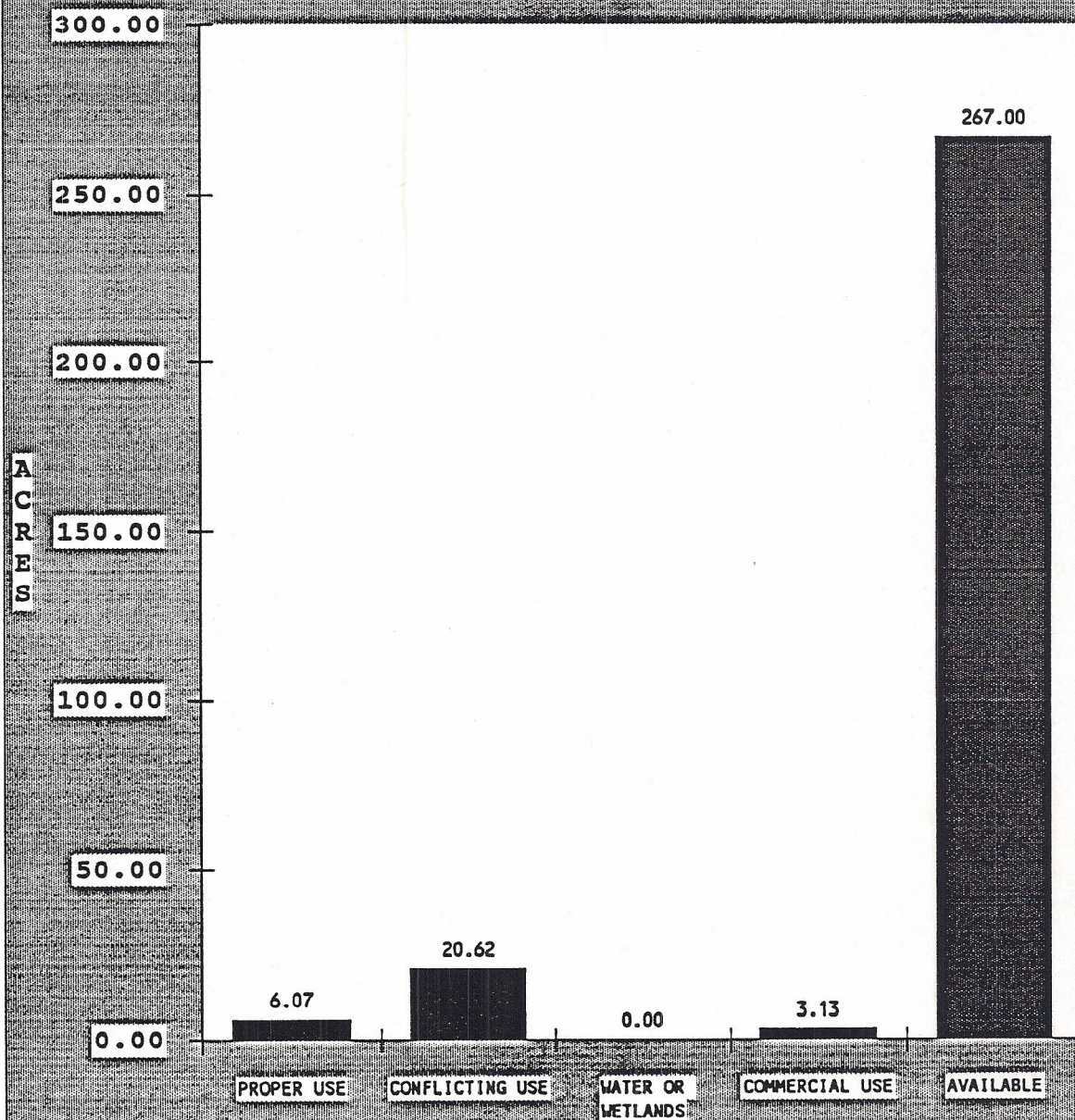
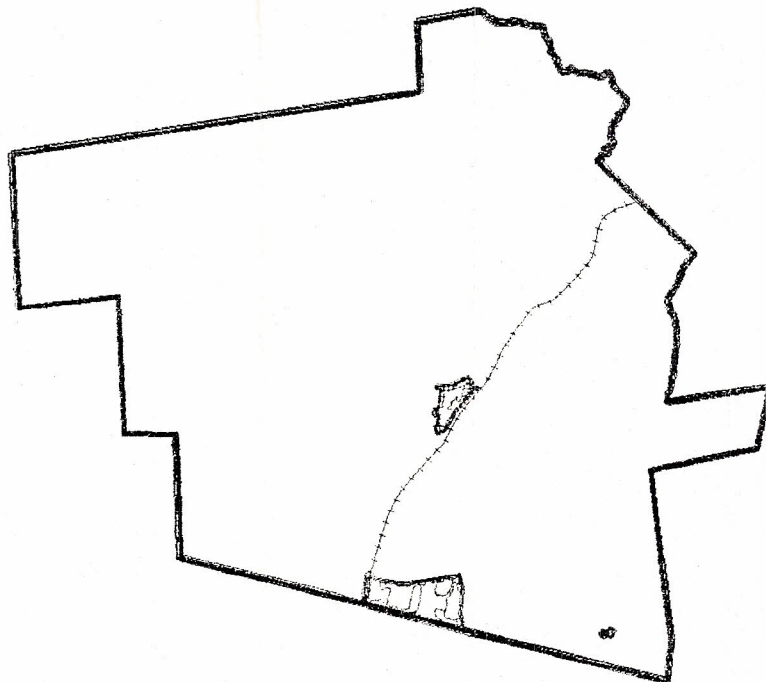


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



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	SOUTHAMPTON AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	6 071	2%
CONFLICTING USE	20 615	7%
COMMERCIAL USE	3 125	1%
AVAILABLE	266 998	90%
TOTAL	296 807	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCE  
LANDUSE: UNAS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS-ND 1:100,000 DLG  
DRAINAGE: USGS-FED - MassGIS Project  
from 125,000 manuscripts

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SOUTHAMPTON



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
SHELburn

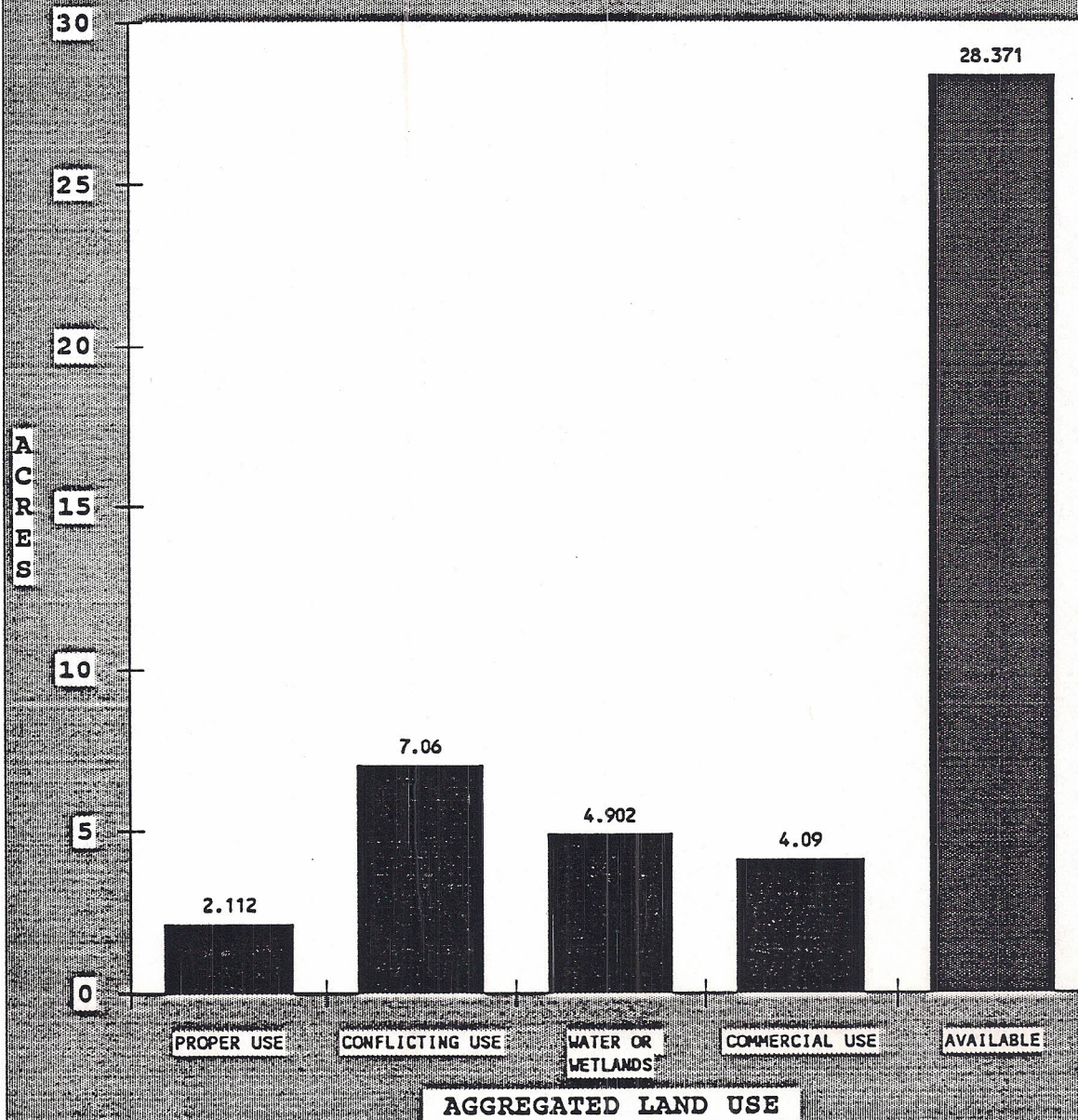
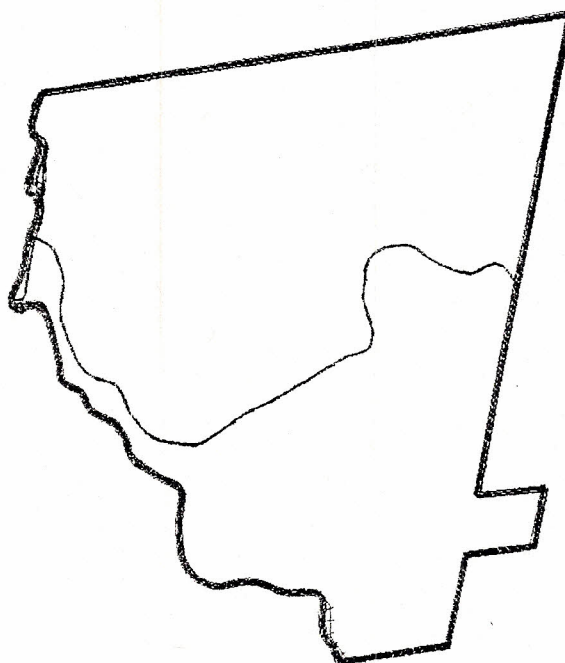


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



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	SHELBURNE AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	2,112	5%
CONFLICTING USE	7,060	15%
WATER OR WETLANDS	4,002	11%
COMMERCIAL USE	4,000	9%
AVAILABLE	20,371	51%
TOTAL	46,537	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES:  
LANDUSE: UNMASS Resource Mapping Unit from  
1986 color infrared photography  
ROADS: USGS-ND 1:100,000 DIG  
DRAINAGE: USGS-WBD - USGS Project  
from 1:25,000 manuscripts

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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
SOUTH HADLEY

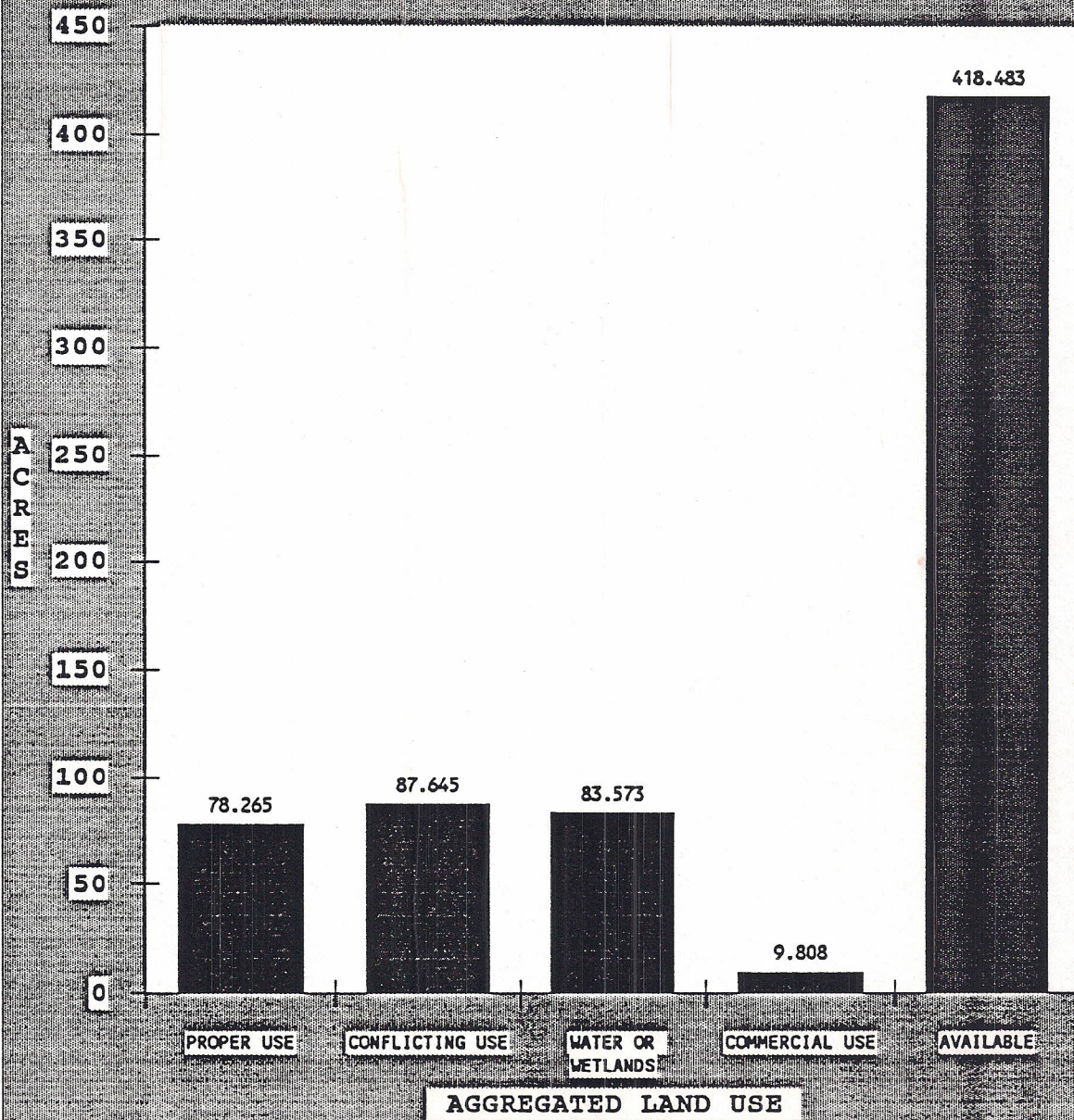
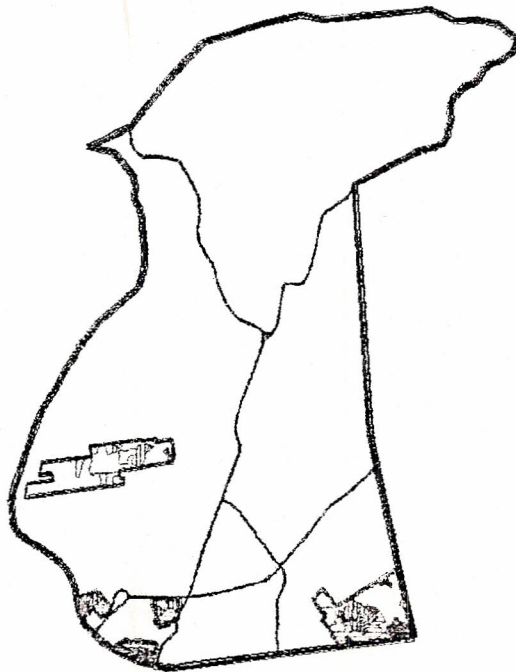


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



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	SOUTH HADLEY AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	78 285	12%
CONFLICTING USE	87 645	13%
WATER OR WETLANDS	83 573	12%
COMMERCIAL USE	9 808	1%
AVAILABLE	418 489	62%
TOTAL	677 770	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
LANDUSE: UMASS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS-AMD 1:50000 DGS  
DRAINAGE: USGS-FED - MASSGIS Project  
from 1:25000 manuscripts

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SOUTH HADLEY



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
SOUTHWICK

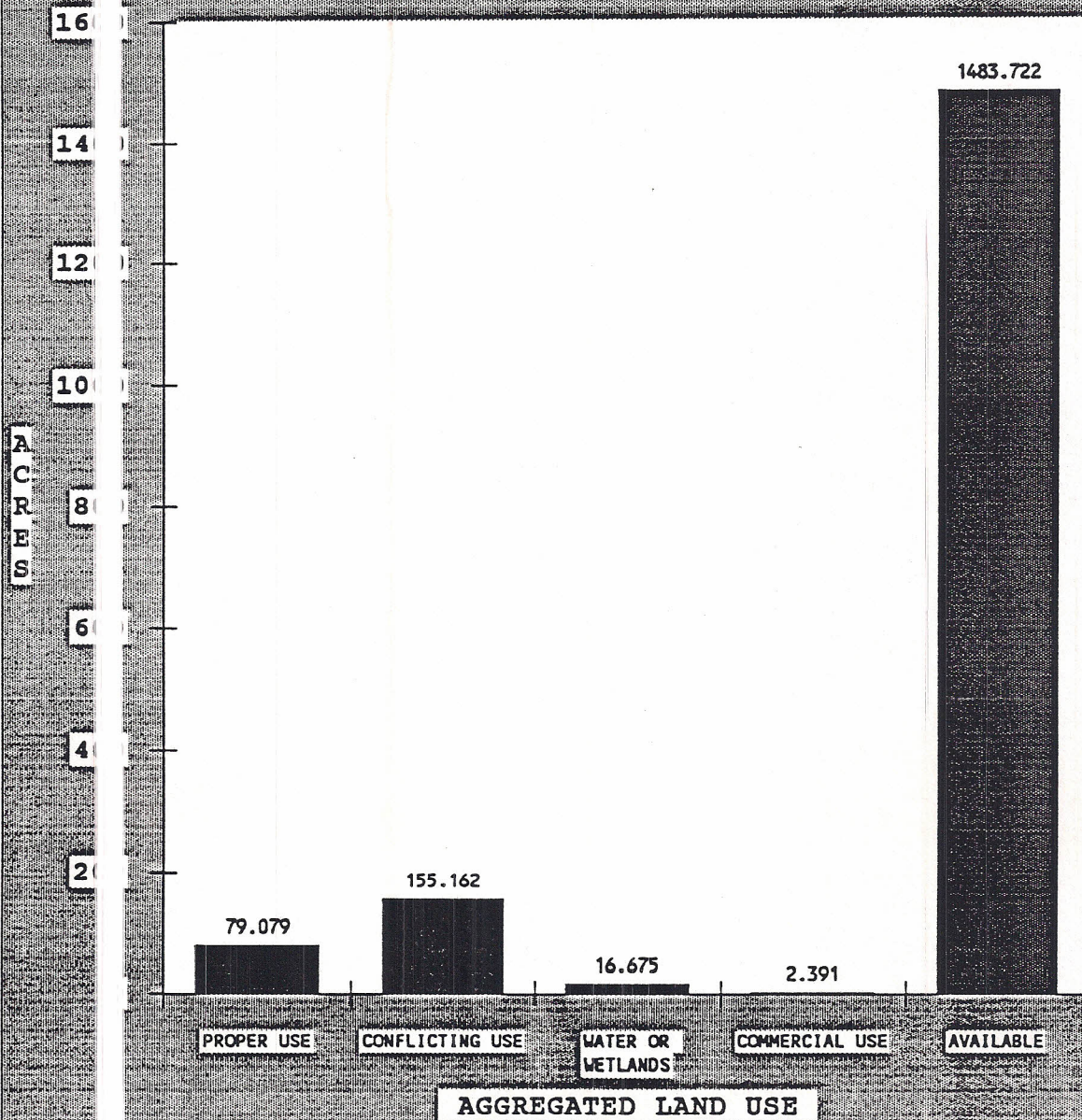
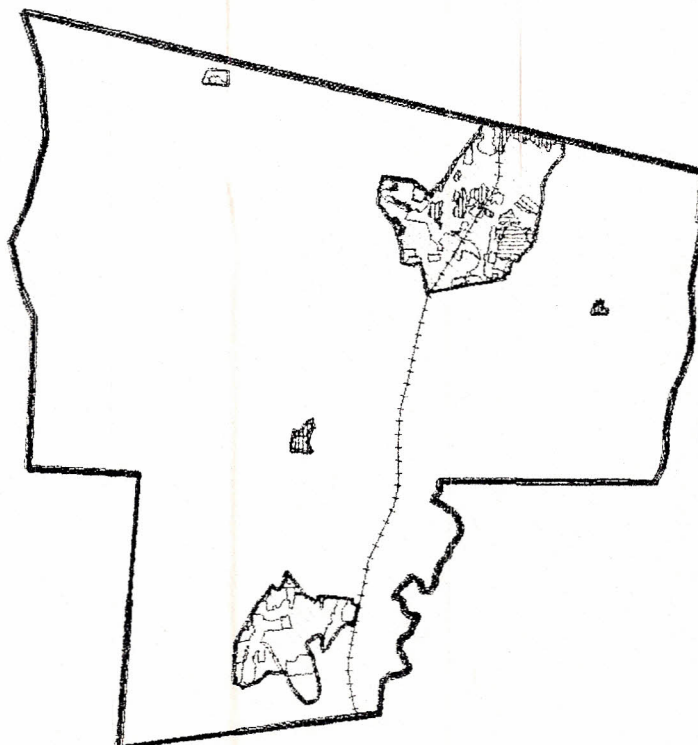


CHART # 4.22



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	SOUTHWICK AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	79 879	5%
CONFLICTING USE	155 162	9%
WATER OR WETLANDS	16 675	1%
COMMERCIAL USE	2 391	0%
AVAILABLE	1483 722	85%
TOTAL	1737 032	100%



- LEGEND
- PROPER USE / INDUSTRIAL USE
  - CONFLICTING USE (RESIDENTIAL ETC.)
  - WATER OR WETLANDS
  - COMMERCIAL
  - AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES:  
LANDUSE: UNL&E Resource Mapping Unit from 1985 color infrared photography  
ROADS: USGS-RMD LANDUSE REG.  
DRAINAGE: USGS-RMD - MASSGIS Project from 1:25,000 manuscripts

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SOUTHWICK



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
SPRINGFIELD

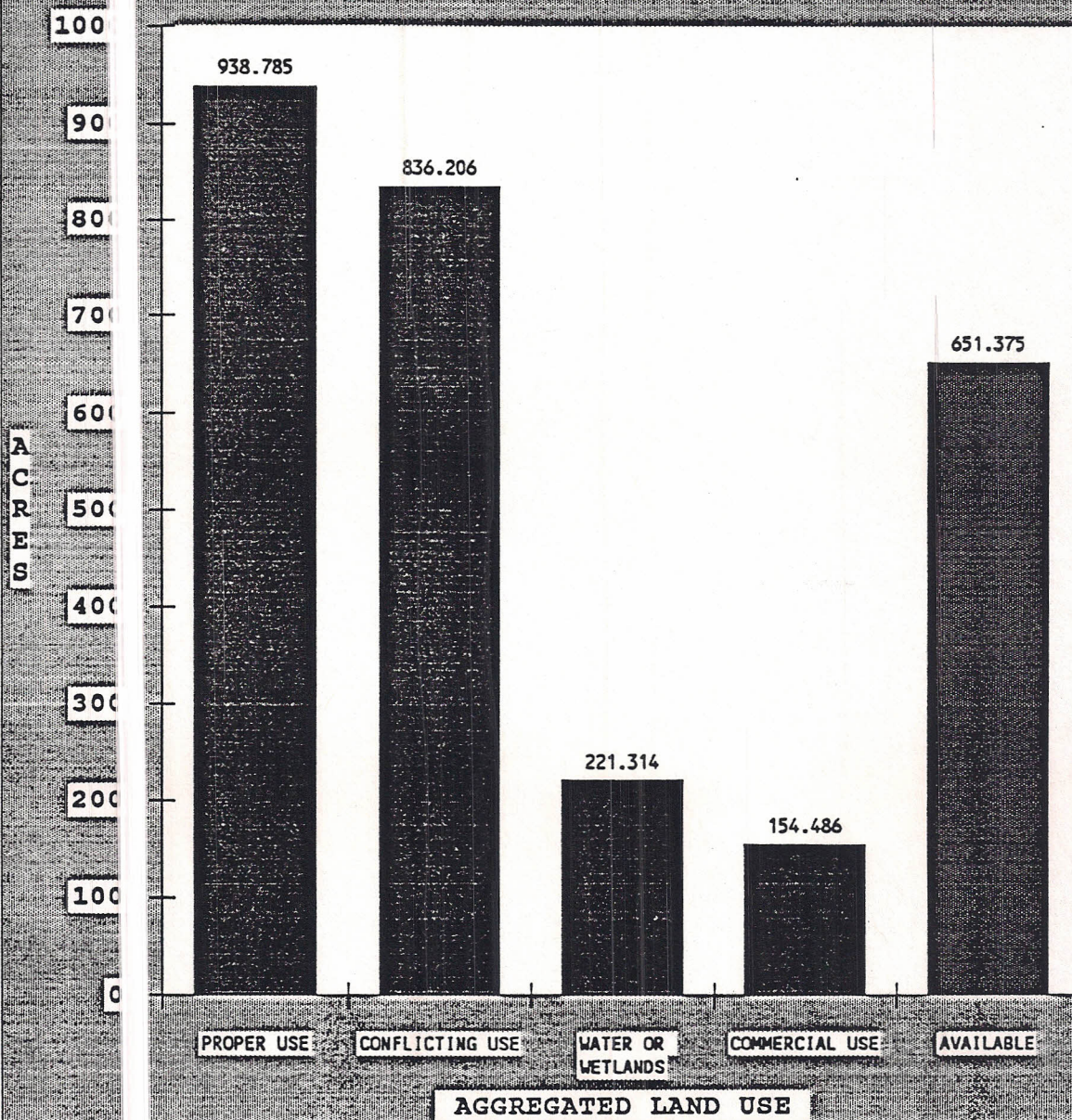
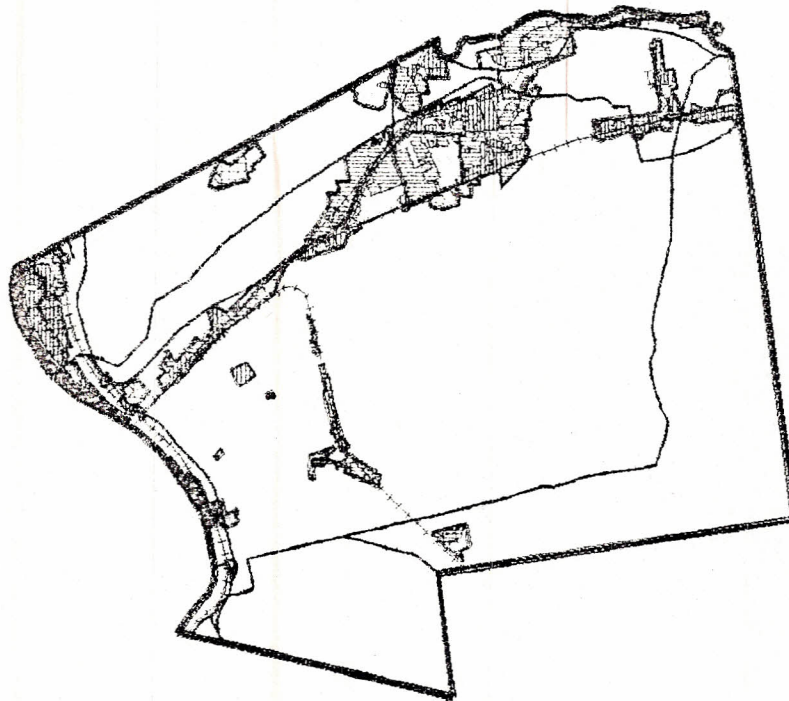


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



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	SPRINGFIELD AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	938 785	34%
CONFLICTING USE	836 296	30%
WATER OR WETLANDS	221 314	8%
COMMERCIAL USE	154 488	6%
AVAILABLE	651 375	22%
TOTAL	2802 169	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCES  
LAND USES: UMMS Resource Mapping Unit from 1985 color infrared photography  
ROADS: USGS-NHD 1:50,000 NGA  
DRAINAGE: USGS-FRD - MassGIS Project from 1985 maps

CENTER FOR ECOLOGICAL  
LANDS ZONED AND S

NO DEVELOPMENT  
ABLE FOR INDUSTRY

SPRINGFIELD



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**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
WESTFIELD**

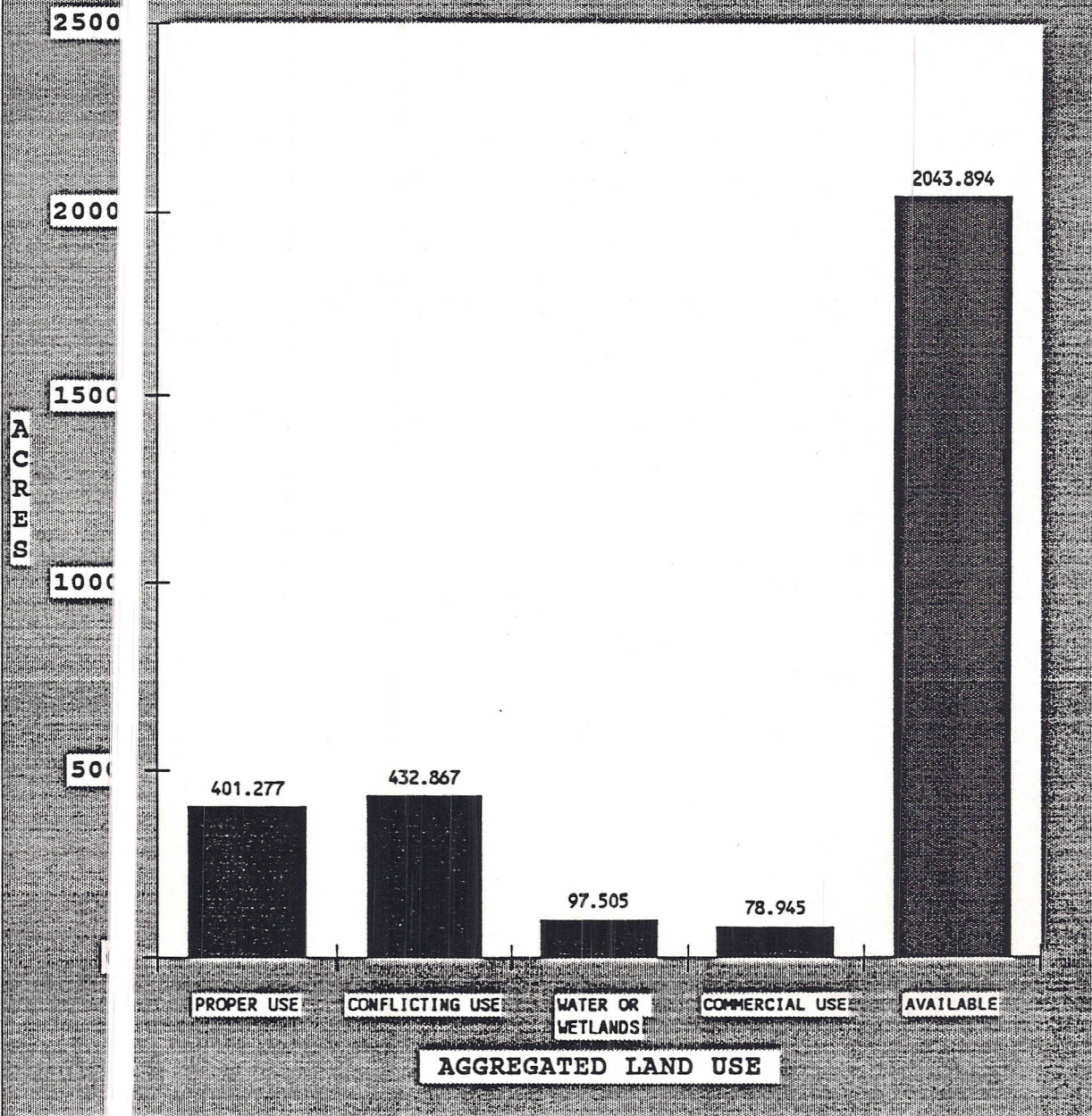
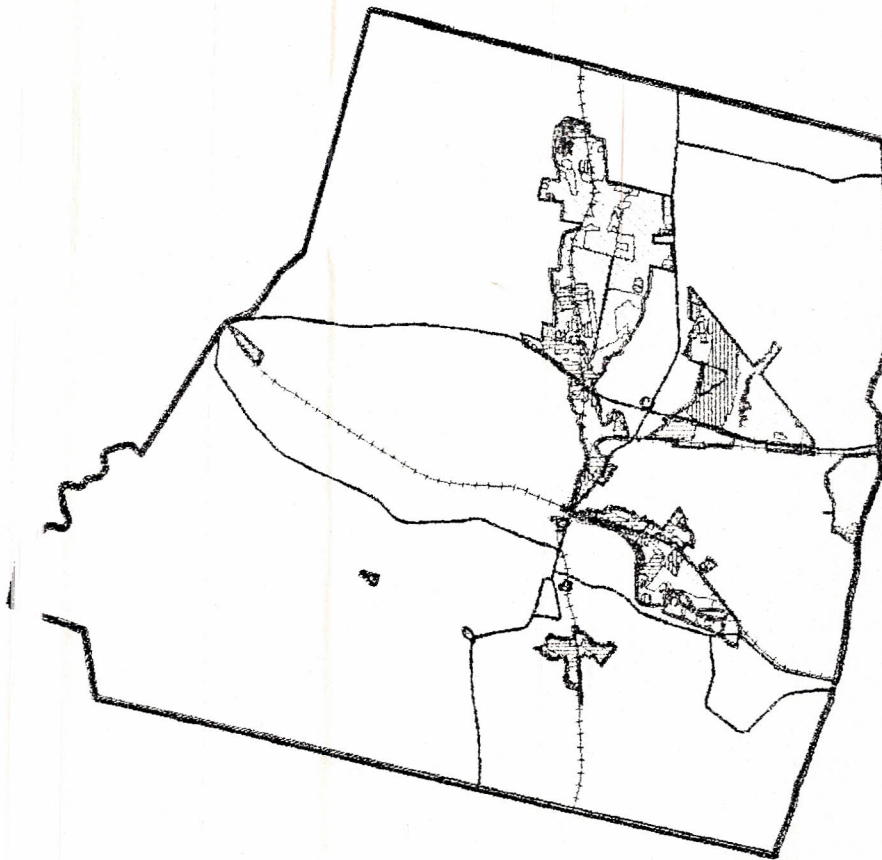


CHART # 4.24








# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	WESTFIELD AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	401 277	13%
CONFLICTING USE	432 887	14%
WATER OR WETLANDS	97 505	3%
COMMERCIAL USE	78 945	3%
AVAILABLE	2043 894	67%
TOTAL	3054 487	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES  
LANDUSE: DMAS Resource Mapping Unit from 1985 color infrared photography  
ROADS: 1:25000 AND 1:50000 D.G.s  
DRAINAGE: 1983-FED - MassGIS Project from 1:25,000 manuscripts

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LANDS ZONED AND AVAILABLE FOR INDUSTRY

WESTFIELD



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
WHATELY

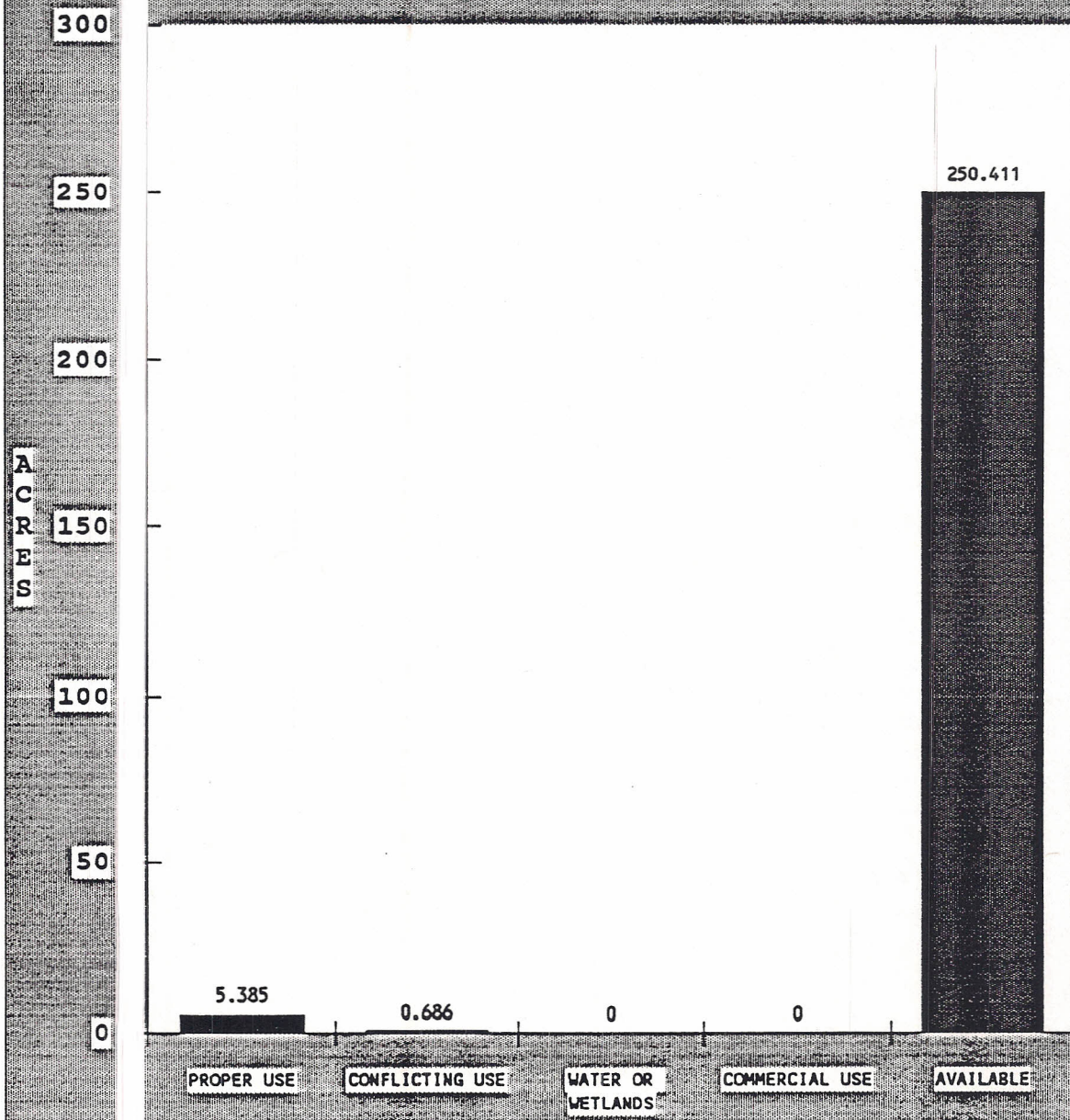
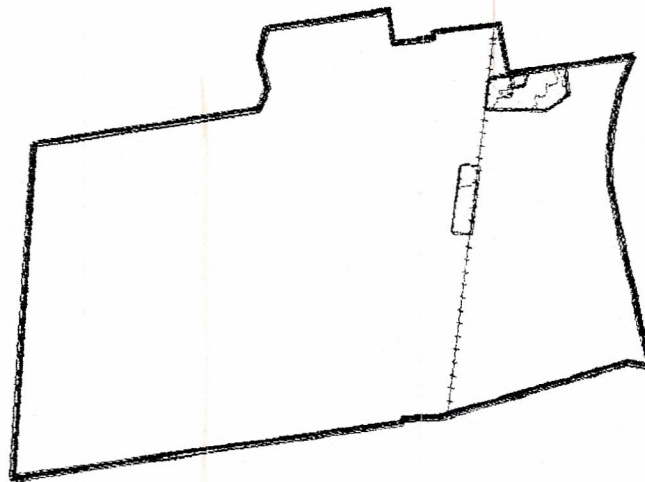







CHART # 4.25

# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	WHATELY AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	5 385	2%
CONFLICTING USE	0 686	0%
AVAILABLE	258 411	98%
TOTAL	258 481	100%



## LEGEND

-  PROPER USE / INDUSTRIAL USE
-  CONFLICTING USE (RESIDENTIAL ETC.)
-  WATER OR WETLANDS
-  COMMERCIAL
-  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25,000



DATA SOURCE:  
LANDUSE: UMASS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS-NOI 1:50,000 DATA  
DRAINAGE: USGS-FRD - MasGIS Project  
from 1:25,000 manuscripts

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LANDS ZONED AND SUITABLE FOR INDUSTRY

WHATELY



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LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
WILBRAHAM

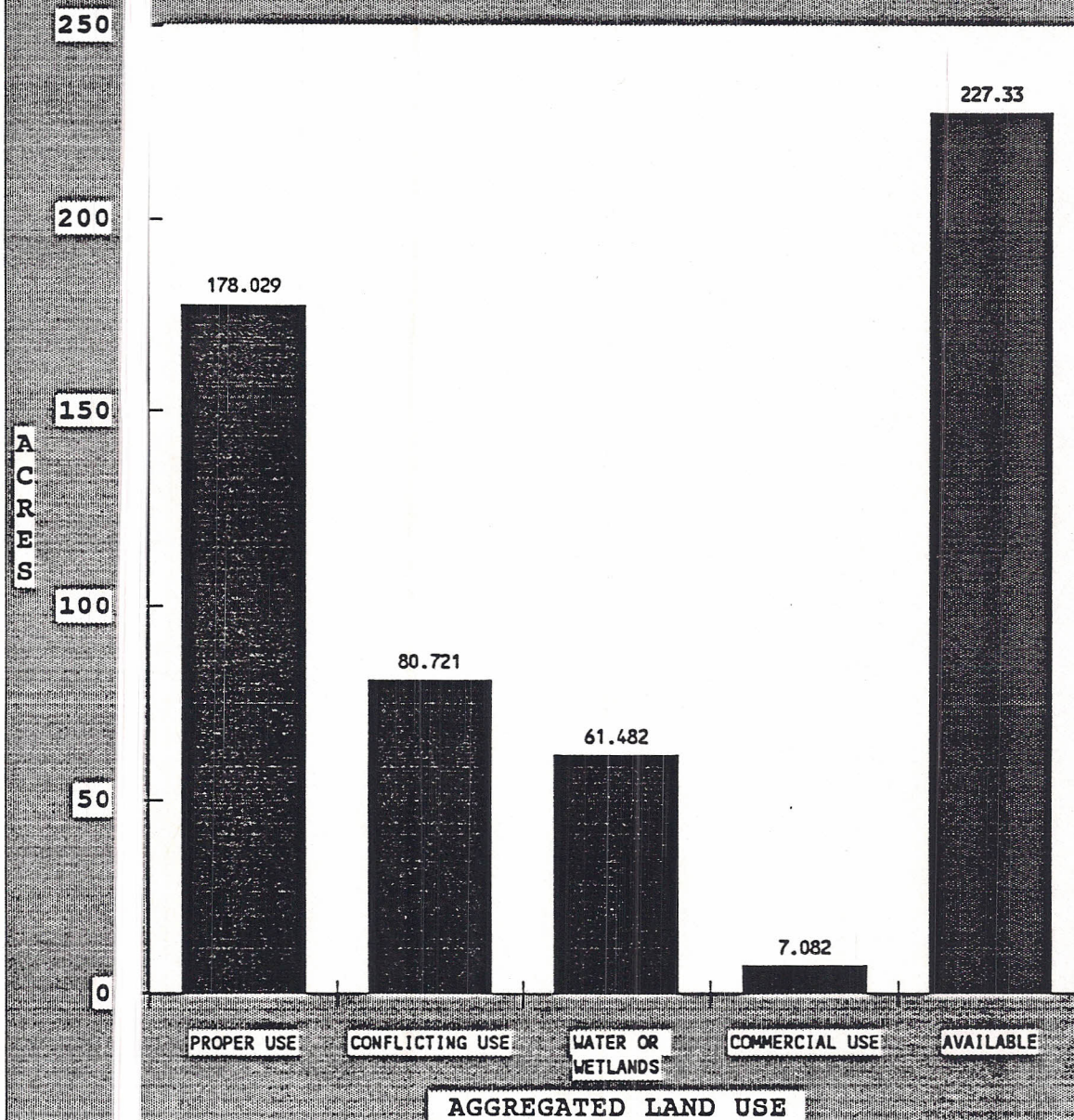
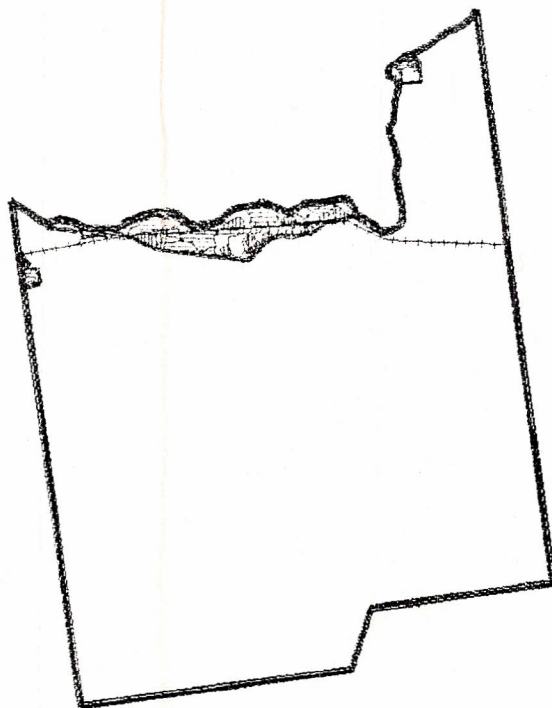







CHART # 4.26



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

AGGREGATED LAND USE	WILBRAHAM AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	178 029	32%
CONFLICTING USE	80 721	15%
WATER OR WETLAND	61 482	11%
COMMERCIAL USE	7 985	2%
AVAILABLE	227 330	40%
TOTAL	554 647	100%



- LEGEND
-  PROPER USE / INDUSTRIAL USE
  -  CONFLICTING USE (RESIDENTIAL ETC.)
  -  WATER OR WETLANDS
  -  COMMERCIAL
  -  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:25000



DATA SOURCES:  
LANDUSE: UMMS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS-ND 1:25000 MGS  
DRAINAGE: USGS-FED - WASHG Project  
from 125000 manuscript

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LANDS ZONED AND SUITABLE FOR INDUSTRY

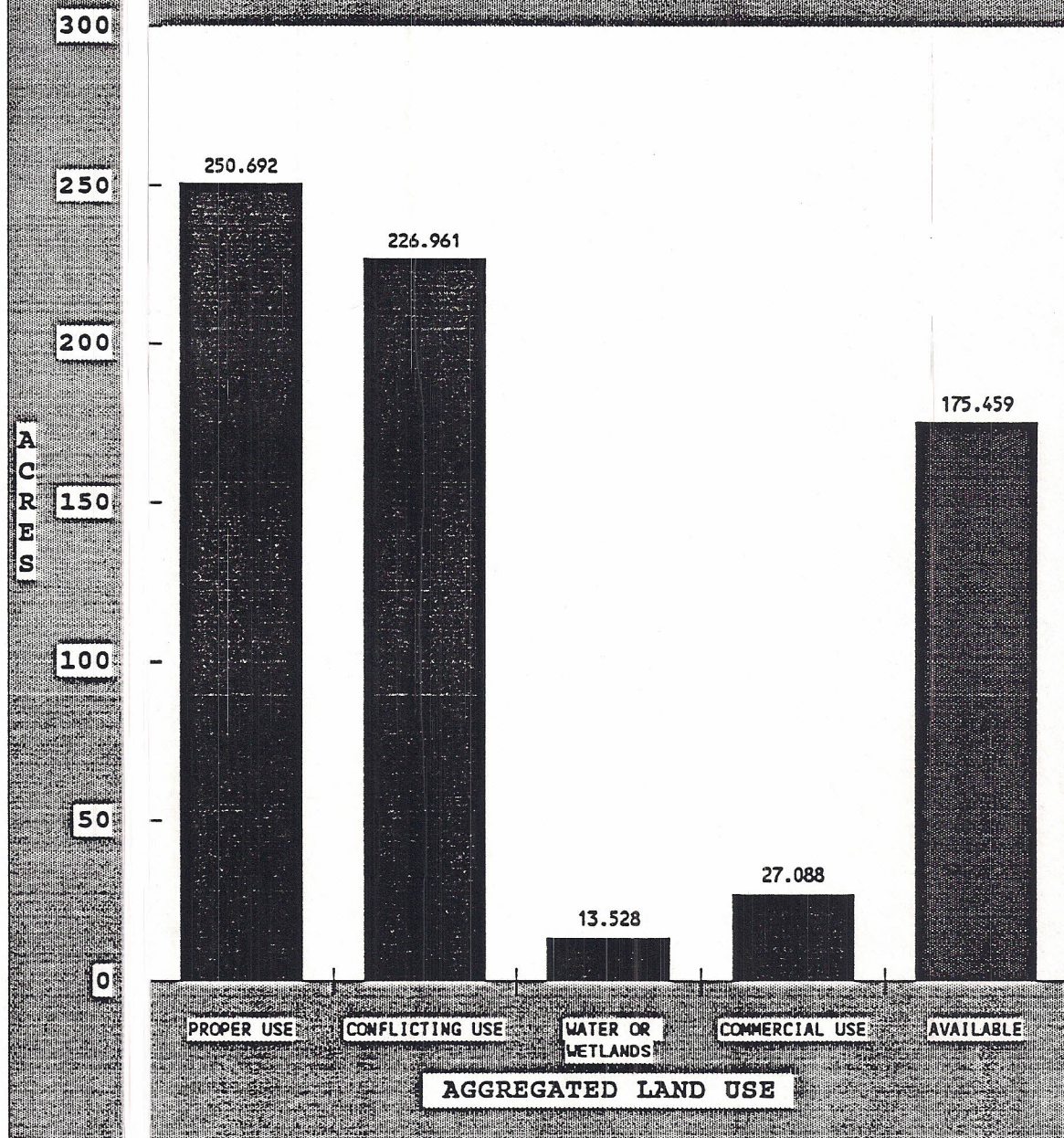
WILBRAHAM



Produced by the WETLAND Research Group  
Dept. of Land, Arch. and Reg. Planning  
University of Massachusetts, Amherst



**LAND USE BREAKDOWN  
FOR  
LAND ZONED INDUSTRIAL:  
WEST SPRINGFIELD**

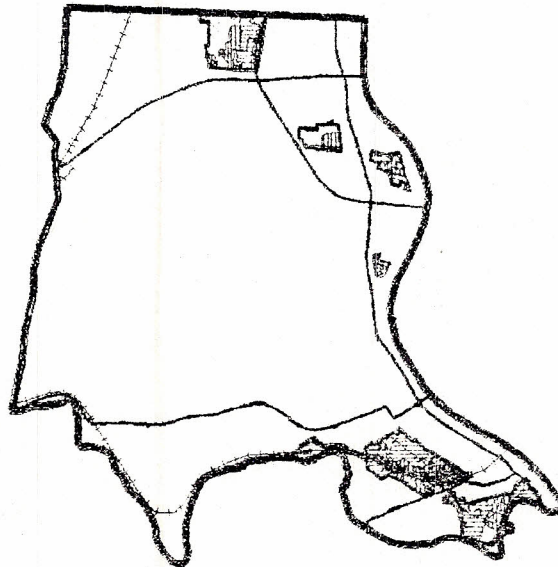







**CHART # 4.27**



# AGGREGATED LAND USE WITHIN INDUSTRIAL ZONES

WEST SPRINGFIELD		
AGGREGATED LAND USE	AREA IN ACRES	PERCENT OF TOTAL
PROPER USE	250 892	36%
CONFLICTING USE	226 961	33%
WATER OR WETLANDS	13 525	2%
COMMERCIAL USE	27 083	4%
AVAILABLE	175 450	25%
TOTAL	693 732	100%



- LEGEND
-  PROPER USE / INDUSTRIAL USE
  -  CONFLICTING USE (RESIDENTIAL ETC.)
  -  WATER OR WETLANDS
  -  COMMERCIAL
  -  AVAILABLE FOR DEVELOPMENT

ONE MILE  
SCALE = 1:250,000



DATA SOURCES:  
LANDUSE: USGS Resource Mapping Unit from  
1985 color infrared photography  
ROADS: USGS-ND 1:50,000 BLG  
DRAINAGE: USGS-WPD - MassGIS Project  
from 1:50,000 manuscripts

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WEST SPRINGFIELD



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University of Massachusetts, Amherst



#### 4. Application of Phase Two: Suitability

The area termed "available" for development does not take into account natural constraints to development such as wetlands or local constraints like "hostile neighbors". It is only lands zoned industrial that have not been built upon. The purpose of the second phase of the industrial suitability model is to look at the actual suitability of the land for industrial development.

##### PART 1 Area Size Assessment

Because this stage of the process requires additional data such as soil and slope, wetlands, and parcel data that has to be collected and digitized, time constraints limited the study to two towns. The two towns chosen were the town of Belchertown and Southampton. Southampton had much of the data needed already in digital form from a study done by UMASS Resource Mapping and Belchertown was a good comparison to Southampton. Most critical, they both contained an area over 100 acres that could be used for the assessment since it was decided to stay with the 100 acre minimum requirement.

##### PART 2 Physical Suitability

The land first was assessed by its natural factors to come up with a physical suitability rating for the site. These factors are discussed in the Methods chapter. The land was then categorized into one of three categories; *Suited for All Development*, *Suited for Light Development*, or *Not Suited for Development*. The results

for Belchertown showed only 28 of the 187.4 acres available for development were suited for all industry. Southampton had only 2.5 acres suited for all industry. Averaging the totals from both areas, nearly 29 percent of the available land over 100 acres is unsuitable for development due to natural factors and only 7.4 percent is suitable for all industry.

### **PART 3 Local Factors Suitability**

The local factors assessment rated those elements within the control of local governments. Again this is discussed in detail in Section 3.2.2.3. The results of this analysis revealed only 7 acres in Belchertown suited for all industry. Southampton had zero land fitting that category. Again, averaging the combined results from these two towns reveals only 1.95 percent of the land suitable for all industry based on local factors although none was assessed as not suited. The results of these first two assessments are shown in Maps 4.31 and 4.32.



# SUITABILITY 1 & SUITABILITY 2



LOCATION OF INDUSTRIAL  
AREA IN BELCHERTOWN

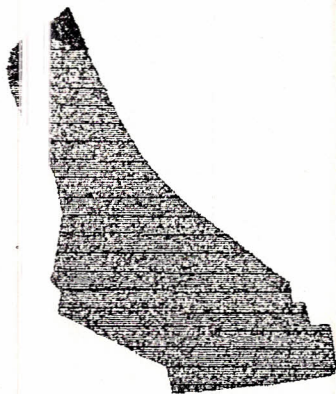
REDUCED FROM ORIGINAL

## NATURAL FACTORS SUITABILITY ASSESSMENT



- SUITED FOR ALL INDUSTRY 28 ACRES
- ▨ SUITED FOR LIGHT INDUSTRY 145.4 ACRES
- NOT SUITED FOR INDUSTRY 14 ACRES

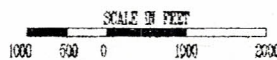
## LOCAL FACTORS SUITABILITY ASSESSMENT



- SUITED FOR ALL INDUSTRY 7 ACRES
- ▨ SUITED FOR LIGHT INDUSTRY 180 ACRES
- UNSITED FOR INDUSTRY 14 ACRES

*Suitability rating 1 is based on natural factors including: soils, slope wetlands, land use land cover and aquifers.*

*Suitability rating 2 is based on local control factors including: an average parcel size rating, existing sewer within 2000' and a potential conflict rating with neighbors.*



DATA SOURCES:  
LANDUSE: UMMS Resource Mapping Unit from 1985 color infrared photography  
ROADS: USGS-MND 1:50,000 RLG's  
DRAINAGE: USGS-WRI - MassGIS Project from 1:50,000 manuscripts

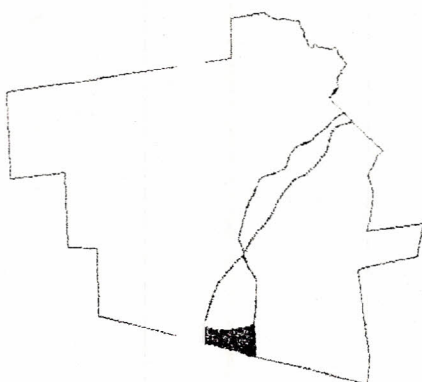
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LANDS ZONED AND SUITABLE FOR INDUSTRY

BELCHERTOWN



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University of Massachusetts, Amherst

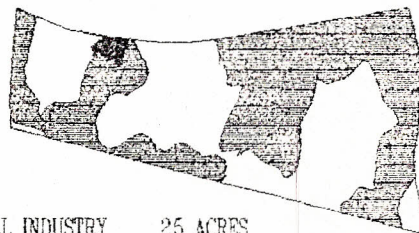
# SUITABILITY 1 & SUITABILITY 2



LOCATION OF INDUSTRIAL  
AREA IN SOUTHAMPTON

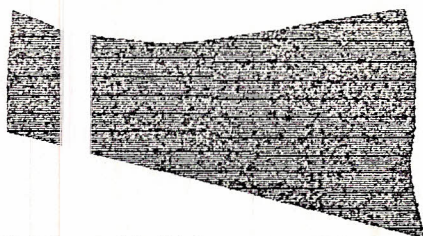
REDUCTION FROM ORIGINAL

## NATURAL FACTORS SUITABILITY ASSESSMENT



■ SUITED FOR ALL INDUSTRY 25 ACRES  
 ■ SUITED FOR LIGHT INDUSTRY 115.6 ACRES  
 □ NOT SUITED FOR INDUSTRY 104.4 ACRES

## LOCAL FACTORS SUITABILITY ASSESSMENT



■ SUITED FOR ALL INDUSTRY 0 ACRES  
 ■ SUITED FOR LIGHT INDUSTRY 222.6 ACRES  
 □ UNSUITED FOR INDUSTRY 0 ACRES

*Suitability rating 1 is based on natural factors including: soils, slope wetlands, land use land cover and aquifers.*

*Suitability rating 2 is based on local control factors including: an average parcel size rating, existing sewer within 2000' and a potential conflict rating with neighbors.*

SCALE IN FEET  
1000 500 0 1000 2000



DATA SOURCES:  
 LANDUSE: UMMS Resource Mapping Unit from  
 1985 color infrared photography  
 ROAD: USGS-NOI 1:100,000 DGS  
 DRAINAGE: USGS-NOI - Shaded Project  
 from 1:25,000 manuscript

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LANDS ZONED AND SUITABLE FOR INDUSTRY

SOUTHAMPTON



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#### PART 4 Overall Suitability Rating

The overall suitability rating combines the results from the first two ratings. The Belchertown rating resulted in 5.6 acres out of 186 acres in the study area left for all industrial development. Southampton still had zero prime land available out of 222 acres. Separating out the factors into the different categories gives a better picture of where the limitations to development are occurring. It is obvious with the case of Southampton that local factors are the major restraint with zero lands in the "all" category. The averaged results from Phase Two, Part 4, generalized to the 6 town study area, shows only 1.36 percent of the land area suitable for *All Industry* and 69.4 percent suitable for *Light Industry*.

The composite suitability assessment lands are then measured to see if they are within the road and rail buffers. These are the same buffers used in the identify stage. The results of this assessment are bleak. Belchertown ended up with only 2.3 acres suited for all industry in relation to rail access and 5.6 acres having access to major roads. This is out of 186 acres that were found available for industrial development. Southampton, having started with zero lands for all industry, resulted in a mere 0.9 acres suited for light industry within the rail buffer. The roads buffer had no limiting effect. The Southampton area started with 222 acres.

The averaged results, again generalized to the 26 towns of the Pioneer Valley with industrial zoning, show 1.36 percent of the area within the roads buffer suitable for *All Industry* and 0.56 percent of the area within the rails buffer suitable for *All Industry*. These results are shown in Maps 4.33 and 4.34.



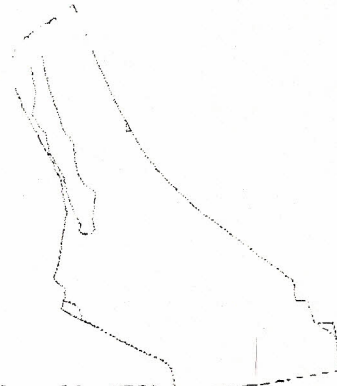
# SUITABILITY 3 & PROXIMITY TO TRANSPORTATION



LOCATION OF INDUSTRIAL  
AREA WITHIN BELCHERTOWN

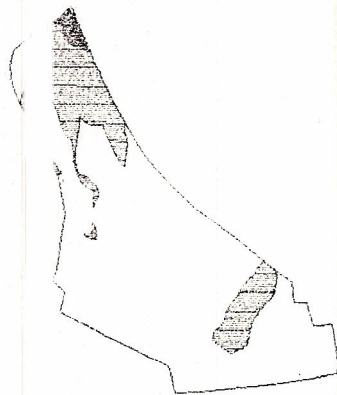
REDUCTION FROM ORIGINAL

## COMPOSITE SUITABILITY ASSESSMENT COMBINED NATURAL & LOCAL FACTORS



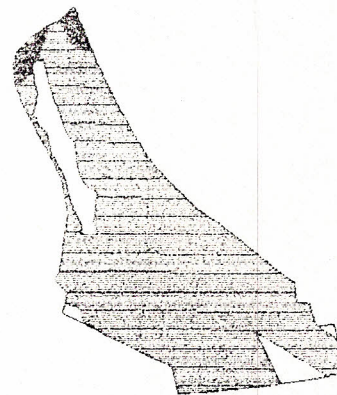
<input checked="" type="checkbox"/>	SUITED FOR ALL INDUSTRY	5.6 ACRES
<input checked="" type="checkbox"/>	SUITED FOR LIGHT INDUSTRY	163.0 ACRES
<input type="checkbox"/>	UNSUITED FOR INDUSTRY	13.6 ACRES

## COMPOSITE SUITABILITY OF LAND WITHIN RAILROAD BUFFER



<input checked="" type="checkbox"/>	SUITED FOR ALL INDUSTRY	2.2 ACRES
<input checked="" type="checkbox"/>	SUITED FOR LIGHT INDUSTRY	33.6 ACRES
<input type="checkbox"/>	UNSUITED FOR INDUSTRY	151.8 ACRES

## COMPOSITE SUITABILITY OF LAND WITHIN ROAD BUFFER



<input checked="" type="checkbox"/>	SUITED FOR ALL INDUSTRY	5.6 ACRES
<input checked="" type="checkbox"/>	SUITED FOR LIGHT INDUSTRY	163.9 ACRES
<input type="checkbox"/>	NOT SUITED FOR INDUSTRY	18.9 ACRES

SCALE IN FEET  
1000 500 0 1000 2000



DATA SOURCES:  
LANDUSE: UMASS Resource Mapping Unit from 1981 color infrared photography  
ROADS: USGS-TMD 1:50,000 DGS  
DRAINAGE: USGS-WFO - MassGIS Project from 1:25,000 manuscripts

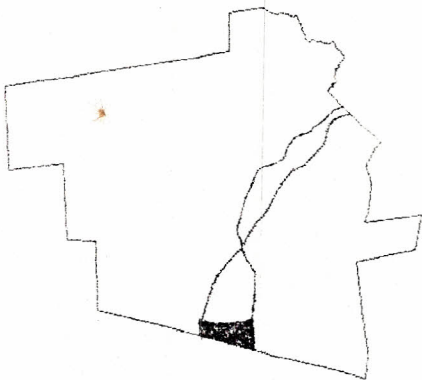
CENTER FOR ECOLOGICAL DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

BELCHERTOWN



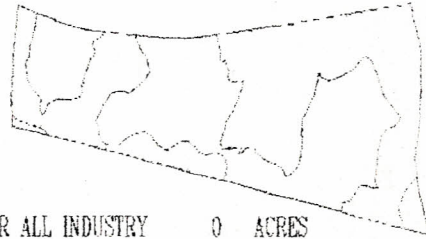
Produced by the METLAND Research Group  
Dept. of Land Arch. and Reg. Planning  
University of Massachusetts, Amherst

# SUITABILITY 3 & PROXIMITY TO TRANSPORTATION



LOCATION OF INDUSTRIAL  
AREA IN SOUTHAMPTON

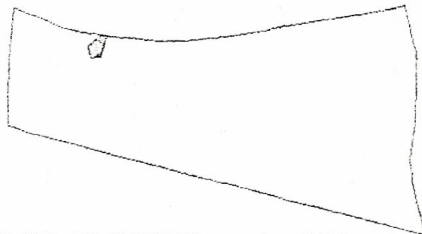
## COMPOSITE SUITABILITY ASSESSMENT COMBINED NATURAL AND LOCAL FACTORS



■ SUITED FOR ALL INDUSTRY	0 ACRES
▨ SUITED FOR LIGHT INDUSTRY	118.2 ACRES
□ UNSUITED FOR INDUSTRY	104.4 ACRES

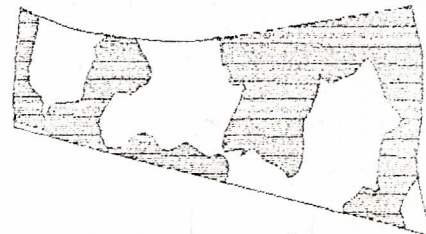
## REDUCTION FROM ORIGINAL

### COMPOSITE SUITABILITY OF LANDS WITHIN RAILROAD BUFFER

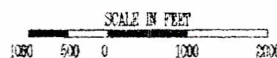


■ SUITED FOR ALL INDUSTRY	0 ACRES
▨ SUITED FOR LIGHT INDUSTRY	.9 ACRES
□ UNSUITED FOR INDUSTRY	221.1 ACRES

### COMPOSITE SUITABILITY OF LANDS WITHIN ROAD BUFFER



■ SUITED FOR ALL INDUSTRY	0 ACRES
▨ SUITED FOR LIGHT INDUSTRY	118.2 ACRES
□ NOT SUITED FOR INDUSTRY	104.4 ACRES



DATA SOURCES:  
LANDUSE: UMARS Resource Mapping Unit from  
1965 color infrared photography  
ROADS: 1:250,000 and 1:50,000 D.G.s  
DRAINAGE: USGS 7.5' - MassGIS Project  
from 1:25,000 manuscripts

CENTER FOR ECONOMIC DEVELOPMENT  
LANDS ZONED AND SUITABLE FOR INDUSTRY

SOUTHAMPTON



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#### 4.3 Conclusion to Application

These preliminary numbers are strong indication of the magnitude of the original hypothesis which stated:

"The premise being that a significant portion of the land now zoned for industry is not suitable for development due to environmental, physical, and political constraints." (1. INTRODUCTION, p. 1)

Distressing, almost half of the lands in the valley zoned and available for industry are not available for industrial development, and the land remaining is to a great extent not suitable for industrial development. Of the 411 acres of industrially zoned land assessed for its industrial suitability (Phase Two), only 1.36 percent of the land was suited for *All Industry* within proximity to major roads. Only half a percent is within rail buffers. There is a definite need for more land to be made available for industry here in the Pioneer Valley.

Assuming the percentages calculated from the Phase Two results on Belchertown and Southampton hold true for the whole Pioneer Valley, only 161.4 acres are available and suitable for all industry within the Pioneer Valley. This is from an original total of 26,963 acres zoned industrial in the Pioneer Valley. Although the calculations are based on only two towns, even if the actual numbers show an 100

percent improvement, the industrial land available would still only equal 322.8 acres. The following tables show the acreage for Phase One and the two towns from Phase Two.

#### APPLICATION TOTALS PHASE ONE

Category	Total Land Area	Percentage Land Area (26 Towns)
Pioneer Valley (40 towns)	667,493.1	n/a
Towns w/ Industrial Zoning (26 towns)	440,026.3	100.0%
Industrially Zoned Land	26,963.0	6.1%
Available Industrial Land between 50-100 ac.	15,770.2	3.5%
over 100 ac.	1,411.8	0.0%
w/in Road Buffer	11,847.8	2.7%
w/in Rail Buffer	13,281.8	3.0%
	4,798.9	1.1%

TABLE # 4.2



# APPLICATION TOTALS PHASE TWO

(Numbers in parentheses (##) are estimates out of 11,847.8 acres of available industrially zoned land in the Pioneer Valley based on averaged results from the Suitability assessment on Belchertown and Southampton, 2 of 26 towns.)

Category	Industrial Lands:		
	Suited for All	Suited Light	Not Suited
Part 2:			
Physical Suitability	(879.2)	(7,523.8)	(3,413.1)
Belchertown	28.0	145.4	14.0
Southampton	2.5	115.6	104.4
Part 3:			
Local Factors	(230.6)	(11,617.2)	(0.0)
Belchertown	7.0	180.0	0.0
Southampton	0.0	222.6	0.0
Part 4:			
Overall Suitability	(161.4)	(8,250.2)	(3,401.6)
Belchertown	5.6	168.0	13.6
Southampton	0.0	118.2	104.4
w/in Road Buffer	(161.4)	(4,750.6)	(6,935.7)
Belchertown	5.6	163.9	18.9
Southampton	0.0	118.2	104.4
w/in Rail Buffer	(66.3)	(4,375.9)	(7,385.4)
Belchertown	2.3	33.6	151.8
Southampton	0.0	.9	221.1

TABLE # 4.3

Although these numbers from Table 4.3 are estimated from only two sample towns, the numbers are still frightening. Industrially zoned land in the Pioneer Valley is mostly not suitable for industrial development. Only 4,750 acres or 17 percent of the industrially zoned land in the Pioneer Valley is suitable for *Light Industry*. Even using the more accurate numbers from Phase One shows that only 44 percent of the industrially zoned land is

available and of large enough size to be considered for industrial development. It is apparent from this assessment that the initial hypothesis is true. That a significant portion of the industrially zoned land in the Pioneer Valley is not suitable for development. The process for zoning industrial land in the Valley took place without the proper information and knowledge necessary to do the job adequately.



## 5. CONCLUSION

This project started with a hypothesis, a major goal, and specific objectives regarding industrial lands in the Pioneer Valley. The results of this project show that the original hypothesis from the data gathered and assessed is true. Less than 3.0 percent of the land in the Pioneer Valley is available and within close proximity to a transportation network. Only 66.3 acres in the entire Pioneer Valley, based on a limited sample of only two towns, are estimated to be available and suitable for *All Industry* that is within close proximity to the railroad network.

The major goal of this project was to provide the information necessary for towns to improve their industrial zoning. This project has been the first step towards achieving this goal. The suitability model developed will provide the information towns need to know regarding their industrial zoning. Of course this is only the preliminary data that shows the problem does exist and steps need to be taken to remedy the situation.

The objectives, mainly creating a suitability model based on the use of readily available data, and an inventory of available industrial lands, have been accomplished. The maps and charts

contained in this report show the results of this assessment. They provide a good source of information to show towns how inadequate their industrial zoning is for providing industrial lands available for industrial development.

The Industrial Suitability Model developed for this project provides the preliminary data needed to show the inadequacy of the Pioneer Valley's present industrial zoning. By simply expanding the study to include all lands within each town of the Valley, the areas most suitable for industrial development will be exposed and can then be zoned industrial. A buffer area around the industrial zone can also be created to ensure compatibility with and protection for the industrial zone. This procedure provides quality information a town planner needs to evaluate and revise current zoning to better fit the land and community. GIS information provides graphical output that is useful in the political realm for persuading changes to the town zoning as well. This type of assessment and revision needs to take place. Using this model to assess areas most suitable for industry and then zoning appropriately is putting the "horse before the cart". In the past, this type of information was not available, but it is today and it is imperative that it be used.

Zoning boundaries are only the beginning. The State of the Art Chapter provides information explaining how the zoning ordinance can be written to both encourage quality industrial development and



provide quality controls to maintain the town's best interests for the future. The new GIS technology provides a unique opportunity for towns to revise their zoning based both on the physical suitability of the land and the important and unique cultural aspects within the town. The benefits the town receives from this new technology is a stronger, more fiscally sound tax base and an improved quality of life.

The problem that becomes apparent from this study is the decision making process regarding industrial zoning. The decisions are not based on solid information or based on the physical constraints of the lands. The zoning lines are placed on the map with the assumption that the land will fit the expected use of the land. This is putting the cart in front of the horse. In more simpler terms - *poor planning*.

As less land becomes available for development the need to use land for its highest and best use becomes more critical. Planners and other officials that make these land use decisions need to take advantage of the spatial information that is available today. Proper land use decisions are dependent upon the type of information this new technology, GIS, can provide at a reasonable cost. The model developed for this project shows how useful this new technology is and how inexpensive it can be. Over two thirds of the data used for this study is available in digital form today.

This data is produced for the entire state which allows the Industrial Suitability Model to be easily run for the entire state. The benefits that can be obtained and utilized from the use of GIS information, such as better use of town's land, greatly offset the cost of such information. This is only the tip of the iceberg. Geographic Information Systems are barely out of their infancy. What word processing has done for office automation, GIS will do to even a greater extent for land information processing and land use decision-making.

The results of this study show how inappropriate it is to zone land prior to assessing its suitability. Zoning without knowledge of the land is like buying property sight unseen or buying a car without looking under the hood. This study has shown where the mistakes have been made, but this as well is the wrong way to apply this technology. The procedure developed for this project assesses land for its suitability for industrial development. Therefore this procedure should be carried out on the whole town to locate the ten percent of the town's land most suitable for industrial development. A buffer area surrounding the industrial land should then be drawn to protect the industrial area from incompatible uses. This same model can then be easily calibrated to locate lands most suitable for the remaining zones using the same data already collected.

GIS is a powerful tool that can make a positive change to our



landscape now and for the future. Assessing the land first and then zoning appropriately is progressive, pro-active planning. The availability of GIS has provided this opportunity that was not an option in the past. A town's land is one of its main resources, why waste it by planning in the past. Plan for the future using the technology available today that is the future of planning.

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