

Worcester Polytechnic Institute

# A Process for Incorporating Community Perspectives in Open Space Preservation

Mass Farms IQP

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# Abstract

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Public opinion is an integral component to land preservation decision making which previous prioritization systems have neglected. To address this, a process was created which incorporates public opinion into the land preservation process. A GIS based framework was used to generate prioritization maps from community member rankings in a focus group setting. This process is effective in gaining a better understanding of the public's prioritization preferences, and can be used to build consensus in the local community.

# Authorship Statement

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This document was authored in a collaborative process between the authors listed on the title page.

# Executive Summary

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Currently, Massachusetts is losing about 40 acres of land to development every day. There are many organizations devoted to the protection of this land, but there is little community involvement in their decisions. To address this, we have created a process for incorporating the public's preference into the open space preservation process. In this report, we present the results of the pilot testing of the process in the central Massachusetts communities of Leicester and Spencer.

## Background and Project Goal

Farmland and open space have value. Most obvious is the value of the land on the real estate market, but external to this – and often overlooked in planning – is the inherent value of the land provided by its ecological services. However, this value becomes more obvious when the land is developed the town has to pay out of pocket to restore natural ecosystem services such as: water purification, flood protection, and wildlife habitats.

Thus, in an attempt to help Leicester and Spencer effectively prioritize land for preservation, and realize the value provided by the undeveloped land in the towns; a framework was created which incorporates public preference into land use data describing these ecological services.

Our project builds on previous systems designed to prioritize land for preservation, by incorporating a measure of public preference into the prioritization calculations. Many of the previously developed systems have focused specifically on prioritizing farmland, and we were able to use several of these factors in our

analysis along with additional factors associated with ecological services.

## Methods

The GIS based prioritization framework contains land amenity data, scored on a scale from one to ten, which is added together with adjustable multipliers derived from community opinion, to create an overall preservation priority map. In this report, 8 different criteria were included in the framework:

- Level of Investment towards Farming
- Prime Farmland
- Wildlife Habitats
- Water Source Proximity
- Proximity to Permanently Protected Areas
- Proximity to Urban Areas
- Parcel Size
- Parcel Price

To incorporate the opinion of the residents of Leicester and Spencer regarding land preservation into the prioritization framework, we chose to use a focus group based approach. To populate the focus groups we used both snowball sampling and a newspaper press release.

In conducting the focus groups a pre-test post-test survey methodology was used. Surveys asking the participants to rank the eight criteria were used to generate the weights used in the prioritization framework.

## Results

In the Leicester focus group, the discussion focused mostly on zoning, farmland

conservation laws, and the cost effectiveness of residential development with respect to the town's budget. The discussion had little mention of ecological services; but one participant was extremely concerned with wildlife habitats and green infrastructure.

The Spencer focus group discussion was focused on ecological issues of the land. A large portion of the discussion was related to farming and its importance in the sustainability of the local economy. The next focus of the discussion was on value of recreational use of open space to the community in the form of public trails. The economic potential of the trails was realized through the continuing discussion of development trends in Spencer.

Both of these focus groups, while the discussion was not exclusively about the criteria considered in our analysis, provided a great deal of insight into how the community members value their land. The prioritization maps generated through community member input promoted discussions about specific parcels of land, and thus the specific benefits they provide to the community.

## Recommendations

From the results of the focus groups, we have demonstrated that the process is effective in encouraging discussion about land use priorities in the local communities. While, the accuracy of the map generated by the prioritization framework was extensively criticized by the focus group participants, it did encourage them to discuss their opinions on land preservation priorities.

Through analysis of these results we have identified several key insights into the

process' effectiveness in creating discussion regarding land prioritization:

- ✓ *Local land use familiarity and specific knowledge is integral to the process.*
- ✓ *The map generated in the focus groups should be used to encourage discussion rather than actual policy changes.*
- ✓ *A medium for discussion is crucial to accuracy of the prioritizations made through the process. Preservation priorities cannot be entirely described through empirical means.*

In addition, we have created a user's guide for the mapping framework, so the criteria considered can be expanded for future use.

## Conclusion

The combination of community opinion with land amenity data creates a medium for the discussion of land preservation priorities. The mapping framework combines these two separate elements into a single, easily understandable map which can be discussed in a group. Within the group, people will be able to express their own individual preferences with regards to the prioritization scores displayed on the map, and thus begin to identify what values of land are important to the local community as a whole.

This process can be used by groups or individuals seeking to preserve land which is most beneficial to the community. In addition to identifying previously unknown lands of high value, the process can also identify lands of low value for preservation, which can be developed without a large loss of value to the community. But, above all, the process is most useful when employed to build consensus about land use through discussion within a community.

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## 1. Introduction

At one time in this country's history, the amount of available land appeared to be limitless. But with over 200 years of expansion and development, we are running out of open land. The farms which fueled the great economic prosperity of the last century are being developed into more profitable residential, commercial, and industrial uses for the next century. While economic development and prosperity is generally purveyed as unequivocally good, the development of farmland and open space has far reaching effects on the local landscapes and environments. Many years of research on these effects has indicated that both farmland and open space provide myriad benefits and services to the communities in which they are located and have significant value which may not be represented in the market value of the land. Due to the harsh realities of the land market, public preference is rarely accounted for in the sale of farm and open land, and many properties which have significant value to the public are developed.

Specifically, the most current data indicates Massachusetts is losing 40 acres per day of farm and open land at a cost of \$200 million dollars in annual ecosystem services (Losing Ground 2003). And because of the benefits provided by these lands to communities, Massachusetts currently has over 130 "land trusts ... watershed associations, open space committees, and advocacy groups" dedicated to conserving them, the highest number in the country (Massland.org 2009). These groups take advantage of many pre-existing legislative instruments created to help people preserve land. With the great variety of land use and types by region in Massachusetts, it is no wonder there are so many individual community organizations dedicated to the protection of land. Despite the large number of land preservation groups, there is no single unifying reason for land preservation. However, many different prioritization systems have been developed to reflect this diverse range of goals. Some groups strive to preserve valuable ecological lands, while others simply preserve land which looks pretty from the roadside; the preferences of each group largely depend on the members of the group and the community in which it is situated.

The Common Ground Land Trust was recently founded with the mission of preserving farm and open lands (red areas in Figure 1) in Leicester and Spencer, Massachusetts. Since the group is new to the community it lacks perspective on the overall community preferences regarding land preservation, and would like to be more effective by preserving lands which have the greatest value to the community.

Prior efforts in the creation of farmland and open space prioritization systems have ranked lands for preservation based on the value of their inherent characteristics, but have more or less ignored the public's valuation of these characteristics. But, public opinion does play an incredibly large role in the actual preservation of the lands, and therefore should be considered in any preservation efforts that rely on public support.

Using a Geographical Information System (GIS) and participatory methodologies to reflect community preference, we have provided the Common Ground Land Trust a process which allows for a better understanding of the land preservation preferences within the communities of Leicester and Spencer, so that the CGLT can consider them in their land preservation actions.

The process described in this report consists of a GIS mapping framework which is capable of generating a visual representation of the preservation priorities, and a focus group designed for discussion of the factors used in generating the map. The overall combination of these two elements provides a great deal of insight to how the local community members value their land, and also provides a medium for discussion in which a consensus can be reached.

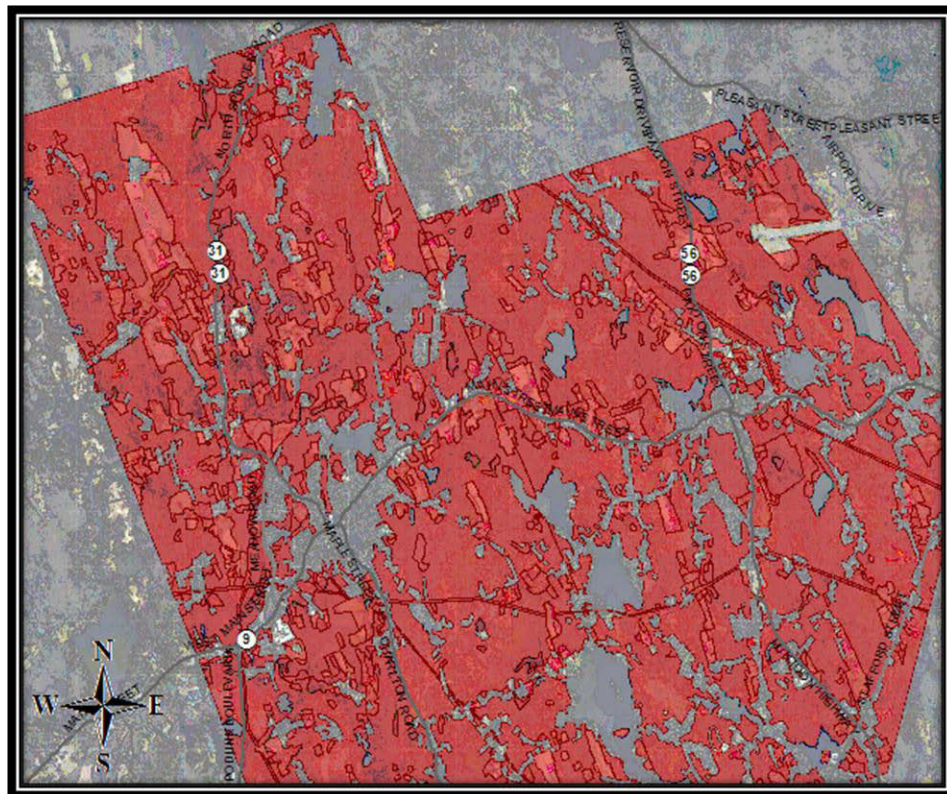


Figure 1: Open space in Leicester and Spencer.



## 2. Background

To accurately frame the relevant factors in the preservation of farm and open land in Leicester and Spencer, a thorough understanding of the relevant aspects of farmland preservation is required. There is much research into the recent trends towards sprawl and urbanization in rural areas of this country which can be applied to this problem. Reasons contributing to open space loss, combined with the economics and regulatory techniques of land preservation provide basic grounding in the theory of land preservation. Research in land prioritization methods demonstrates empirical methods for valuing farmland.

### 2.1 Trends in Land Use

Over the past thirty years, the number of farms and amount of farmland has been steadily decreasing nationwide (USDA 2007). The USDA “Farms, Land in Farms, and Livestock Operations 2007 Summary” shows the decreasing trend in the number of farms nationwide from the years 1980 to 2006 (see Figure 2). The discontinuity in the graph is a result of the expansion of the minimum definition of a farm to include small family farms.

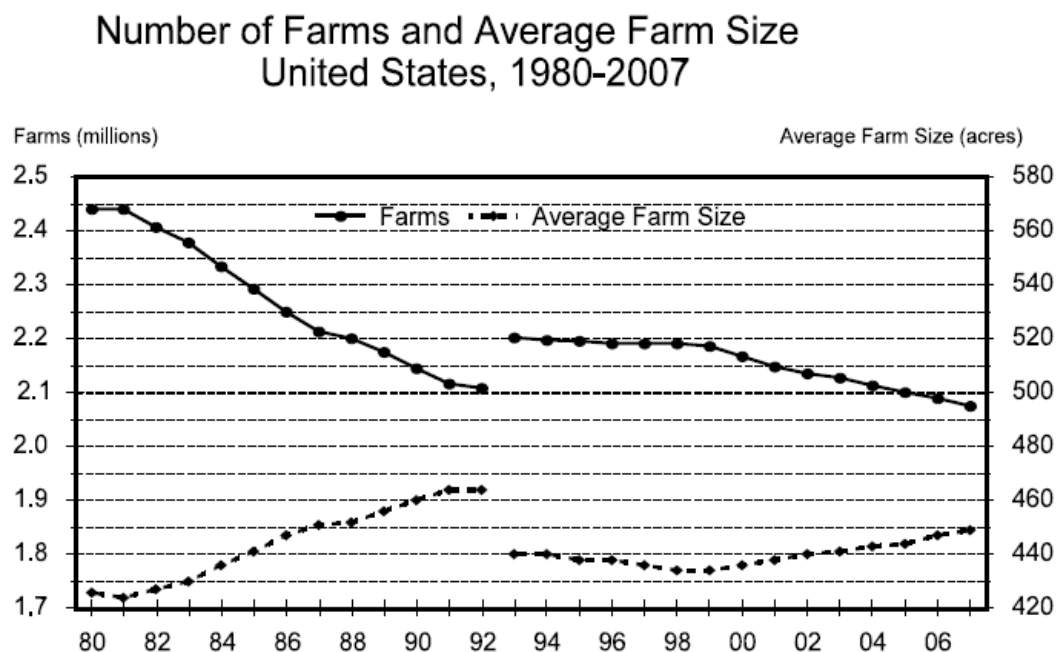


Figure 2: Nationwide farmland 1980-2007.

The report indicated not every state has had a loss in farmland, but there are many states that have had a decrease in farms and farmland, including Massachusetts which, over the span of 33 years has lost 98,789 acres of farmland to development. (USDA, NASS census of agriculture)

### 2.1.1 Factors Contributing to Development

A major reason for the loss of farmland and open space in Massachusetts is pressure from urban development (Losing Ground 2003). High prices and saturated housing markets in the immediate Boston suburbs have pushed people seeking affordable housing to the exurbs of the I-495 corridor, creating an expanding frontier of sprawl across the southern and western parts of the state as seen in Figure 3.

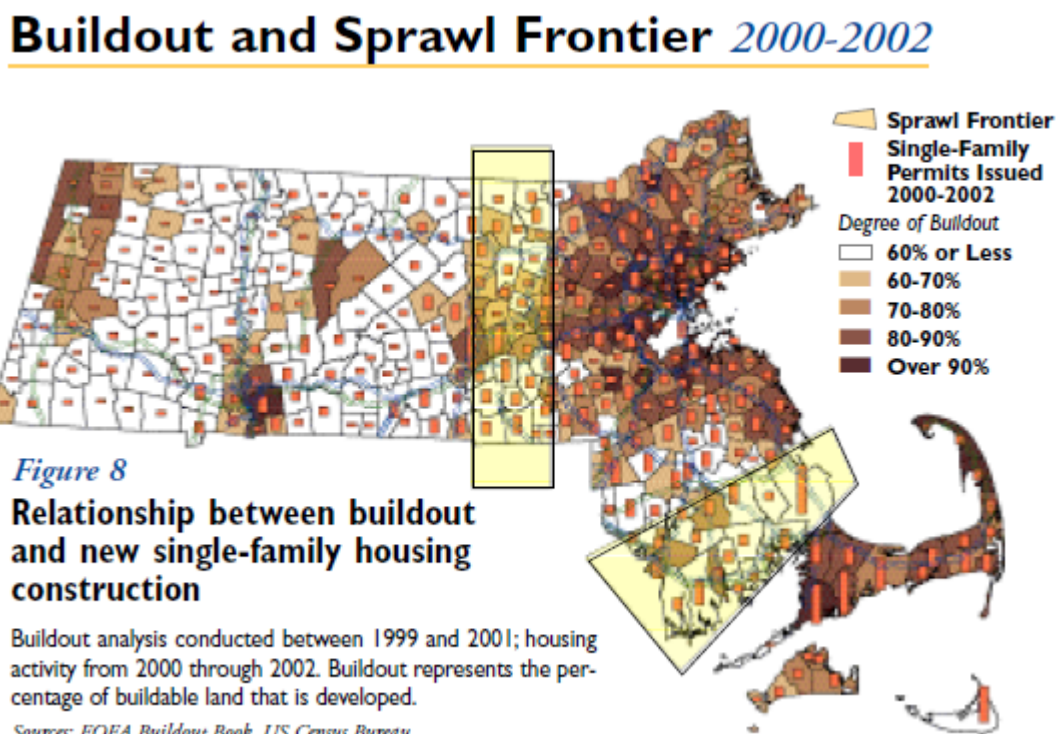


Figure 3: Massachusetts sprawl frontier (Source: Losing Ground 2003).

This increased demand for housing in rural Massachusetts is the primary reason for the development of open space. The exurban communities are ideal for new development because the low price of the existing land combined with their less rigorous zoning laws make it extremely profitable for developers to subdivide and develop large tracts of open land (Losing Ground 2003).

### 2.1.2 Reasons for Preserving Open Space

There are a variety of reasons to justify the preservation of farmland. Historically, the roots of the farmland preservation movement arise from food security concerns (Bunce, 1998). The American Farmland Trust uses the slogan “no farms, no food,” in their campaign to preserve farmland, which helped to bring \$12.5 million towards the Farmland Protection Program in Massachusetts. However on a nationwide scale, studies have shown that the loss of farmland has not made a significant impact on the production of food (Bunce, 1998).

More recent movements in farmland preservation have been centered on preserving farmland and open space for the value of its non-agricultural aspects. Farmland, in general, produces many goods which are necessary for human sustainability. In addition to their obvious agricultural values, farmland provides aesthetic and environmental values as well. This fairly recent concept is rooted in the idea that communities need a significant amount of connected open space in order to maintain natural resources (Benedict, et. al., 2002).

In Massachusetts alone, open land was estimated to provide the equivalent of \$6.3 billion annually in services to the environment. These “non-market goods” provided by the environment are defined as “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life,” and fall under the broader category of green infrastructure (Losing Ground 2003). Green infrastructure is a term in urban planning referring to any system of connected open space, which allows for sustainable development in communities by providing essential services to the environment, such as water purification and flood control (Benedict, et. al., 2002). While the monetary value of the services provided by the environment is only an estimate, there are several important instances in which the environment has actually provided a real monetary benefit to the community:

### How Ecosystem Services Save Massachusetts Taxpayers Money

*A few examples of how “free” services provided by nature have allowed the state and municipalities to save money on infrastructure.*

- Wetlands in the Charles River Basin reduce peak river flows during storms and delay storm surges, preventing \$18 million in flood damage each year. The Army Corps of Engineers concluded that protecting these wetlands was more cost-effective than building new flood-control infrastructure. Surrounding property values are also higher thanks to the flood-protection services provided by these wetlands.
- The Massachusetts Water Resources Authority (MWRA) avoided the cost of a new \$180 million filtration plant because of natural waste treatment provided by protected watershed lands around the Quabbin and Wachusett reservoirs.
- The US Forest Service estimates that urban forests in Massachusetts store 16 million metric tons of carbon, and capture an additional 523,000 metric tons per year, with a social value due to migration of global warming effects of over \$300 million

**Table 1: Real savings provided by environmental services.**

In addition to the value of the environmental services lost when land is developed, cost of community services studies have shown that any additional tax revenue gained through development does not offset the cost to the local community (Daniels 2005).

## 2.2 Economics of Land Preservation

In light of the very real savings associated with the so-called “free,” or non-market goods mentioned above, a large field of economic theory known as ecological economics, deals with estimating dollar values for goods and services that typically have had no value in traditional economic systems. Prior to the formalization of ecological economics in the 1980’s, traditional economic models tended to assume that the capacity of the environment to produce resources and absorb wastes was unlimited. However, data describing large scale environmental phenomena such as pollution persistence and global climate change had been largely ignored in formulating this assumption. Thus the field of ecological economics models the economy using traditional economic methods adapted to recognize the constraints of fixed environmental resources (Røpke, 2004).

Both traditional and ecological economics can be used to describe the value of a piece of land. Traditional economic methodologies are used in modeling the value of land on the “land market,” and can provide an accurate representation of the price a developer would have to pay for the development

rights. Ecological economic methodologies are then used to provide a valuation of the features of the land which are not represented in its traditional market value, such as the \$6.3 billion in annual services provided by open land in Massachusetts.

### 2.2.1 Ecological Economics Attributes Value to Externalities

Like all land, the land a farm occupies has intrinsic value. The major way in which it differs from developed land is that the farmland itself is a means of production because crops and animals can be raised using the land, and then sold for profit. So in addition to typical land value factors, i.e. location and size, farmland is additionally valued by land quality indicators such as “soil fertility, slope, and permeability” as well as other productivity related factors (Hellerstein, et al, 2002). In short, the summation of the value of the land and the productivity of the land is what determines the traditional market value of a farm.

According to traditional economic theory, the market for land will efficiently allocate the use of the land based on its market value. That is to say, the market value associated with a specific piece of land will be greater, if its current use is more profitable than an alternative usage. This process can be seen in the purchase of commercial storefront, a company will only purchase a commercial location if it believes that the additional income generated by the location will be greater than the cost of the land. The decision-making process for farmland is similar, a farmer will only sell his land if he believes that sale of the land will generate more income than continued farming operations.

However as mentioned above, farms provide goods and services that have real value (i.e. green infrastructure), which are not directly represented in their market value. These goods and services are referred to in traditional economics as externalities, because they are external to the market value for a good. A basic example of an externality is a chocolate factory which during routine production must use large volumes of air to dry their chocolate, creating an enjoyable chocolate odor around the factory. The odor is an externality because it has value in the overall economy but cannot be distributed in a controlled manner as a market good, like a similarly scented chocolate air freshener could, for example.

Traditionally, the market values of the goods produced by a farm (crops and livestock) generally have been the sole determinants of the farm value. But simply through their existence as non-developed land, farms contribute a number of goods and services to the economy which do not have a market value in the traditional sense, because they cannot be bought and sold. Exactly which “non-

market outputs” farms produce is largely open for debate; however Hellerstein et al. (2002) provide the following general table:

Positive		
<b>Environmental:</b> <ul style="list-style-type: none"> <li>• Open space</li> <li>• Soil conservation</li> <li>• Biodiversity</li> <li>• Wildlife habitat</li> <li>• Recreational opportunities</li> <li>• Scenic vistas</li> <li>• Isolation from congestion</li> <li>• Watershed protection</li> <li>• Flood control</li> <li>• Groundwater Recharge</li> </ul>	<b>Rural Development:</b> <ul style="list-style-type: none"> <li>• Rural income and employment</li> <li>• Viable rural communities</li> <li>• A diversified local economy</li> </ul>	<b>Social:</b> <ul style="list-style-type: none"> <li>• Traditional country life</li> <li>• Small farm structure</li> <li>• Cultural heritage</li> </ul>
Negative		
<ul style="list-style-type: none"> <li>• Odor</li> <li>• Pesticide runoff</li> <li>• Soil erosion</li> <li>• Ecosystem fragmentation</li> </ul>		

**Table 2: Externalities produced by farmland.**

The positive non-market goods serve to contribute value to the farm, and the negative goods detract value. Thus the theoretical “real” value of a farm, including both traditional and ecological economic valuations, is based on the agricultural productivity related market value and its positive externalities, subtracting the value of the negative externalities. However, this “real” value does not correspond to the value of the farm on the land market, because it includes the ecological economic valuation.

### **2.2.2 Farmland Can be Protected Through Compensation**

When faced with selling their land, farmers base their decision on the market value of the land. The farmer has essentially two pieces of information to consider: the market value of his land (based on its productivity) and the price the developer is willing to pay for it. If the market value of the farm is greater than the developer’s offer, the farmer will continue to farm, otherwise he will sell the land. At no point in this transaction does the farmer incorporate the non-market goods he produces into his analysis because they are meaningless to the traditional market valuation of the farm. And accordingly, a farm which generates a significant amount of positive externalities would be sold for the same price as an equally productive farm which does not; resulting in an overall loss of value to society in general.

Since the externalities produced by farms are used by the general public, the compensation for these “public goods” (see Hellerstein, et al. 2002, Appendix A for an in-depth economic discussion) comes from public funds. This is accomplished through taxpayer funded farmland preservation programs and private organizations, which attempt to provide incentives which adjust the market value of farmland based on the value of the externalities it generates. While prior legislation did not allow the government to effectively compensate landowners for externalities, recent movements in the legislative aspect of farmland preservation and protection have created several instruments which have a greater ability to directly affect the market value of farmland (Duke and Lynch, 2006).

## 2.3 Methods for Protecting Farmland and Open Space

Farmland and open space retention is often done at the private level through a committee known as a community land trust (CLT). The acquiring of land through a CLT is accomplished through private initiative. Members of a community form a CLT which attempts to retain land that is threatened by development or other factors with the intent of preserving the land for the greater good of the community as a whole (Bourassa, 2006).

CLT are the primary method in which the legal techniques in farmland retention are employed. Duke and Lynch’s (2006) paper provides a table (Table 3) that includes many of these which is broken into four categories; regulatory, incentive-based, participatory, and hybrid.

FARMLAND RETENTION TECHNIQUES BY TYPE			
Regulatory	Incentive-Based	Participatory	Hybrid
Agricultural protection zoning	Exactions (including impact fees and mitigation ordinance) Mortgage assistance	Fee-simple purchase or sale Eminent domain	Eminent domain with rights of first refusal Land value as pension plan with PDR/PACE
Cluster zoning	Tontine	Land banks	Point systems/PACE
Right-to-farm laws	Use-value assessment (UVA), including rollback and recapture taxes	Purchase of agricultural conservation easements (PACE), purchase of development rights (PDR)	Transfer of development rights (TDR)
Growth boundaries	Circuit breaker tax	Term easements	Marketable development rights (MDR)
Growth management	Transfer tax	Rights of first refusal	Agricultural districts
State executive order			Capital gains reduction/PACE Bargain sale, charitable donation/PACE State income tax forgiveness/PACE Installment payments/PACE

Table 3: Farmland retention techniques by type (Source: Duke and Lynch 2006).

Regulatory approaches involve definition of allowed land use through zoning and similar policies. Zoning laws define boundaries within which certain land uses are allowed or prohibited. Particular to our project, agricultural use zones as well as cluster zoning, which allows controlled development on parcels of open space, can be implemented through these techniques. Incentive-based techniques, as is implied by the title, provide benefits for agricultural use of land and dissuasions for development both in the intent upon purchase and potential conversion of land use. In other words, if a particular land use is desired by the government the owner who enacts this land use will be compensated through monetary benefits. This is also applied during the buying of land. If the buyer's intent is to farm the land they can receive mortgage assistance through reduced interest payments. Though not able to implement these types of retention directly, a CLT can elicit aid from their respective representatives and effectively protect land from development.

Participatory techniques see the government acting within the market as a buyer or seller of land. This category also includes the sale of development rights and conservation easements, or the sale of land use. Most prominently, this category includes fee simple purchase or sale of land. This is where the government directly purchases or sells land at market value. More specifically to our project, due to economic feasibility, land use can be purchased through the sale of conservation easements and development rights. Effectively, the owner is compensated by allowing specific land use on their land. Once a conservation easement is purchased for a particular parcel, though some residential use is often allowed, most development is restricted.



The fourth category compiles techniques that use a combination of techniques and is therefore labeled as hybrid techniques. Of particular importance in Massachusetts are the purchase or transfer of development rights (PDR/TDR) and the purchase of agricultural conservation easements (PACE) hybrid programs, where the where both private organizations such as CLT's and the government work together to provide incentives which "restrict most new residential uses and all new commercial and industrial uses." (Duke and Lynch 2006 and Losing Ground 2003) These programs attempt to specifically adjust the market value of the land with respect to development by providing the owner some form of monetary compensation in exchange for the legal right to develop the land. This compensation as incentive to discourage farmers from selling their land, while providing legal means to protect the land from development indefinitely.

## 2.4 Systems of Prioritization for Farmland Preservation

Because no CLT has an infinite supply of funds, there needs to be some way of determining which farmlands should be preserved and which farmlands do not require immediate attention. As mentioned earlier there are many reasons to preserve farmland; consequently one land trust may not have the same intentions and goals as another. As a result many diverse systems of prioritization have been developed. By conversing with the Common Ground Land Trust of Leicester and Spencer area of Massachusetts, it was determined that there is no clear standard for determining the level of priority of parcels of land. The Common Ground Land Trust seems to determine the priority of farmland almost solely on qualitative values and availability. Although this may work for now, they have expressed a growing need for a more uniform basis on which to judge the level of attention that each parcel necessitates.

### 2.4.1 Agricultural Prioritization Systems

The attempts to develop methods to prioritize farmland have changed focus over time. Originally, the soil of the farmland itself was the most important factor (Wood, 1976). The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) has a classification system of soils consisting of twelve classes of soil, each with several subclasses (University of Idaho, 2009). Many areas of the world, the United States especially, have been examined for the soil properties. While the properties of the soil are useful for determining which crops can be grown, they are not the sole determinant of farm value. The main problem is that a comprehensive definition of prime farmland cannot be determined nationally, or even on a state-by-state basis because different crops are grown in different regions. Even if two places have the exact same soil conditions and land qualities, the same

crop may not be able to be grown there because of environmental differences. It was argued, however, that if factors such as sunlight exposure, temperature range, and precipitation were taken into consideration, prime farmland could be determined for a particular crop on a nationwide scale (Wood, 1976).

Due to the impact of these environmental effects, the USDA SCS developed a system of evaluating land that considered factors other than strictly the properties of the soil (B.M. et al, 2003). The system has two main parts. The first of which is the land evaluation (LE) part, largely the soil based qualities discussed above. Followed by the site assessment (SA) consisting of other factors that affect the productivity of the land, including: size of the property, shape of the property, and the uses of land adjacent to the property. This system, cumulatively called LESA, has been used extensively at federal and state levels to prioritize farmland for preservation based on its agricultural value (Hellerstien, et al. 2002).

#### **2.4.2 Economic Prioritization Systems**

Much research has been done in determining the economic factors contributing to the market value of farmland. Although the price of the farmland is unrelated to the prioritization of the preservation of farmland, the factors that are considered in the analysis of the price of the land are similar to factors considered for preservation. There are three essential elements of farmland that give that land value (Stewart, et al 1998). The first of these is the production value of the land; the amount of returns that the land can provide. The second element is the amount of investments in the land such as barns. And the third element the consumptive value such as enjoyment of the location, or the externalities produced. The production value of the land was considered to be affected by public policy such as zoning laws as well as the soil information and size, factors that could be determined by LESA, and the level of investment. The consumptive value was evaluated by factors such as the proximity to towns and highways. Although the ultimate goal of Stewart's paper was to predict the price per acre of the farmland, the factors considered are same to determine how valuable it would be to preserve the farmland.

The model that was developed by Stewart's paper has a bias toward farms that primarily grow crops. A more general approach to determining the price of the farmland is needed to be able to compare farms such as dairy farms to other farms. The method that was explored in the paper by Xu, F. et al., is generalized to incorporate all types of farms. A LESA based system was used to determine the production value of the land. This evaluation put more weight on the level of investment and included

more factors that attempted to weigh each type of farming evenly, including amount of acres irrigated by different methods. The consumptive value took aesthetic values into consideration, but did not consider the green infrastructure related services, such as the protection against flooding.

A prioritization method has also been developed which identifies which parcels of farmland that face the greatest threat of development (D.F. Levia, 1998). To do this, two different categories of criteria were examined: environmental criteria such as the farm size and the distance to the town center, and socio-economic factors such as the number of barns on the property and the mean annual household income.

### 2.4.3 Combined Prioritization Systems

Combining aspects from the above prioritization methods, a system was developed that takes LESA based values, economic valuations, and the threat of development into consideration (Daniels, T. et al., 2005). The philosophy of this system was that there are three main goals of farmland preservation, but there are limitations of funds for farmland preservation. One main goal of preservation is the maintenance of agricultural viability. This was determined using a LESA type system taking climate and urban surroundings in to account for the site assessment factors. Preserving rural amenities served as the second main goal of preservation. This accounted mainly for the scenic value of the land, measured by the proximity to highways. The ability of preserving farmland to guide urban growth to more acceptable areas was the third goal. Using projections of how and where the city was expected to grow, the level of threat of high productivity farms was determined. This system also evaluated the cost effectiveness of preservation by dividing the sum of the three scores corresponding to each goal by the easement cost (Daniels, T. et al., 2005). This meant that the highest scoring farms were the highest socially and agriculturally scoring farms that could be most cost effectively preserved. System also acknowledged that not every organization would weigh the three goals the same way and incorporated weightings to adjust for individual preference.

### 2.4.4 Summary of Factors Considered in Section 2.4

The following table compiles the prioritization factors used by the methods discussed in this section.

Farmland Productivity	Scenic Value and Social Factors	Cost Effectiveness	Green Infrastructure
<b>Land and Natural Environment</b> i. Soil condition ii. Slope iii. Sunlight exposure iv. Precipitation v. Temperature  <b>Economic and Social Environment</b> i. Size ii. Shape iii. Pasture area (livestock farms) iv. Number of milking stalls (livestock farms) v. Acres irrigated vi. Number of barns vii. Size of barns viii. Age of barns ix. Size of house x. Age of house xi. Value of machinery xii. Adjacent uses of land	<b>Proximity to development</b> i. urban areas ii. town centers iii. to major roads  <b>Size</b>  <b>Appearance</b>	<b>Easement cost</b>  <b>Cost of Development</b>  <b>Naturally Provided Services*</b>	<b>Ability to form parks</b>  <b>Ability to form greenways</b> i. Along roads, utility lines, or waterways  <b>Adjacent property</b>  <b>Ability to preserve forests and wildlife</b>  <b>*Ability to protect and control water source</b> i. Water purification ii. Storm water retention

Table 4: Summary of amenities considered in various prioritization systems.

## 2.5 Importance of Public Involvement in Land Preservation

There are many ways by which to prioritize the preservation of farmland and open space in general, each one tailored to its own set of goals. And as can be seen in the above section, the important factors in farmland preservation can vary greatly. A wide number of studies have indicated that the American public has a general positive preference for preserving farmland, but there is considerable variation among the underlying reason for this preference depending on region (Bunce, 1998). Bunce, however, identifies a general trend in the rhetoric of the farmland protection movement as shifting from food security and productivity concerns to environmental concerns. These environmental amenities are simply the externalities associated with the land, and have market value to

the public. So in order for land preservation programs to most efficiently benefit the public, they should attempt to preserve the farms which have the greatest value to the public.

A recent nationwide review of public preference studies concludes that the public definitely has a strong preference for farmland preservation but no single underlying reason “seems to dominate, though some reasons may be most important in some [regional] areas.” (Hellerstein et al, 2002) Hellerstein discusses at length the nationwide trends in preference, with a repeated emphasis on the regional variability of preference towards the amenities provided by farmland.

Even though there is no unifying reason for farmland preservation, public preferences towards the amenities provided by farmland can provide useful data. Simple public preference surveys and focus groups, while lacking the statistical rigor of other methods, can be used to determine the general order in which people rank the value of amenities provided by farmland. Other methods such as contingent valuation (CV) or the analytical hierarchy process (AHP) can be used to determine a “willingness to pay,” (WTP) or a monetary value associated with each amenity (Kanninen 2007). These highly quantitative methods are grounded in a rigorous economic framework, and are widely used in economics to estimate the market value of environmental externalities. However applied to the case of farmland preservation, the WTP for the non-market goods produced by farmland has little to do with the actual market value of the land (Duke and Lynch, 2006 and Hellerstein et al, 2002).

In order to elicit the opinion of a set of people, such as the residents of an area, some type of surveying must be conducted. Though there are many methods available to be used, the most appropriate for the type of data collection for our purposes is a focus group. This is because a preference of land amenities is a complex idea to be understood for an entire group. Conversations created between group members pertaining to a specific subject are moderated and analyzed. The type of information collected during a focus group can vary which allows for a widespread application of this technique. A focus group allows discussion to occur. A conversation between the group members allows a more complete idea to be formulated, or possibly competing ideas to surface. Either way, the group’s opinion on the topic is better understood.

## 2.6 Summary

As we have seen, the amount of farmland and open space is declining both nationwide and specifically in Massachusetts, with deleterious effects. In addition to its traditional economic value, farmland (and open space) provides a vast array of non-market goods and services – in the form of

ecological, social, and other benefits – which are lost when the property is developed. To date, there have been many different prioritization methods for farmland which attempt to incorporate the value of the externalities produced by the land; however, these prioritization methods are specific to the preferences and goals of the region in which they were developed and thus cannot be directly applied to the communities of Leicester and Spencer. So to create an effective prioritization system for these communities, we must understand their specific preferences and goals regarding farmland preservation.

### 3. Methods

In order to help the towns of Leicester and Spencer effectively prioritize land for preservation, a framework was created which incorporates public preference into land use data. First, relevant data describing the features and amenities of the land in Leicester and Spencer was gathered from publicly available sources. Then, the various data types were scored on a consistent scale within a GIS so that they could be weighed against each other. After this was completed, public preference was incorporated into the framework through focus group interviews where community members were surveyed on their preferences regarding land preservation. From the survey, weightings for each amenity class were generated in the framework and used to produce a land preservation prioritization map for broader community review.

#### 3.1 Objective I: Develop the Geographical Information System Framework

Since land use is a complicated issue, and is described by a variety of data types, it is hard to visualize land use scenarios without some type of visual aid, like a map. Geographical information systems (GIS) are widely used to perform calculations on and display spatial data. In a GIS, data is fundamentally organized by spatial location and thus relevant data describing a particular piece of property can be correlated and displayed on a map.

##### 3.1.1 Describing Land Amenities in the GIS

We have used the current industry standard software, ESRI's ArcGIS 9.3 as our Geographical Information System. Like many GIS packages, ArcGIS handles three main types of data: map data, the location and shape of a feature; attribute data, the descriptive data linked to the features; and image data, the aerial photos of the attribute (ESRI 2009). The software also has two "data models" for handling the description of spatial attributes: the vector model and the raster model. The vector model uses points, lines, and polygons to describe discrete attributes on the map such as streams, parcel,

roads, etc.; whereas the raster model is used to describe continuous attributes of the map like elevation and soil type (ESRI 2009).

Data describing the land amenities shown in *Table 4: Summary of amenities considered in various prioritization systems* was integrated into ArcGIS. The majority of this data is collected and maintained by both the state of Massachusetts and the local municipalities. Within the state government, the Office of Geographical and Environmental Information (known as MassGIS) exists under the Massachusetts Executive Office of Energy and Environmental Affairs and holds the legislatively mandated responsibility for the “collection, storage and dissemination of geographic data” in the state of Massachusetts (MassGIS 2009). MassGIS maintains a publicly available list of GIS “layers” (see: Table 5), or data files, that were used to represent the relevant land amenities listed in Table 4.

Data Layer Name	Data Type	Date Updated
Land Use	Vector	January 2002
Major Ponds and Streams	Vector	July 1998
Assessors Parcels	Vector	December 2007
NHESP Priority Habitats of Rare Species	Vector	September 2008
Protected and Recreational Open Space	Vector	September 2008
Prime Farmland	Vector	October 2008

**Table 5: Publicly available data used as inputs to analysis.**

Our project closely follows the raster computational methodology of Niemann et al. in their 2000 report entitled *Farmland Preservation and GIS: A Model for Deriving Farmland Priority Zones*. The authors first created a base layer in the GIS consisting of the farmland parcels in the area, and then populated this layer with the attributes relevant to each parcel. Once the base layer was adequately described in the GIS, the authors demonstrated used a raster based method for calculating priority zones.

In the raster method, scores and weights are assigned to the amenities provided by each parcel of land. Each amenity is scored on a “consistent scale” like the federal LESA model, assigned a weight which “ranks [each amenity] in order of influence,” and the weighted scores are subsequently calculated for each property (Niemann et al. 2000).

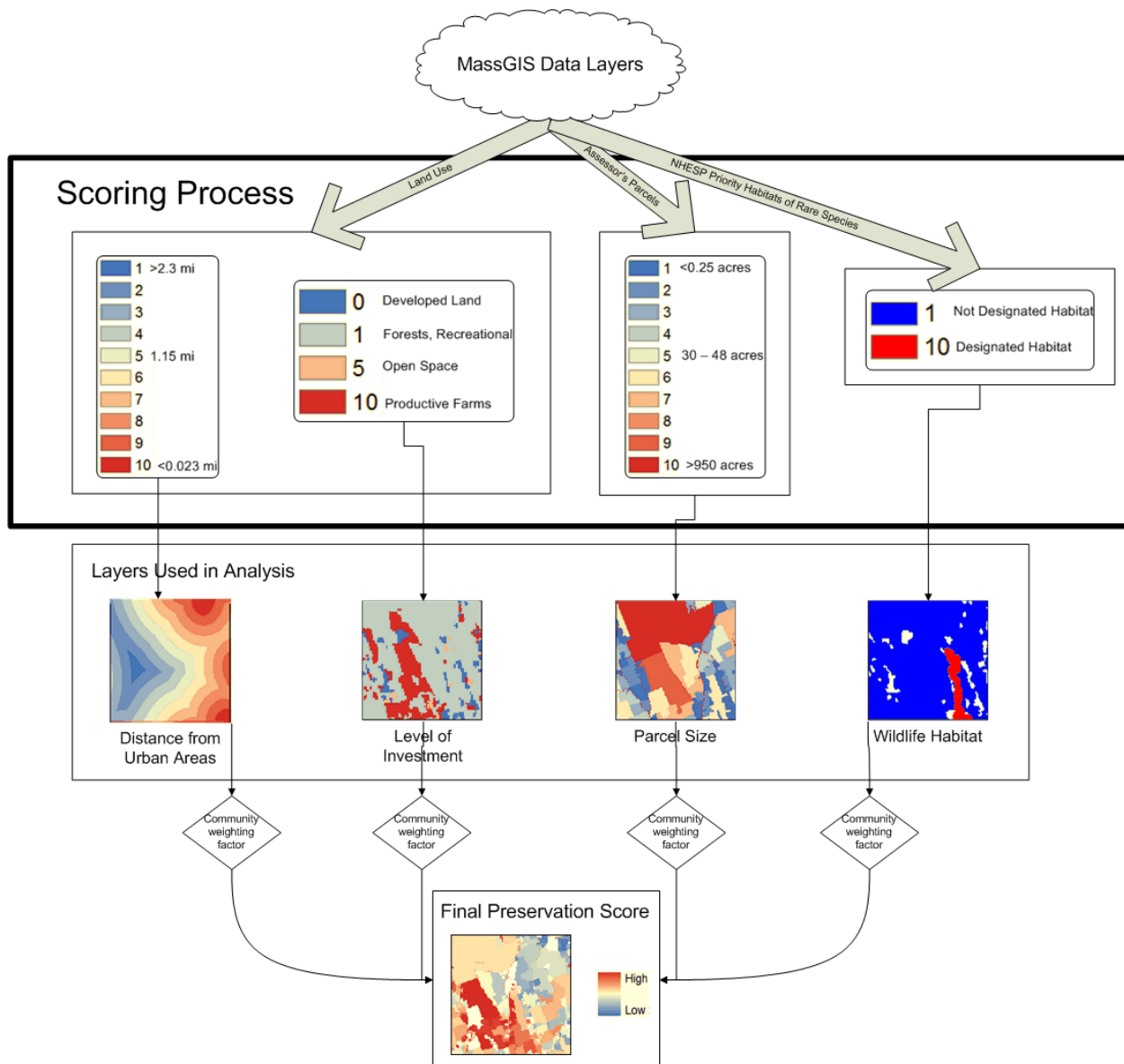


Figure 4: Overview of GIS processes.

### 3.1.2 Creating a Scoring and Weighting System in the GIS

From the MassGIS data, we created GIS layers which describe the relevant amenities discussed in Table 4. Each layer was created either directly from a raster conversion of a MassGIS layer or by calculations performed on MassGIS data (See Appendix A for more detail of the ArcGIS functions used). The data describing each of the 8 amenity classes selected for analysis was then subjected to a scoring process in order to directly compare the disparate data types. This was done by determining the maximum and minimum values for each data set and dividing this into even increments, producing a



linear scale (see: Figure 4). This process was used for all the criteria that were measured except the parcel size and price layers, as explained below.

A base layer defining the lands for analysis as the open land in Leicester and Spencer was first created from the MassGIS Land Use layer. Within the context of this analysis, open land was defined as the: forest, cropland, pasture, non-forested wetland, open land, recreational open land, and woody perennial categories of the 21 category land use classification. From this base layer, the following data layers were created for use in the analysis:

### *Level of Investment*

The Land Use layer was also used to approximate the level of investment towards farming. The Land Use shape file was converted to a raster data type and scored into three different categories based on the 21 category land use information. The maximum value of 10 was assigned to land that is already a productive farm. The minimum value of 1 was assigned to land types which would require significant investment in order to clear and farm, like: forests, wetlands, and recreational land. Open land that is not currently farmed was assigned the intermediate score of 5.

### *Proximity to Urban Areas*

The proximity to urban areas was also created from the land use layer. High density residential, multi-family residential, commercial, and industrial lands were selected from Leicester and Spencer and surrounding towns and defined as “urban” areas in the GIS. The maximum possible distance away from urban areas in the towns of Leicester and Spencer was found to be 2.3 miles using the buffer tool. A multi-ring buffer was created around the urban areas with ten even increments, from zero to 2.3 miles, each scored from 1 to 10.

### *Proximity to Water Sources*

The ability of land to protect water sources was measured by a buffer analysis. A buffer of approximately 160 ft. was created around water features and wetlands selected from the Land Use shape file and the major streams, rivers, and ponds in Massachusetts. The lands inside the buffer were given a score of 10 and lands outside were given a score of 1.

### *Parcel Size*

To score the parcel size, the assessor's parcel layer from MassGIS was converted into a raster using the acreage information for each parcel contained within the layer. Because of the range and distribution of the different parcel sizes in Leicester and Spencer, if the aforementioned linear process was used all of the data points would fall into the either the first category or the last. So as to better display the range full range of parcel size, the "natural breaks" scoring function within ArcGIS was used. This function defines the scoring cutoffs in such a way that each category has a similar number of data points, and therefore is not linear.

### *Parcel Price*

In order to take the price of each parcel into consideration we used the same process as the size of the parcel, but the parcel price information was used to create the raster. Since lower priced parcels are easier to purchase to preserve and therefore preferable, the highest prices were given a score of 1 and the lowest prices a score of 10. Again due to the nature of the data set, the natural breaks function within ArcGIS was used here as with the size layer.

### *Wildlife Habitat*

By downloading the NHESP Priority Habitats of Rare Species, a wildlife habitat layer for Leicester and Spencer was generated. This layer was converted to a raster and areas defined as habitats were given a score of 10 and the areas that were not were given a score of one.

### *Distance to Permanently Protected Land*

The distance to permanently protected lands layer was created and scored in much the same way that the distance from urban areas was measured. The maximum distance from permanently protected land was found to be 1.1 miles, and a multi ring buffer was created with 0.11 mile increments.

### *Prime Farmland*

To identify areas of high farming value, the MassGIS soil layer was used. This has three categories of soil: Prime Farmland, Farmland of Unique Importance, and Farmland of Statewide Importance. All three of these soil classifications were given a score of 10 while the areas that are excluded from these classifications were given a score of one.

A summary of the data layers, their descriptions and data types is provided in Table 6 below. Graphical representations of these layers can be found in Appendix A.

Layer Name	Description	Data Type
Open Space	An inventory of the open space in Leicester and Spencer	Vector
Level of Investment	The level of investment towards farming	Raster
Distance to Urban Areas	The distance to nearest urban areas of Leicester and Spencer and surrounding towns	Raster
Water Source Surrounding	The area around ponds and streams	Raster
Prime Farmland	The areas which are identified as good soil conditions for farming	Raster
Parcel Size	The size of each parcel	Raster
Parcel Price	The price of each parcel	Raster
Wildlife Habitats	The areas that are wildlife habitats	Raster
Distance to Permanently Protected Areas	The distance to the nearest permanently protected areas in the areas in and surrounding Leicester and Spencer	Raster

Table 6: GIS layers created for use in analysis.

### Weighting Process

The weighted sum function was used to combine these scores into one final score. Since this function subtracts the areas in which any layers have no data, a raster was created with a value of zero for all the open land that is not permanently protected in Leicester and Spencer and has no data anywhere else. To create this modifying raster the permanently protected areas were joined with the open space base created earlier. This was converted to a raster using the level of protection information, then the permanently protected areas were assigned no data and the rest of the land was assigned a value of zero.

The weighted sum function allows for weights of any rational number. These weights were determined by an average of the responses given in the focus group survey. Where parcel data was available, namely Spencer, the final priority score was averaged over each parcel using a zonal statistics function. To create the zones, parcel data was converted to a raster using the unique identifier for each polygon.

## 3.2. Objective II: Identify the Community Preferences for Land Preservation

To identify the preferences of the residents of Leicester and Spencer regarding land preservation we chose to use a focus group based approach. We can recruit members of the community who are opinionated with respect to land preservation – such as farmers, real estate agents, developers,

etc. – and allow them to share their opinions in a focus group. This will provide a valuable medium for discussion, from which we can extrapolate appropriate weightings to input in the GIS.

### 3.2.1 Selecting and Recruiting Focus Group Participants

Through our research, we found many ways to recruit volunteers to participate in our focus groups. Given the limited resources and time allotted for this project, we advertised the focus groups by using three different methods. The first method used to recruit volunteers was through a well established recruiting process in focus group research called snowball sampling. We also advertised the focus groups via newspaper press releases and the internet.

Snowball sampling is a simple and cost effective method that uses existing social networks to collect a list of contacts (Krueger R.A., 2000). In a snowball sampling, an initial list of interested community members is created and then each contact on the list is asked to provide a few contacts that they know of who would be interested in our project. Those contacts then become the next list of contacts in which more contacts can be collected. This process is repeated until the desired amount of contacts is reached.

For each focus group, we wanted to recruit a diverse group of individuals who were interested in open space preservation and other land use issues. Our initial list of contacts included our sponsor, members from the Common Ground Land Trust, and the town planning departments of Spencer and Leicester. In Spencer, we were given names of some influential landowners, planning and conservation board members, and some contacts from Camp Marshall, a local 4H camp. In Leicester, we were given a comprehensive list of people who would be interested in our project, including members of the planning board, local developers, and local organizations who are active in land preservation. Each of these people on our contact list was contacted through email, and their attendance was confirmed either through email or phone.

A disadvantage to a snowball sampling is the potential to create a bias among the referenced contacts (Krueger R.A., 2000). To mitigate this, we have also advertised our project to the larger community of Leicester and Spencer through a press release published in the local newspaper, the *Spencer New Leader*. The press release (see: Appendix B) gave a brief overview of our project and the times and locations for our focus groups. Our contact information was included for those who wish to participate. This press release was also placed on the Spencer town website.

We were invited to set up a table at the Leicester Planning Board Open House where we met with many members of the Leicester Planning Board. Many of the members were very interested in our project and some of them signed up for our focus group. We created and handed out pamphlets (see: Appendix B) that advertised the goal of our project and dates of our focus groups. After the open house, the pamphlets were left at the town hall for anyone who is interested to take.

### 3.2.2 Conducting the Focus Groups

The interaction that takes place within a focus group is ideally a natural conversation (Krueger R.A., 2000). A moderator must keep the conversation on topic while the entire discussion is recorded and transcribed for later analysis. A particular method of conducting a focus group which we have employed is a pre-test post-test experiment (Krueger R.A., 2000) , which shows if there is any change in the focus group member's valuation of land during the course of the focus group by administering the weighting survey before and after the focus group discussion.

We began the focus group by distributing a survey (see: Appendix C) of the land amenities which are presented in Table 6. The members of the focus group were asked to score these land amenities with respect to which amenities they feel have the most value for preservation. This "pre-test" was followed by a brief presentation which describes the GIS scoring and weighting system along with an overview of some concepts in land use. To encourage appropriate discussion related to the preservation of open space, four land use categories were presented to the group: developed land, farmland, recreational open space, and general open space (see: Appendix C for the slides used). During this presentation one of our group members calculated the weights generated by the group in the pre-test.

After the presentation the resulting map was displayed. The following conversation was fueled by the focus group member's reactions to the map they have just created. Ideally, there will be obvious points of conversation that will arise as the members associate their knowledge of their community and land with the map. Parcels of interest within the town will be recognized and the preservation suitability of these parcels will be understandably conveyed through the map.

Despite the fact that the map is intended to create a natural conversation, there are key topics which may not be naturally covered in discussion. Therefore, an outline was generated (see: Appendix C) that identifies the key concepts in the discussion along with sample questions, so that the focus group moderator could redirect discussion if necessary. The focus group intends to discover how ecological

services, farmland retention, and development pressure play into the results displayed in the pre-test map. Key concepts to be noted for ecological economics will include water purification, storm water retention, habitat preservation, and ecological connectivity and how these benefits are lost or gained based upon the map. Farmland retention will focus on the basic economics of farming and the externalities provided by farmland as well as the preservation the rural character of the communities. Specific farms and their score on the map will be noted for discussion. Development pressure's role in the pre-test map will be exemplified by referencing specific examples of recent development and the parcels on the map showing least suitability for preservation, and therefore, highest potential for development.

At the end of the conversation the same survey that was handed out at the beginning of the focus group was distributed again. After the post-tests have been collected the members were asked if there are any layers which they feel we have left out of our analysis. During this brief discussion the post-test results were tabulated and a new map was presented to the focus group.

## 4. Results and Recommendations

Through analysis of the focus group proceedings, we have been able to gauge the success of the overall process with respect to its ability to elucidate the public's preferences for land preservation. While the focus groups were not ideal in terms of their composition and suffered from many tangential discussions, they still provided strong evidence that the process is effective at getting people to talk about how they value land.

Insight from the focus groups has allowed us to provide several recommendations designed to improve both the GIS and the focus group components of the overall process. These recommendations, in addition to a "User's Guide" created for the GIS component, will allow anyone to easily adapt the process to their own needs.

### 4.1 Focus Group Results

The discussions within the focus groups are the most significant result of this project. For the purposes of this project the focus group discussions provide the best insight into the success or failure of our outline. In actual use, the result of the process is best understood through the discussion. The discussion contains the information pertaining to how the focus group members, and ultimately the community, feel about the value of their land.

The process described in Section 3.2.2 was followed for both focus groups, with the exception of the post-test survey. The maps generated by each focus group can be found in following sections. For the actual survey data submitted by the focus group members, please see Appendix A.

#### 4.1.1 Leicester Focus Group Summary

Out of the six people who were confirmed for the Leicester focus group, four attended. There were two town planner board members, a town worker and a local farmer (See Table 7 for the complete demographic information).

<b>Leicester Focus Group Composition</b>		
Age	Hometown	Association
51	Leicester	Town Planner
58	Leicester	Town Planner
61	Leicester	Farmer
N/A	Leicester	Municipal Employee

Table 7: Leicester focus group demographics.

The discussion began with direct criticism of the tool. A zoning layer was suggested immediately due to the fact that a piece of land of high priority to preserve, according to the map (see: Figure 5), was within a recently created commercial district. Leicester had just recently rezoned their town, so the map did not reflect the new zoning. The conversation revolved around this new zoning plan which made it hard for the moderator to channel the discussion towards our main topics. One participant kept reminding the group: “there needs to be money to buy and preserve this land,” even if it is scored highly for preservation.

The cost effectiveness of residential development was the next focus of the discussion. Residential development in the form of single family homes, according to the focus group members, was actually an expense to the town once all of the costs and taxes were considered.

The moderator redirected the discussion onto ecological services after the previous discussion had ceased. Proximity to water was specifically referenced and the local farmer brought up the issues concerning the Massachusetts DEP waterway protection laws and the effect they have on his ability to use his land. Some discussion followed with the farmer and another member which was not related to the nature of this project.

Following this, another member realized one of the implications of green infrastructure. He said, “We are losing a lot of land, and the animals have nowhere to go. Deer and bears have started moving down into our town. I don’t want bears around my house,” which only evoked agreement from the other focus group members. The discussion closed with more direct criticism of the tool and suggestions as to how it could be made more applicable.



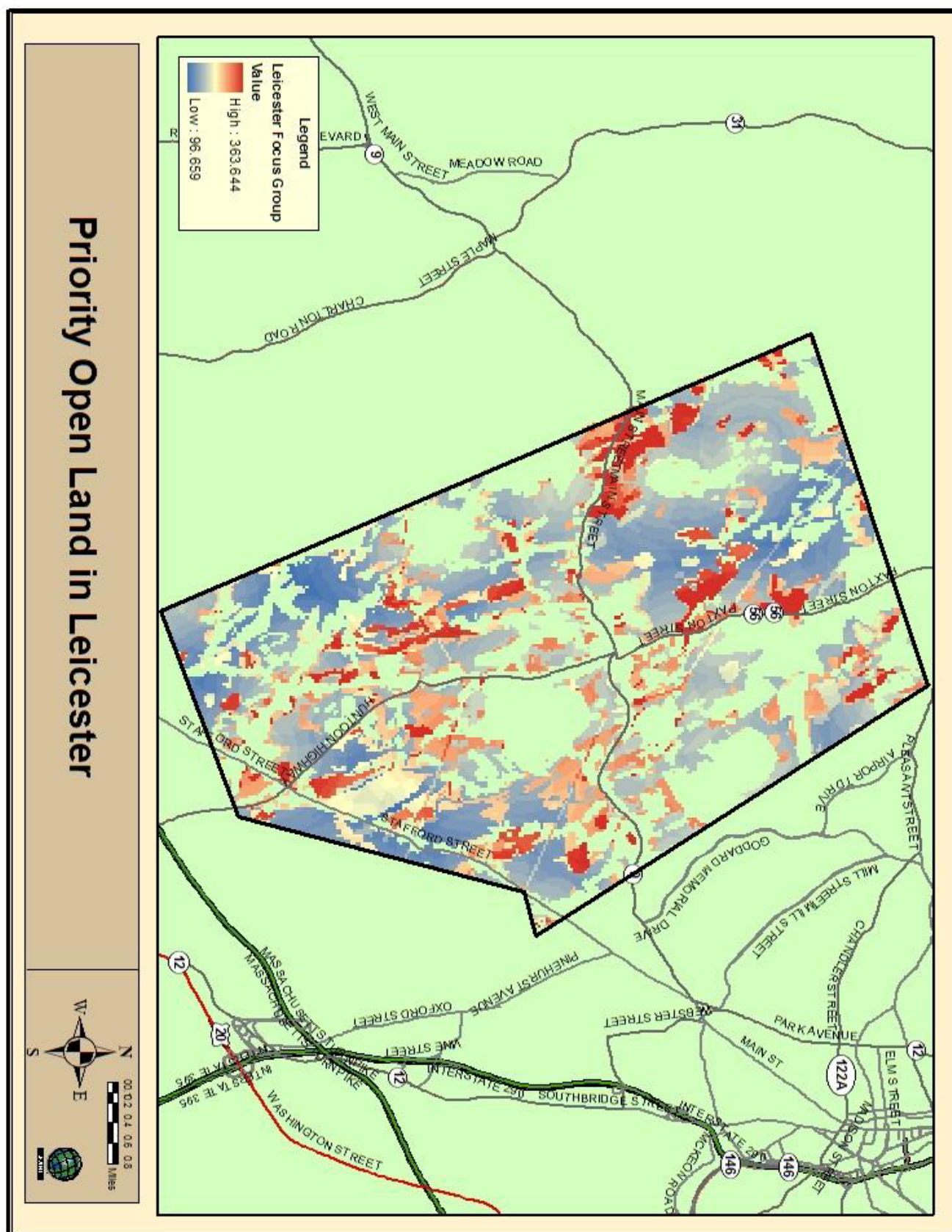


Figure 5: Prioritization map generated in Leicester focus group.

#### 4.1.2 Spencer Focus Group Summary

In Spencer everyone who confirmed attended, or sent someone else to take their place, for a total of three farmers and three conservationists (see Table 8 for complete demographic information).

Spencer Focus Group Composition		
Age	Home Town	Association
63	Spencer	Conservationist
41	Spencer	Conservationist
58	Spencer	Conservationist
N/A	Spencer	Farmer
46	Spencer	Farmer
62	Spencer	Farmer

Table 8: Spencer focus group demographics.

To open the focus group, a member conveniently laid out a broad idea explaining why open space provides value through community sustainability. (See: Figure 6 for the map generated) This brought the conversation to the importance of agriculture in Massachusetts, a point which was unanimously agreed to be significant.

The next topic of discussion was concerning the recreational use of the land and how that brings value to the community. This idea was correlated back to specific areas of the map that contained trails. A discussion of some of the values provided by these parcels followed. A value that was expanded upon was the water sources within the town. Concerns about the ability of the land to protect the water within the community were brought up and discussed at length. A plan of action in which trails should be preserved along rivers and other water sources was suggested through the connection of the two larger concepts of recreational use and ecological services.

A member specifically noted the urgency of the issues concerning open space and farmland preservation following this. Agriculture's loss of importance within the community was spoken about at length and education and land allocation opportunities in farming were specifically noted as important.

Afterwards, through the guidance of the moderator, the discussion was directed towards the significance of economic development within the community of Spencer. The focus group members advocated a revitalization of the existing town center as opposed to large scale commercial development.

Finally, the moderator moved the discussion to the effectiveness of the focus group process as a whole. Many ideas of how to properly educate and reach out to the population were discussed. The focus group naturally closed as topics reemerged and conversation died down.

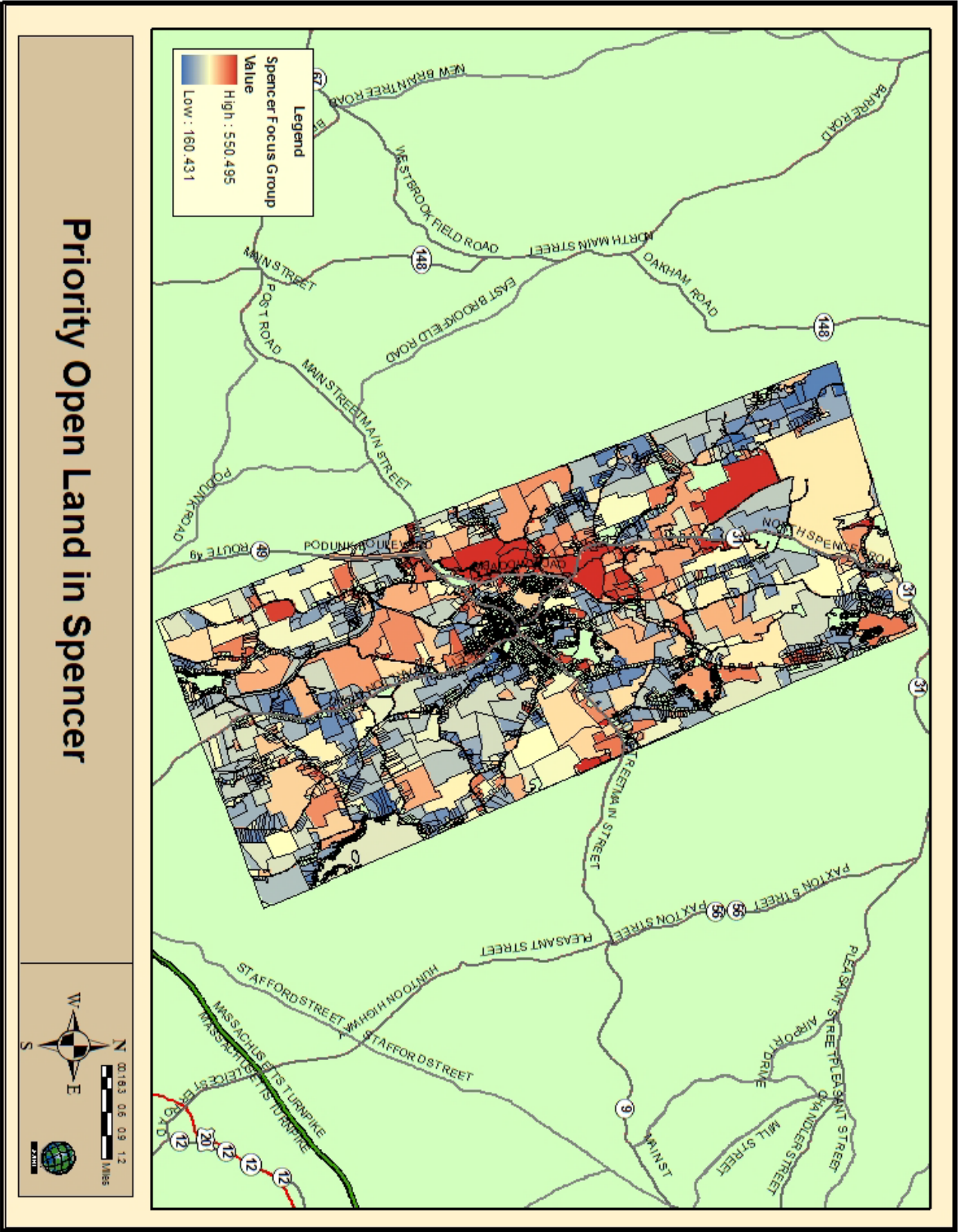


Figure 6: Prioritization map generated in Spencer focus group.

## 4.2 Recommendations

After conducting the focus groups, it was evident that the process was effective in promoting discussion about land valuation. However, there are several places where the process can be improved.

### 4.2.1 Focus Group Composition and Recruiting

- *Direct contact with focus group participants promotes their participation. Print advertisement is considerably less effective.*
- *Local land use knowledge and familiarity with general land use concepts among participants is integral to the quality of the resultant focus group discussion.*

Due to the project design, we were unable to recruit enough people needed to generate a statistically representative sample of the community's opinions. Instead, we specifically contacted people who had a preexisting interest in land use issues and therefore would be most likely to participate in our focus group. Initially two focus groups were scheduled in Spencer, one focus group during the evening and the other during lunch. However when given the choice between the two, the people we contacted exclusively preferred the lunch focus group, resulting in the cancellation of the other group.

Those who came to our focus groups were the individuals whom we contacted directly. We found that our outreach through e-mail, town visits, and the telephone were the methods that were most effective. We were able to get a direct connection to the individual and it was more personal. We also had a press release that was printed in the local newspaper and was posted on the Spencer town website. Due to the time constraints on our project, the press release in the news paper and on web did not have enough the time to air, and most people from the focus group had not heard of them.

The focus groups were designed to get people to talk about their land and to make them think about the use of their land. A key factor in promoting useful and relevant conversation in the focus group is to get an appropriate balance of participants. To achieve this, there are a few things that should be considered when trying to recruit volunteers for focus groups. Primarily, the participants should know the local area and be familiar with the land being discussed.

In our focus groups, people were able to immediately react to the map because they could address specific parts of the land they were familiar with. The participants should also come into the focus groups with preconceived opinions about land use and preservation. Ideally to facilitate discussion, the participants should have some specific knowledge of the key concepts of land use that



are presented in the opening presentation: open space recreation, ecological services, farming, and development.

#### 4.2.2 Focus Group Process

- *The survey should be easily understandable to the anticipated members of the focus group.*
- *Incorporate relevant local data into the presentation describing the tradeoffs between land uses.*
- *Stress that it may not be feasible to preserve the land as indicated by the map, and that the map is meant to encourage discussion rather than actual policy changes.*

##### Survey

Although there was some confusion as to what was meant by the names and description of the factors, the survey was successful in serving two purposes. Most obviously, it successfully provided the numerical data needed to generate the map. The second purpose that the survey served was that it successfully introduced the specific factors in our analysis and therefore the larger concepts to be considered in the discussion. As one member asked, “What is meant by the price of the parcel?” another member responded with, “I think it means whether you want to consider how much bang you get for your buck, or if you want to preserve the best land, no matter the price.”

##### Presentation

After the surveys were collected we gave the introductory presentation. Through this we were able to effectively explain the topics for the discussion and the workings of our tool. In both focus groups, concepts in the presentation immediately sparked discussion, indicating that the presentation was successful in introducing the focus group members to the topics at hand for discussion.

To improve the effectiveness of the presentation, the relationships between the four categories of land use should be stressed. The four land use categories are not mutually exclusive and there are some tradeoffs between them. Although the discussion did eventually touch upon this with the help of the moderator, it would be useful to mention these tradeoffs in the presentation so the participants begin the discussion thinking critically about land use. Also, to keep the topic of the discussion away from the financial and legal aspects of land preservation, as it did in the Leicester focus group, the presentation should stress that the map generated is simply for discussion purposes, not actual preservation purposes.

### 4.2.3 GIS Framework

- *Parcel data is extremely important to participants' understanding and interpretation of the map generated.*
- *Zoning and recreational trail layers should be included in the layers used for analysis.*
- *Any additional layers desired can be added by following the User Guide in the appendices.*
- *The "Level of Investment" layer was poorly understood by focus group members and should be removed from the analysis.*

Even before the focus groups, we knew specific improvements that could be made to our GIS framework. This came in the form of two factors that were used in the analysis of one town but could not be used in the other. Digital data concerning the size and price of each parcel was available for the town of Spencer, but the parcel maps for the town of Leicester are hand drawn and thus we could not integrate this information into the GIS. The lack of parcel lines on the map in the Leicester focus group made it hard to participants to easily identify specific pieces of land, and thus hampered the discussion.

From our focus groups we determined two other specific factors that were not used in our analysis that the members deemed important. The first factor came primarily from the Leicester focus group. Since the town had recently completed a master plan, most of the members there were concerned about the zoning of the area and repeatedly asked what the zoning of a particular area was.

In the Spencer focus group, the participants were interested in the specific location of trails in their town. This was important to the members as they argued that a good network of trails helps bring people to their town, and provides valuable recreation for the people in the town.

Since both focus groups identified layers that we did not incorporate into our analysis, we have created a "User's Guide" to the GIS software, which describes the process for adding data layers to the analysis framework. The user guide can be found in the appendices of this document.

Also, in both focus groups the Level of Investment layer was a confusing concept. The level of financial investment towards farming is a useful way to compare one area of farmland to another, but was confusing when discussing open land in general. This layer could be removed and replaced by a layer that identifies just the areas of existing farms.

## 5. Conclusion

The process described in this report has been shown effective in providing a way in which to better understand how a community values their land. And this cannot occur without the focus group

discussion. While the map produced is primarily a way to discuss the values of individual parcels, it also provides a means to discuss the larger ideas behind preservation prioritization to specific areas of the town, and help build consensus among group members.

In the discussion the focus group participants bring up topics and share opinions that matter to them individually. This discussion process causes a reconsideration of their initial ideas, because not only will they have to defend their ideas in front of the group, they will have to reconcile them to the map created from an average of the group's priorities. In this way the map serves a dual purpose, because not only is it used to start the discussion with the focus group members, it can be also used to help explain the results of the discussion to a planning board or other organization. The maps of different focus groups could be compared and contrasted to help explain the differences in the discussion.

The prioritizations generated in the group also have some tangible value in addition to their conceptual value. If after comparing the maps of several different focus groups an area keeps coming up as important for preservation, concrete actions could be considered. The survey, presentation, and map created by the survey all feed into the discussion where it is possible to elicit what matters to the members of the focus group. Using the maps and the focus group process it is then possible to obtain a more accurate understanding of the community preferences towards open land preservation, and use this opinion to guide land use decision-making processes within the local community.



## 6. References

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# Appendix A

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*GIS Framework User's Guide*

*Graphical Representation of Layers Used in Analysis*

*Survey Data Used to Generate Weightings*

Worcester Polytechnic Institute

# GIS Framework User's Guide

A Process for Incorporating Community Perspectives in Open Space Preservation

Mass Farms IQP

Sponsor: Massachusetts State Representative Anne M. Gobi

Authors:

Nick Crider

Peter Maurer

Austin McDannald

Caleb Oswald

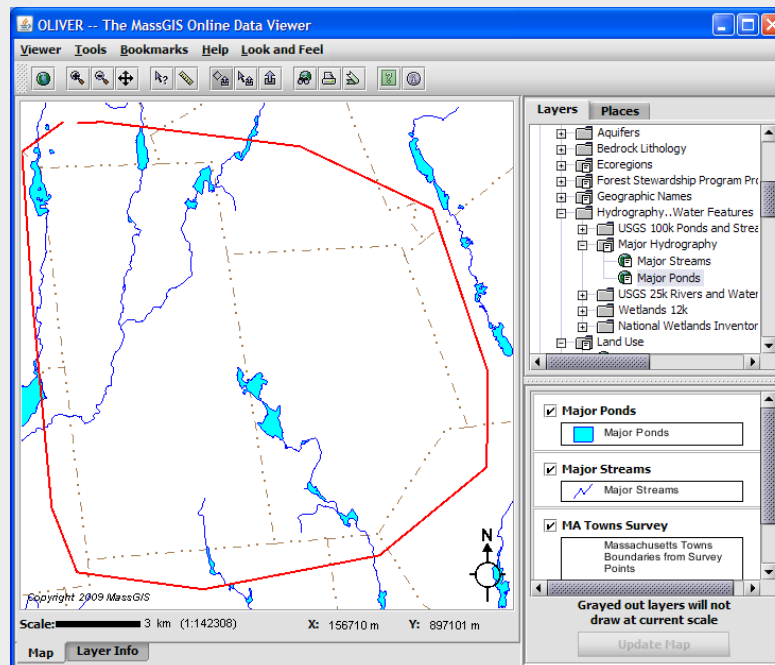
April 30, 2009

# Users Guide

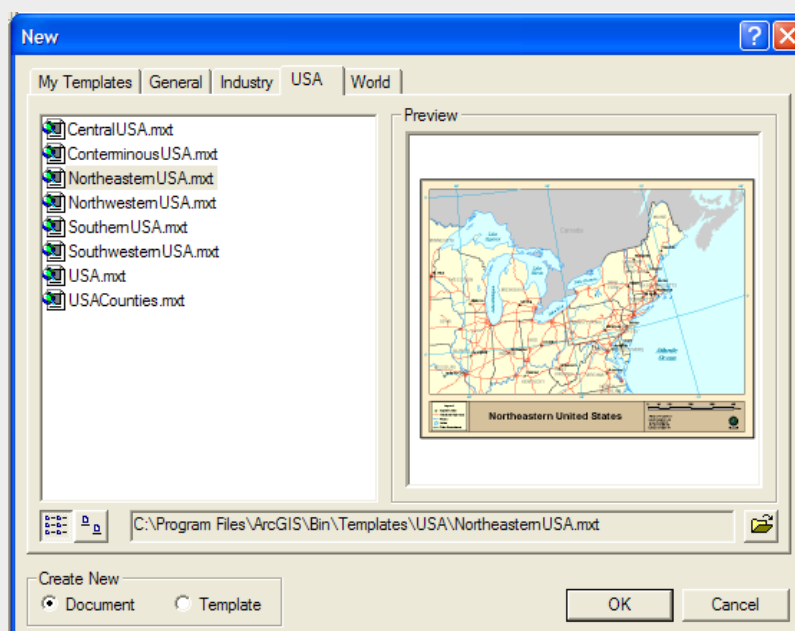
This guide is intended to help you recreate the mapping framework that was used in the attached report. The following will provide step-by-step instructions for adding more map layers into the analysis, starting with obtaining the raw input data all the way to the final map produced. After installing ESRI's ArcView 9.3 and the Spatial Analyst extension on a compatible computer, you are ready to start.



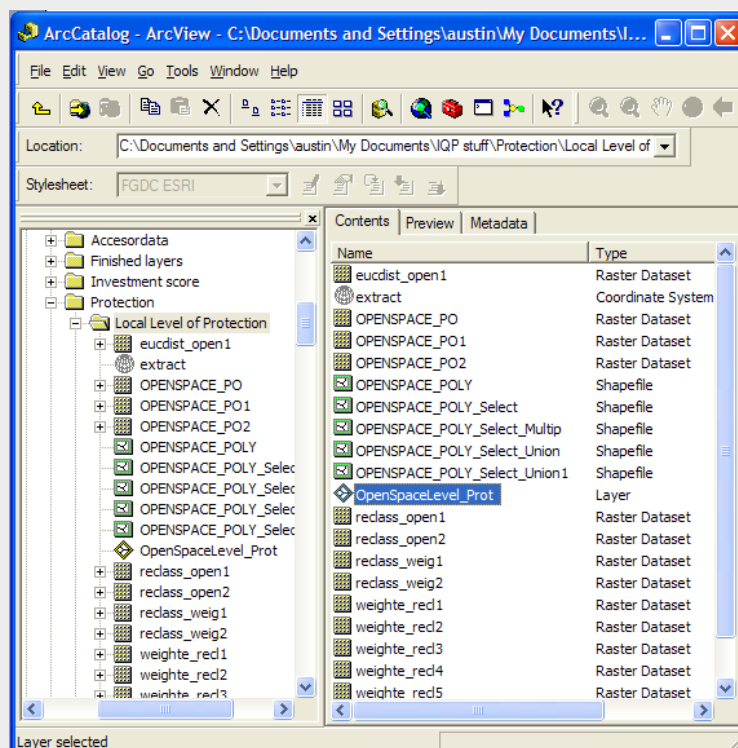
Step 1. Find a source for the information data layers. We used the publicly available MassGIS data. If possible collect the data only for the area you are concerned with; we were able to do this with the help of the MassGIS online data viewer, Oliver.



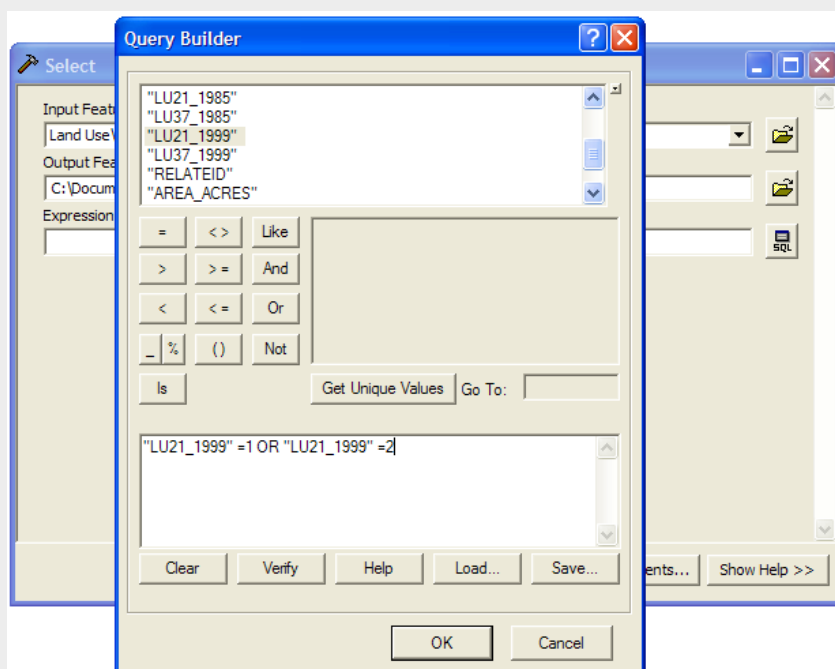
Step 2. Start with a base map to add the data to. ArcView comes with several starting maps. We used a simple one of the New England area.



Step 3. Use ArcCatalog to add the collected information data layers to the map.

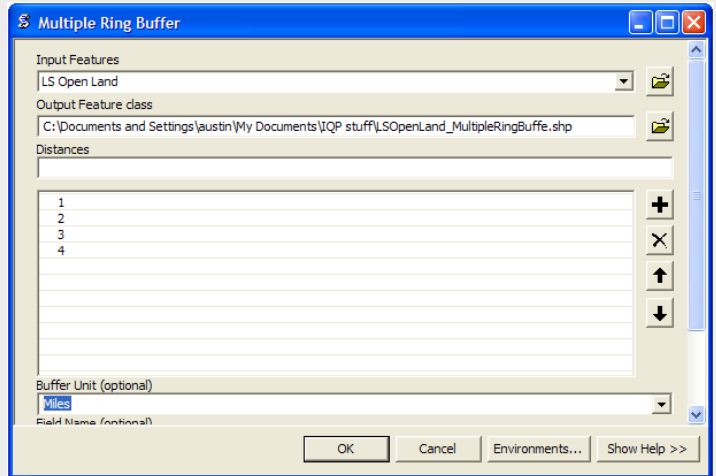
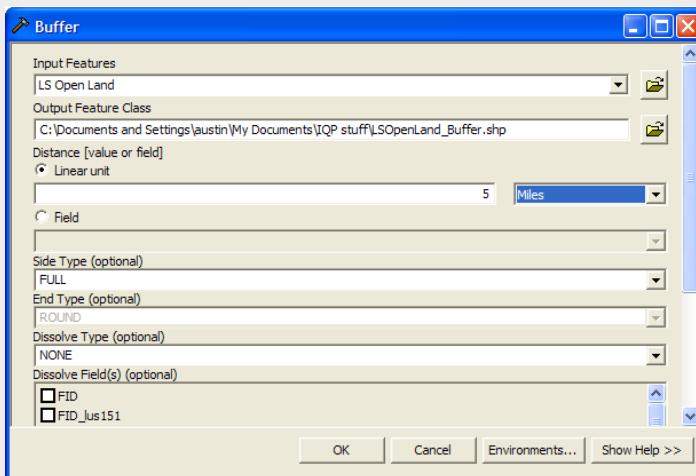


Step 4. Use the Land Use data to create a base layer that can be used in the analysis. Use the Select tool to select the open lands from the land use values. The input value for our case was called LU21\_1999, for the 21 land use category data from 1999.

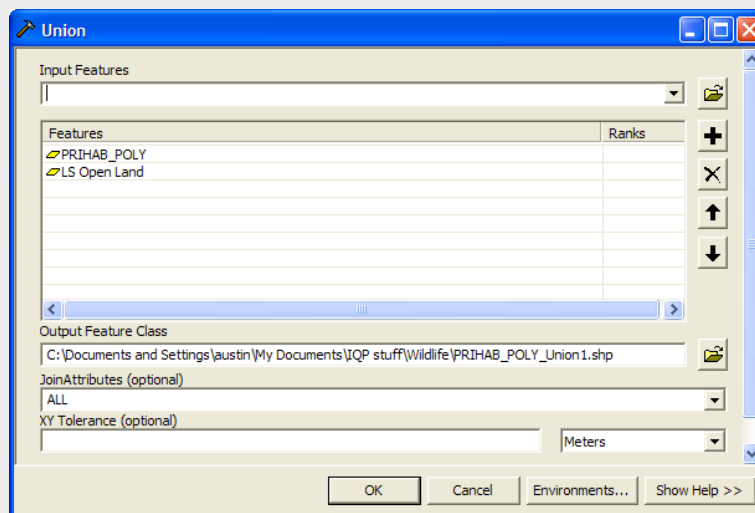


Step 5. In order to perform the analysis, it must be decided for each factor whether it will be a gradient, have a few intermediate values, or be binary. It will also be necessary to decide on a scale that every factor will be scored on. We used a scale from 1 to 10.

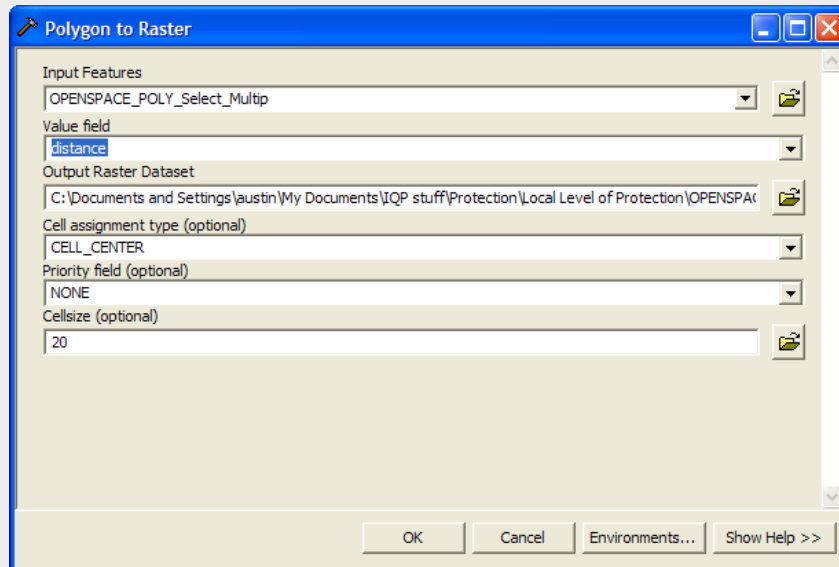
Step 6. For factors that are concerned with the proximity, a buffer analysis is necessary. For the binary factors, use the Buffer tool, then take the result and use the Union tool to add it to the base layer created in Step 4. For the factors that are not binary use the Multiple Ring Buffer tool. This tool creates a buffer that is divided in to different rings. Use as many rings as increments as decided were necessary in Step 5. The outermost ring should cover the entire town. To find the smallest distance that will still cover the entire town use the Buffer tool and guess and check until the buffer just covers the town.



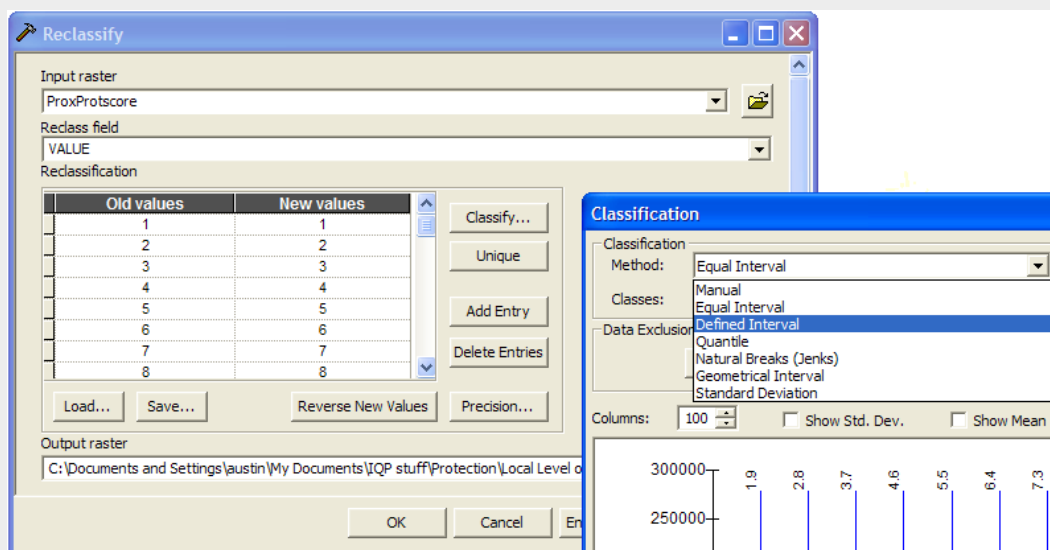
Step 7. For factors that only have values for certain areas of the town, wildlife habitats for example, use the Union tool to add this data to the base layer created in Step 4.



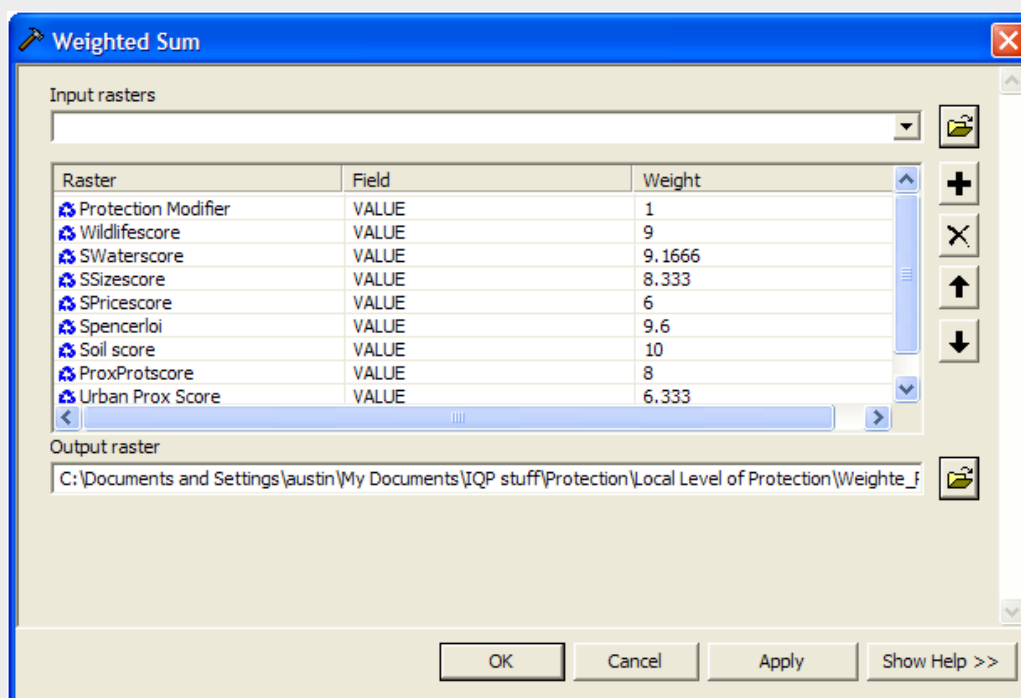
Step 8. Take the results of Steps 6 and 7 and the factors that have values for all areas of the town, the size of each parcel for example, and convert them to a raster using the Polygon to Raster tool. For the factors in Step 6 use the buffer distance as the input features. For all other factors use the input values associated with the relevant information.



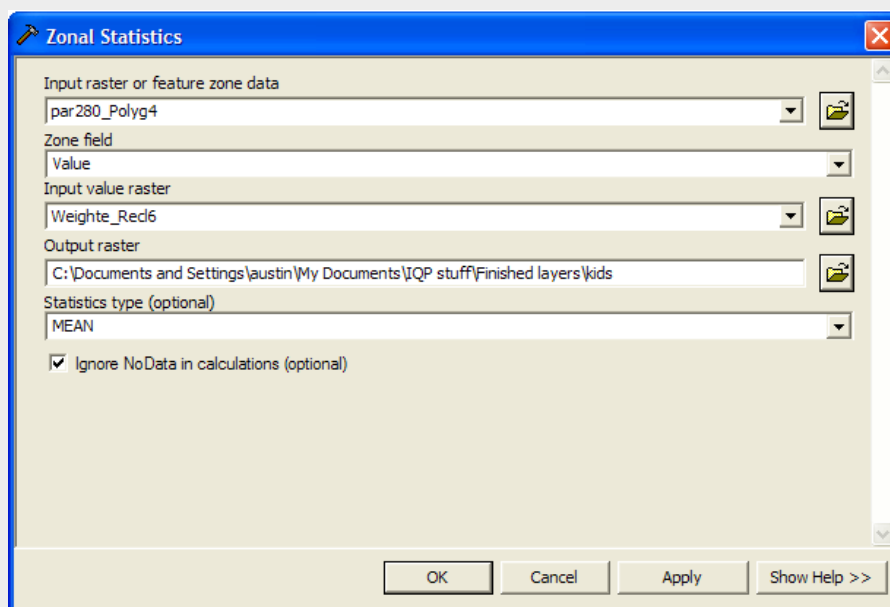
Step 9. Use the Reclassify tool in the Spatial Analyst extension to convert each factor to the scale decided on in Step 5. Most of the factors have already been divided into the categories of the scale in Steps 6 and 7. Other factors, such as the size of each parcel, have yet to be broken into these factors. This can be done a variety of ways, such as equal intervals or natural breaks, using the Classify function of the Reclassify tool.



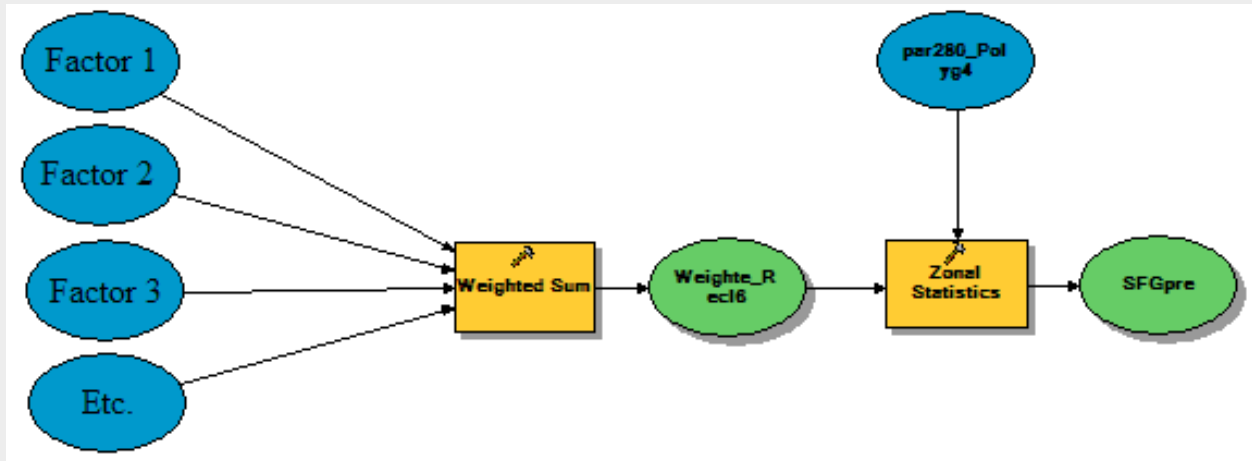
Step 10. Use the Weighted Sum tool in the Spatial Analyst extension to add all of the factors together.



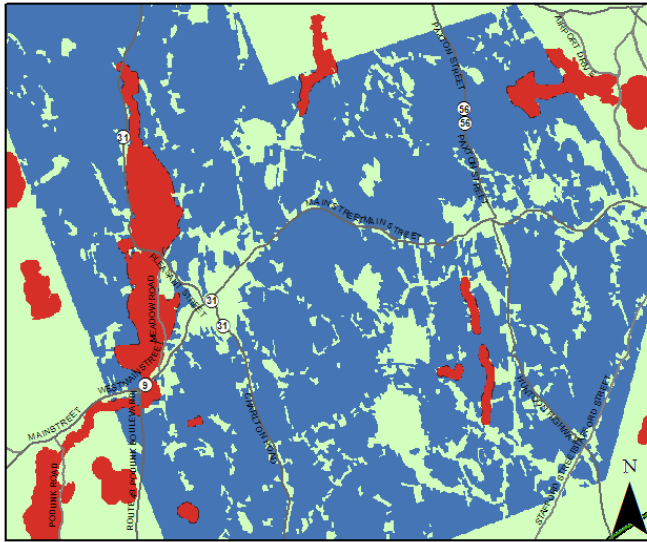
Step 11. If parcel data is available, use the Zonal Statistics tool to average the final scores over the area of each parcel. Convert the parcel vectors to a raster using the unique identifier for each parcel. This raster will be the input zone raster, while the result of Step 10 will be value raster.



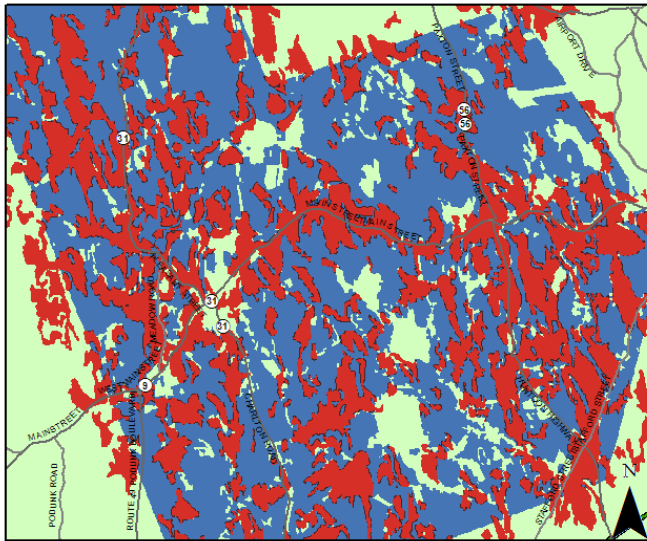
Step 12. It is easy to omit the areas that you are not considering by creating a raster that has a value of zero for the lands considered and no data for the lands not considered. For example we did not consider any lands that were permanently protected or already developed. To do this we used the Union tool to add the open lands, created in Step 4, to lands that are not permanently protected. Convert this to a raster and reclassify so that all the lands considered have a value of zero. Use the Weighted Sum tool to add this raster to the raster created in Step 11. Note that Steps 10 through 12 can be easily done in the model builder.



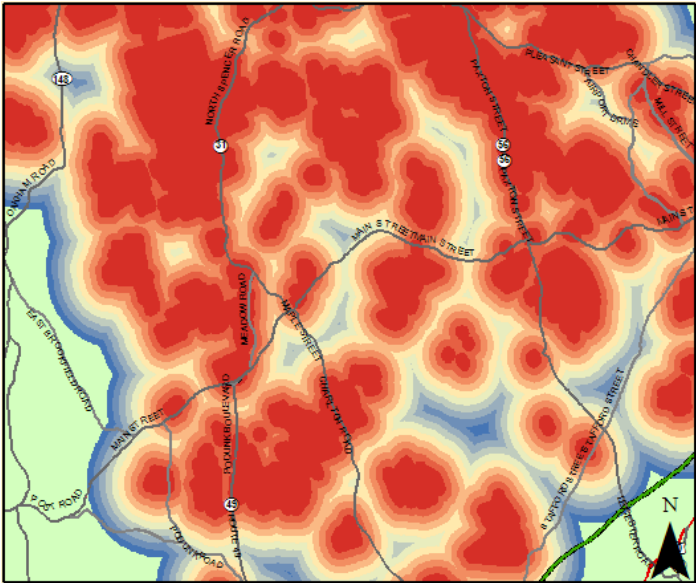
## Layers Used in Analysis



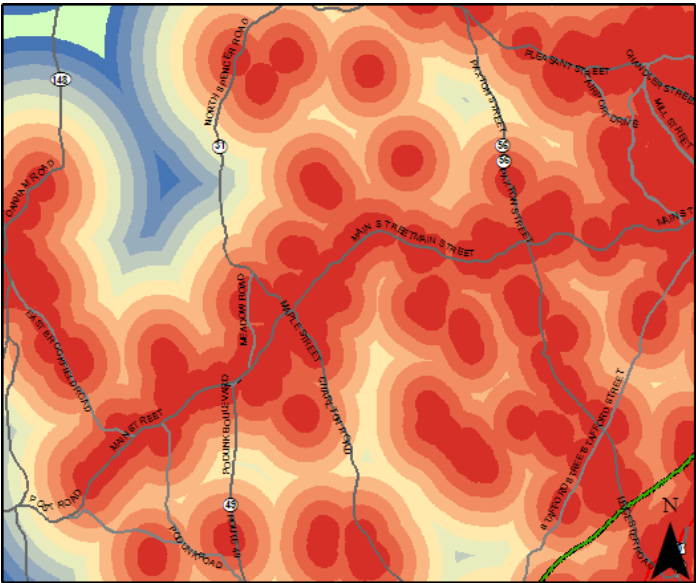
Wildlife Habitats



Prime Farmland



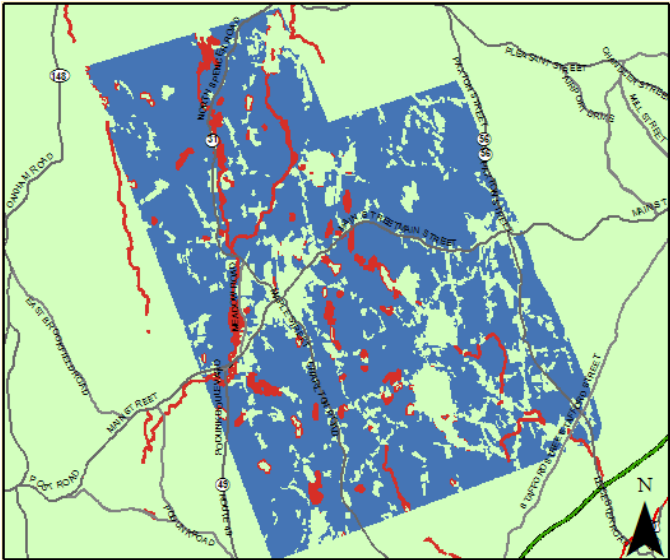
Proximity to Permanently Protected Areas



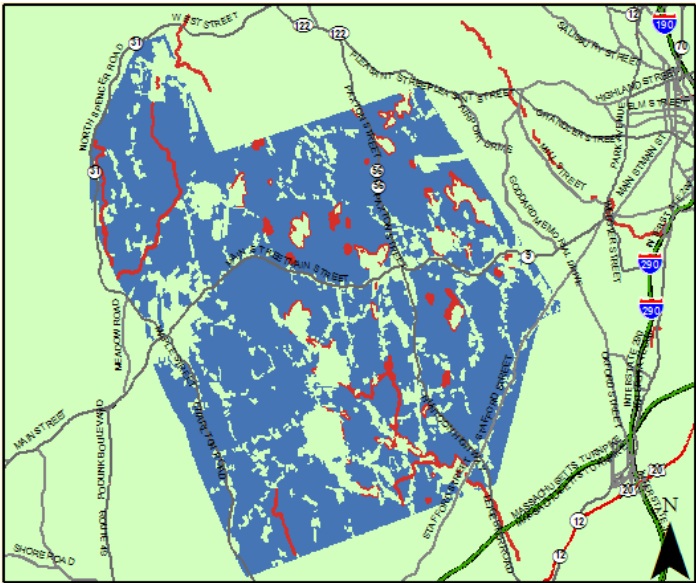
Proximity to Urban Areas



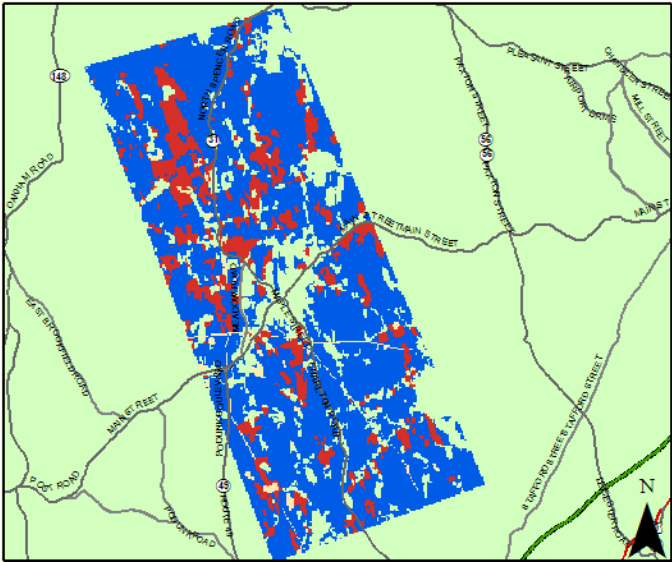




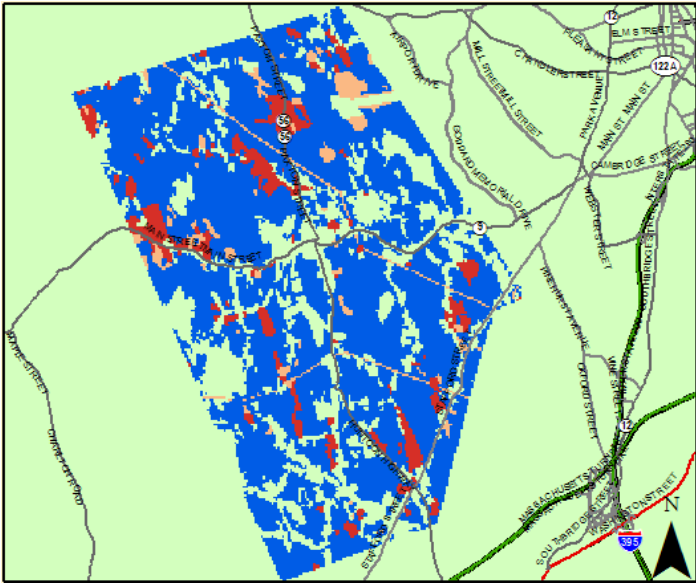
Proximity to Water Sources in Spencer



Proximity to Water Source in Leicester



Spencer Level of Investment



Leicester Level of Investment

## Survey Data Used to Generate Weightings

### Leicester Focus Group

	Member 1	Member 2	Member 3	Average
Prime Farmland	9	9	8	8.7
Level of Investment towards Farming	8	8	6	7.3
Wildlife Habitats	6	8	7	7.0
Water Source Proximity	8	5	8	7.0
Proximity to Permanently Protected Areas	8	6	6	6.7
Proximity to Urban Areas	6	8	6	6.7

### Spencer Focus Group

	Member 1	Member 2	Member 3	Member 4	Member 5	Member 6	Average
Prime Farmland	10	10	10	10	10	10	10.0
Level of Investment towards Farming	8	N/A	10	10	10	10	9.6
Wildlife Habitats	10	8	10	10	8	8	9.0
Water Source Proximity	10	10	10	10	8	7	9.2
Proximity to Permanently Protected Areas	9	6	10	8	8	7	8.0
Parcel Size	8	7	10	7	8	10	8.3
Parcel Price	7	0	10	8	6	5	6.0
Proximity to Urban Areas	7	7	5	8	6	5	6.3

# Appendix B

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*Focus Group Press Release*

*Leicester Planning Board Open House Pamphlet*

April 3, 2009 – FOR IMMEDIATE RELEASE

### **Open Space Preservation in Spencer and Leicester**

Research conducted by the Massachusetts Audubon Society indicates that the state is losing over 40 acres of open land per day to development. The continued existence of open land in Massachusetts is integral to maintaining both the historic rural character of the state and the integrity of its fragile ecosystems. It has been calculated that open space provides Massachusetts with over \$6 billion annually in “free” ecosystem services such as water treatment and flood regulation. And these free services – along with critical wildlife habitats – are lost when the land is developed for commercial and residential use.

High housing prices in the greater Boston area encourage affordable home buyers to look west, creating a “sprawl frontier” of development expanding past the I-495 corridor directly threatening the unprotected open lands in Leicester and Spencer. To address this, the Common Ground Land Trust is partnering with local landowners to protect the remaining forests, farms, and scenic and historic areas of Spencer and Leicester for the use and enjoyment of the community. However, this cannot be done without an understanding of what lands are important to the community.

Massachusetts State Representative Anne Gobi is sponsoring a group of Worcester Polytechnic Institute researchers conducting a study of open land in your area. They will be holding a series of focus groups in Leicester and Spencer so that local residents can express their opinions on land use and open space preservation in their towns. The information gathered from these groups will directly influence the future actions of both the CGLT and local government with regard to open space in your community.

An evening and a lunchtime session will be held in the Spencer Library community room on Tuesday, April 14 from 5:30pm-7pm and Thursday, April 16 from 11:30am-1:30pm. And a third session will be held in the Leicester Library community room on Wednesday, April 14 from 6pm-8pm. A light meal and refreshments will be provided for your convenience at all sessions. Each session is intended for residents of both towns; please contact [farms09@wpi.edu](mailto:farms09@wpi.edu) if you are interested in participating.

Residents of Leicester and Spencer are encouraged to attend the focus groups because their opinion will directly affect land preservation efforts in their communities. The Common Ground Land Trust seeks provide the greatest benefit to the community through its preservation efforts, and this can only be accomplished with your input.

Common Ground Land Trust, Inc. – As a private, non-profit land trust, Common Ground Land Trust Inc. (CGLT) partners with landowners to protect the remaining forests, farms, and scenic and historic areas of Spencer and Leicester for the use and enjoyment of present and future generations. Our goal is to protect our natural resources, at the same time helping landowners find alternative solutions to selling their land for development. – [www.commongroundlt.org](http://www.commongroundlt.org)

XXX

## Focus Groups Dates

Please contact us if you are interested in participating in our focus groups.

Mass Farms IQP Group

farms09@wpi.edu



WPI Mass Farms IQP

Mass Farms IQP Group

Date: Tuesday April 14, 2009

5:30 pm - 7 pm

Location: Spencer Public Library



State Representative  
Anne Gohi  
Fifth Worcester District



Date: Wednesday April 15, 2009

6 pm - 8 pm

Location: Leicester Library Conference Room

Mass Farms IQP Group

Nick Crider  
Peter Maurer  
Austin McDannald  
Caleb Oswald

Sponsor: Mass. Rep. Anne Gohi

E-mail: farms09@wpi.edu

Preservation of  
Land In Leicester  
& Spencer



## Our Goal

We are a group of WPI students sponsored by Representative Anne Gohi, researching land preservation issues in Spencer and Leicester. We aim to provide recommendations to organizations that are preserving land based on community preferences.



## Prioritization of Open Space

Not all land needs our immediate attention, but there needs to be a way to determine which lands needs protection. Focus groups will be conducted to gather the community opinions and using this data we will be able to determine the most suitable land to preserve. Through carefully formulated questions we wish to stimulate a conversation that will ultimately better reflect the community's position on the matter.

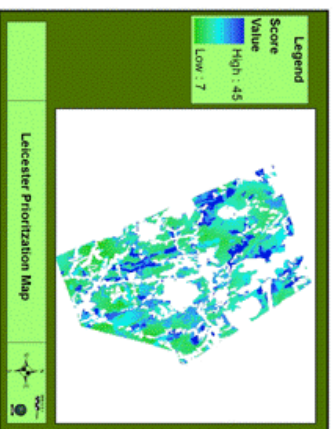
## Come Share Your Insight and Opinions

## Our Framework

Using GIS mapping software we have calculated several criterion for valuing land. Represented as varying colors on a map of the town, these amenities allow us to determine which parcels of land contain the most desirable attributes. The focus groups will allow us to collect the community's opinions, and by weighting the amenities appropriately, our maps will reflect which land the community finds most important to preserve.

## The Importance of Land

Leicester, as a community, collectively owns the land within the town. The decision of what is to be done with this land is most appropriately decided by the community. Effectively collecting and displaying the community's preferences and acting upon them allows land to provide the greatest social benefit.



## Mass Farm's IQP Group

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# Appendix C

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*Focus Group Survey*

*Focus Group Presentation Slides*

*Focus Group Discussion Outline*

## Developing a Framework for Open Space Prioritization in Rural Massachusetts

### Worcester Polytechnic Institute Research Group

We are interested in how community members value the town's open land against the criteria below. Please write in a numerical value for each criterion below in the space provided. Chose your value based on level of importance on a scale from 0 to 10. The same value can be given to more than one criterion.

Exclude Criterion = 0 · 1 · 2 · 3 · 4 · 5 · 6 · 7 · 8 · 9 · 10 = Utmost Importance

Land Criteria	Value
<b>Prime Farmland</b> Prime farmland includes areas with good soil and slope conditions	
<b>Level of Investment towards Farming</b> The amount of financial investment towards farming that is currently on the land	
<b>Wildlife Habitats</b> Priority habitats of rare species determined by the NHESP	
<b>Water Source Proximity</b> Areas within 150 feet of rivers, streams, and other surface water sources	
<b>Proximity to Permanently Protected Areas</b> High values given to lands close to permanently protected areas	
<b>Parcel Size</b> High values given to large parcels of land	
<b>Parcel Price</b> High values given to the least expensive parcels of land	
<b>Proximity to Urban Areas</b> High values given to lands close to developed areas	

### Demographic Questions:

1. Age\_\_\_\_\_ 2. What town do you live in? \_\_\_\_\_

3. What group do you most associate with? Please circle one.

Developer   Town Planner   Farmer   Conservationist   Other\_\_\_\_\_

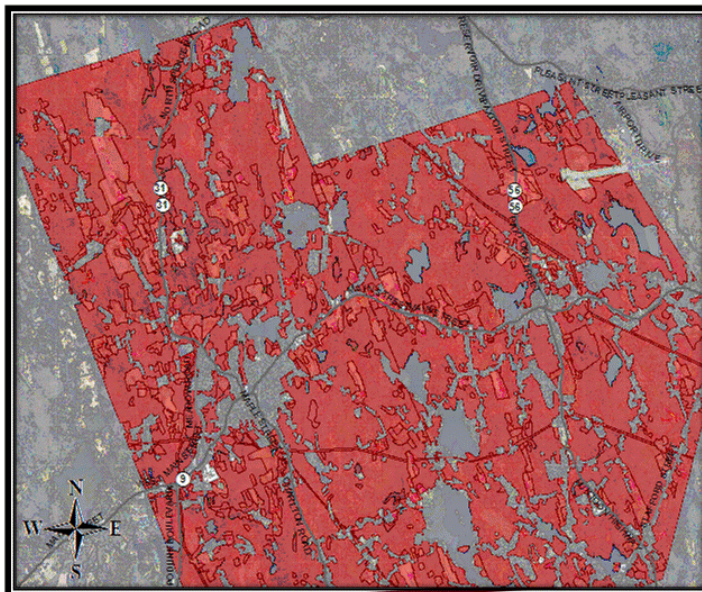


## A Focus Group to Explore Land Use Priorities

**WPI**



## Open Space in Leicester and Spencer



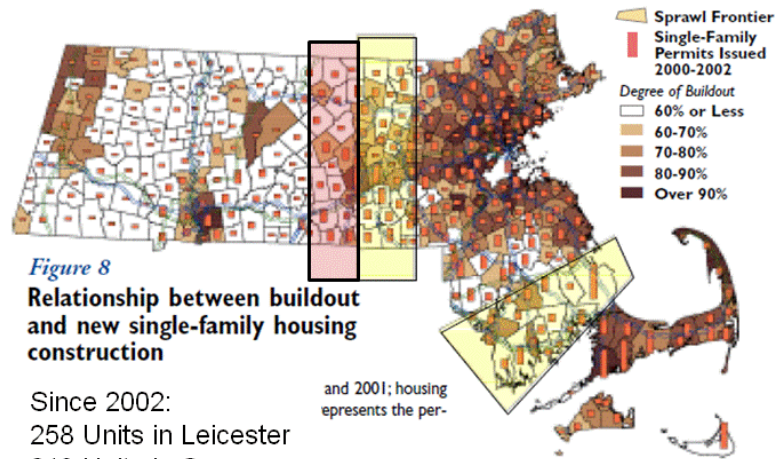
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**WPI**

# Development Pressure

## Buildout and Sprawl Frontier 2000-2002



3

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## Open Space in Leicester and Spencer



4

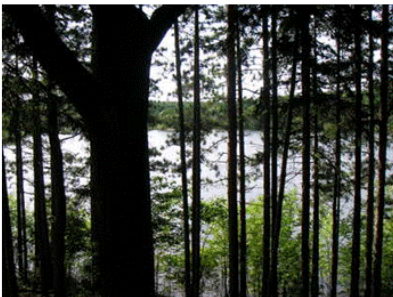
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# Ecological Services



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# Open Space





## Farmland



WPI

## Development



WPI

## Land Use Factors

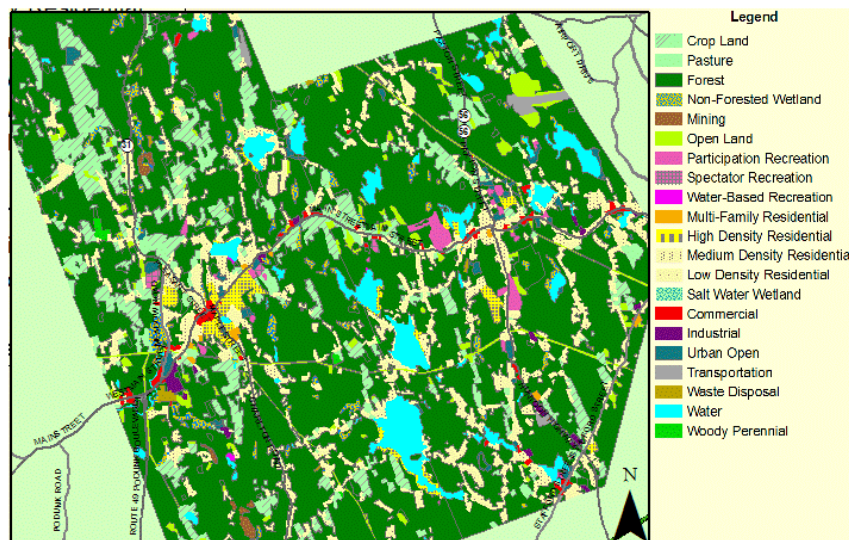
- Proximity to Preserved Land
- Proximity to Water
- Proximity to Developed Land
- Level of Investment
- Wildlife Habitats
- Prime Farmland
- Parcel Size
- Parcel Price

9

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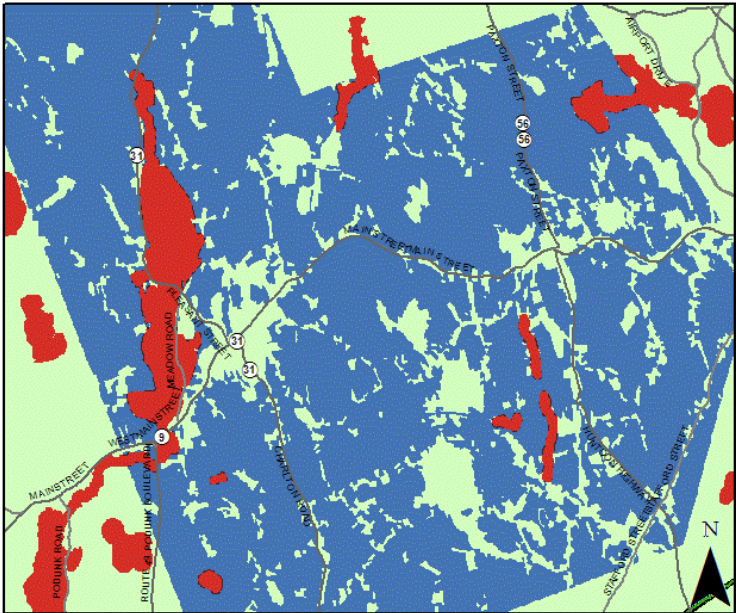
## Land Use Map



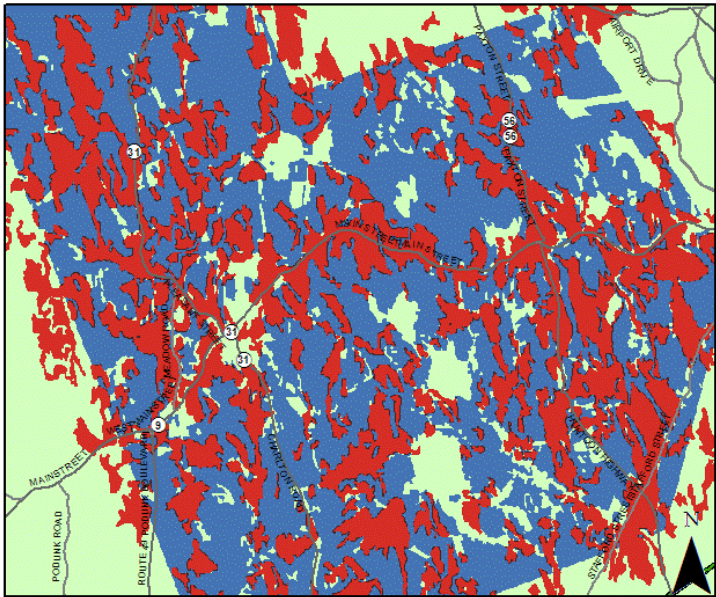




# Wildlife Habitats



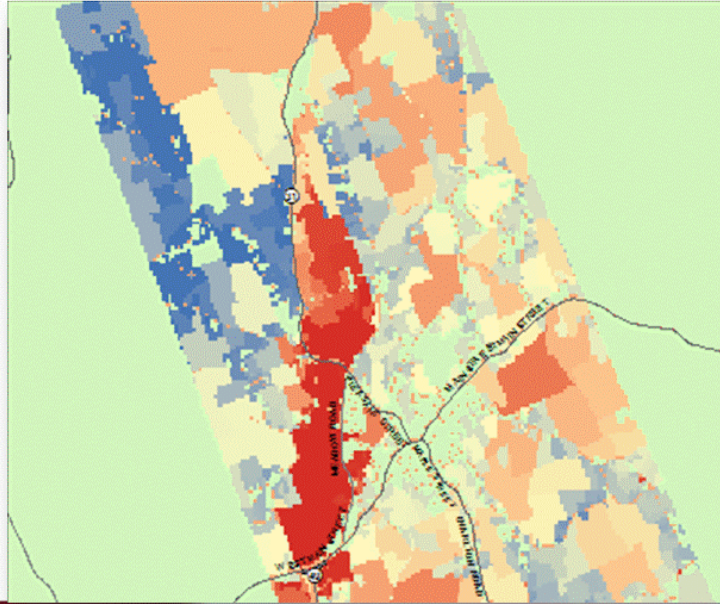
# Prime Farmland







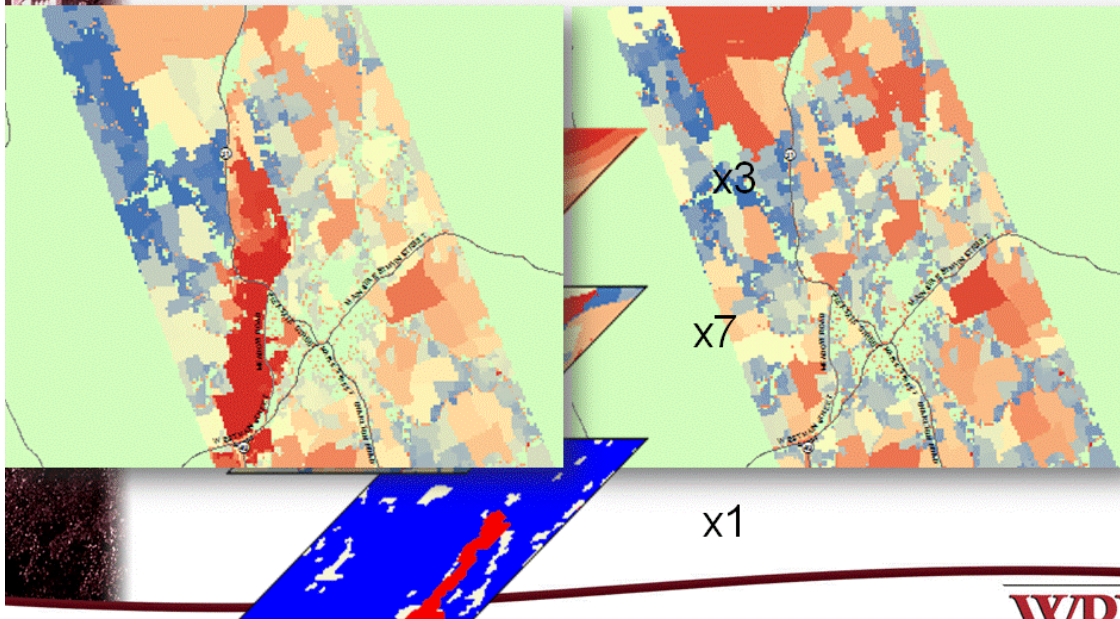
## Weighting



WPI

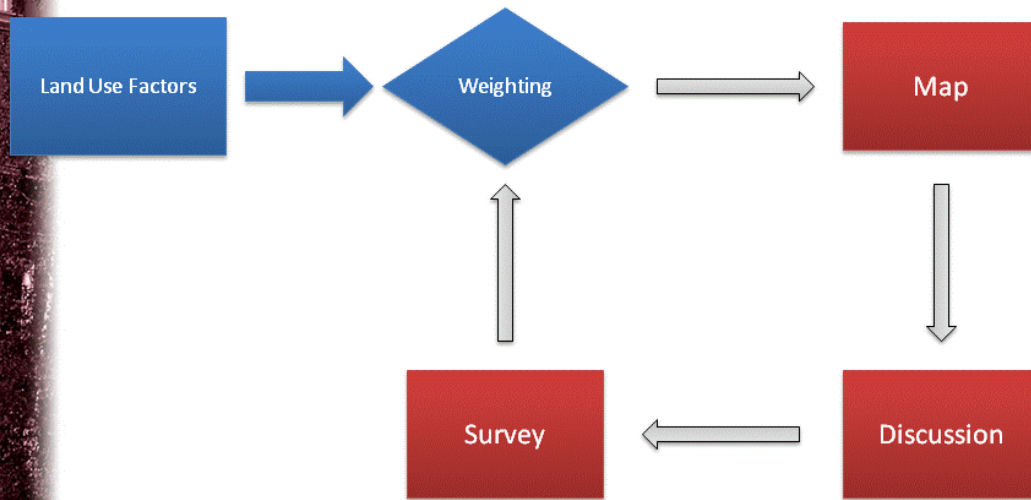


## Weighting



WPI

## What We're Going to do Today



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## Focus Group Discussion Topics

Help the participants to better understand the trade-offs in land values.

### ❖ Ecological Services

#### ➤ **Water issues (purification, flood control)**

1. *How vulnerable do you think your town is to floods?*
2. *Is pure water of local importance?*
3. *Do you think development near water sources contributes to pollution?*

#### ➤ **Plant and wildlife habitats**

1. *Are there any rare plant and wildlife species in your town you are aware of?*
2. *Do you think wildlife habitats are a valuable resource in your community?*

#### ➤ **Greenways (green infrastructure, connectedness)**

1. *Does the total acreage of preserved land have any bearing on its value to the community?*
2. *Studies report open space saves Massachusetts over \$6.3 billion dollars a year in annual ecological services. Do you see any direct evidence of this? Is it a valid estimate?*

### ❖ Farmland Preservation vs. Open Space

#### ➤ **Traditional economic issues (productivity)**

1. *How important do you think farming is to the local economy?*

#### ➤ **Ecological services provided by farms vs. open space (additional pollution)**

1. *Are farms as valuable as parks and other publicly accessible open space?*
2. *Is an operating farm more important to preserve than a piece of land which provides flood protection?*

#### ➤ **Contribution to rural character**

1. *Do you consider Leicester and Spencer rural communities?*
2. *Is your town becoming more or less rural?*
3. *How vulnerable do you think your town is to urban sprawl?*

### ❖ Development Pressure

1. *Is commercial/industrial or residential development more valuable to your town?*

➤ **Distance from developed areas**

1. *Do you prefer a land preservation strategy which: creates a buffer around developed areas, or preserves pristine lands far away from developed areas?*

➤ **Undevelopable areas**

1. *Ideally, where should new development occur in your town?*
2. *Are there any parcels in your town that you think are “undevelopable”? If so, should they be protected?*

➤ **Recent examples of development (Wal-Mart)**

❖ **Implication of Land Use on preservation**

➤ **Land of historical importance**

1. *Is it important to preserve properties of historical importance? Are these areas more at risk to be developed than an average open parcel?*

➤ **Recreational Uses**

1. *Many land preservation programs tend to ignore the recreational value of land and focus more on the farming or ecological aspects. Is this appropriate?*

❖ **Layers Missing From Analysis**

1. *What is the single most important amenity provided by open land?*
2. *What benefits do you expect to gain from preserved lands?*

### Open Space

- Ecological services
  - Water issues
- Green Infrastructure
- Potential for development/farming
- Plant and wildlife habitats
- Green ways
- Rural character

### Farmland

- Produces goods
- Provides some ecological services
  - Water issues
- Green Infrastructure
- Potential for cluster zoning
- Rural character

### Development

- Tax base
- Residential vs. Commercial services
  - Stores
  - Restaurants
  - Housing
- Suburban character