THE PROSPECT OF A MARKET IN DEVELOPMENT RIGHTS TO ALLOCATE LAND TO PERMANENT PRESERVATION

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Authors: Paul Thorsnes, Ph.D Economics
Rod Denning, Research Associate

Principle Investigator: John Koches, Program Manager

Annis Water Resources Institute
Grand Valley State University
Lake Michigan Center
740 W. Shoreline Drive
Muskegon, MI 49441

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PREFACE

The purpose of this report is to investigate the potential for a market in development rights to play a practical role in the allocation of land between permanently preserved and developed uses in developing suburban areas. The motivation for the project comes from two sources. First, markets in tradable rights are showing success in allocating resources in other types of settings, such as fishing rights and sulfur-dioxide emissions. Secondly, some of the methods of land preservation currently in practice – specifically cluster zoning on large parcels and transfer of development rights programs – appear to represent an evolution toward a more general role for a market in development rights. This report describes that more general role in the context of a case study of a developing suburban jurisdiction in the Grand Rapids, Michigan metro area.

The choice of the area for study was strictly ours. Neither the elected officials nor the planning staff in the jurisdiction requested that this study be conducted, nor did they exert any influence on the analysis. The views reflected in this report are strictly ours, and the responsibility for the work remains entirely with us. That said, jurisdiction staff were extremely helpful in assisting us with data collection, and we are indebted to them for their willingness to help us on this project.

The analysis of the development rights market is conducted with the tools of mainstream urban land economics. Though we have tried to make this report accessible to as general an audience as possible, be warned that the report contains technical material that may be difficult to understand fully without a background in economics. The key advantage to these analytical tools is that they are designed specifically for this kind of application.

The technical material comes in two forms. First, the analysis builds on a simple model of the suburban land market as described in Chapter 1. This represents a relatively straightforward application of a model that is standard in environmental economics. Nevertheless, a full appreciation of the model may require the background provided in most textbooks in introductory economics and environmental economics. Teitenberg (2000) is a good reference, though essentially any of the introductory texts found in college bookstores would serve.

The other technical material involves statistical analysis. Empirical work in economics often requires the use of regression analysis. The analyses presented in this report represent rather straightforward applications of regression analysis. But regression analysis in general represents a fairly sophisticated form of statistical analysis. Though we try to explain the results of the statistical analyses in a way that is understandable to non-specialists, fully understanding the analysis may require some background work in regression analysis. Again, any introductory text in econometrics could supply that background. Specific questions can be directed to the authors.

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CHAPTER 1

INTRODUCTION TO THE METHODS OF LAND PRESERVATION

I. Introduction

This report focuses on a certain method – a market in development rights – with which to allocate land in developing suburban areas across developed and permanently preserved natural uses. That is, the focus is less on whether land is preserved, and more on how to choose the tracts of land that get preserved from those that are allowed to develop. In the extreme, a market in development rights gives to the owners of land and development rights the power to choose which tracts get preserved. In this sense, the allocation decision is decentralized. At the other extreme is what is usually referred to as regulatory allocation: some governmental body is given the power to choose what land is preserved and what land is allowed to develop. Clearly, this involves a more centralized decision-making process.

Notice that we describe purely market and purely regulatory allocations as extremes. In practice, the allocation of most resources – not just land – in market-oriented economies occurs in an environment in between these extremes. Automobiles, for example, are manufactured by private companies and traded in markets to private consumers. A wide variety of federal and state regulations, however, influence how those automobiles are designed, assembled, and marketed. And, of course, the boards of directors of large privately owned companies are themselves governance bodies. In contrast, most children in the U.S. go to publicly owned and operated schools; the elected school board adopts district-wide school policies. But the market influences the public allocation of resources: some parents choose to send their children to private or charter schools, and parents can 'shop' school districts when deciding where to buy a home. This mix of allocation mechanisms is why most introductory economics texts describe ours as a mixed-market economy.

This mix is especially pronounced in local land markets. On the one hand, most land in suburban areas is in private ownership. The owners of that land are free to decide when and to whom to sell. And the owner usually has some discretion about how to use his land. But local governments exercise considerable power over the land owner's choices. The local government provides or regulates the provision of most 'public' infrastructure: roads, water, sewer, drainage, energy, and so on. They regulate the characteristics of private development. And they have the legal power to allocate land across uses through zoning. In practice, the market allocation of land across uses is almost certainly influenced by the combination of public development regulations, land-use plans and zoning, and capital-improvement programs. The extent of this influence varies by jurisdiction.

Critical to understanding the public role in local land markets is that the local government really is for the most part local. Local government policy makers almost always consist of locally elected representatives. In smaller jurisdictions these positions are often part-time; the office holders make their livings in some other way. Full-time public employees are hired to inform decision-making and to execute decisions, and it is not unusual to see conflict among full-time staff and elected officials. But all of these people usually are locals, and suburban jurisdictions are often intentionally kept small to keep decision-making local.

In general, this localness has mixed effects on the ability of local officials to regulate resource allocation. On the one hand, their localness gives them access to better information than is generally available to more distant officials. The manager of a production plant similarly has a better understanding of what goes on in his plant than does a regional manager. But the fact that he has to interact regularly with those he's regulating limits his ability to impose a regulatory allocation. Due to his distance, a regional manager is generally more able to impose a policy change than is the plant manager. Unlike corporate governance, many decisions about land-use policy, especially open-space policy, are local. What this means is that while local governments have considerable legal powers to regulate, local politics in practice limits their ability to exercise that power: the mechanism for allocation of suburban land is, in practice, most often a mix of market and various local government interventions.

A key theme of this report is that the choice of allocation mechanism, including where on the market-regulatory continuum to fall, is a choice that the local jurisdiction has to make and its choice should depend on the circumstances. In some circumstances, a relatively regulatory approach may make sense. In others, a more market-oriented approach may be desirable. The key objective of this project is to distinguish the circumstances under which a market in development rights could play a role in the allocation of land to open-space uses.

The purpose of this chapter is to exploit a simple model that is standard in the economics literature to identify and begin to evaluate the various mechanisms with which to allocate land to permanently preserved natural uses. The analysis provides the foundation for what comes in the remaining chapters of the report. The rest of this chapter consists of three sections. Section II develops the simple graphical analysis of a land market in which preserved natural areas generate benefits for the users of developed land. Section III develops a taxonomy of land allocation mechanisms in the context of the model of the land market. Section IV summarizes the analysis and reveals the direction of the remainder of the analysis in the report.

II. A Simple Model of a Land Market with External Forestland Benefits

Mills (1980, 1989) applies the standard economic model of a market with externalities to develop a stylized, but useful, model of the land market in the presence of external benefits from permanently preserved natural areas.[1] Mills' algebraic analysis can be portrayed graphically as in the series of Figures 1-1 to 1-3. The graph shown in Figure 1-1 contains two curves, one labeled V_D for 'value in residential development' and the other labeled MEC for 'marginal external cost of development'. The horizontal axis of the graph is labeled in acres;

[1] Economists refer to benefits as external when they accrue to parties not involved with a particular market transaction. In this case, the forested parcel generates benefits for the users of other, mostly nearby, land. Yet those land users would not typically be involved in the market sale of the forested parcel (though there are exceptions in practice, which we will discuss).

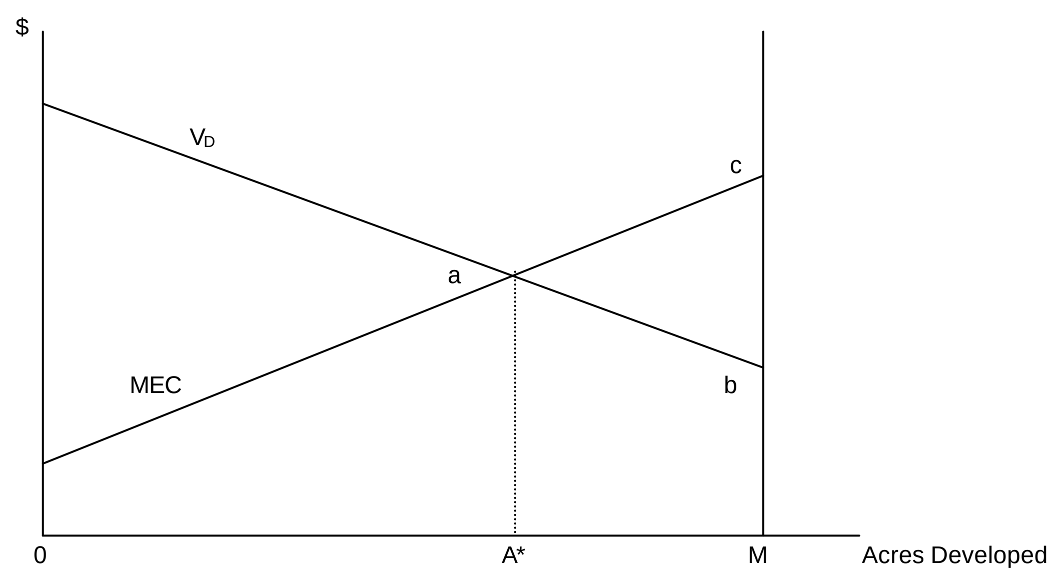
both value in development and marginal external cost vary with the amount of land allowed to develop.

Consider first the V_D curve. Each acre in the market area has a market value in residential development that depends on the acre's characteristics. We describe in detail in Chapter 4 the characteristics that affect this value. The V_D curve simply sorts these acres in decreasing order of market value in residential development. This value is net of any costs associated with development of the land (i.e., these are not building-lot values, but rather the value to a developer of 'raw' land with ready access to public services). The downward slope indicates variation in the characteristics of the land in the market; units of land to the left have relatively desirable characteristics. As this market is small relative to the metropolitan-area land market, changes in the metropolitan market shift the V_D curve in Figure 1-1. At any point in time, the value of each acre includes the discounted value of all expected future changes in the metropolitan land market.

Note that the V_D curve is **not** a standard demand curve. A downward-sloping demand curve shows that the more identical units of land that are brought to market in a given time period, the lower the price needed for all to sell. The curve V_D shows value in a longer-term way, more in keeping with the way land owners typically think of value. It may take decades for most of the market area to develop. Land owners bring their land to market gradually as market conditions and their personal situations warrant. Thus, the value of each acre in the figure depends on its characteristics rather than on the amount of land put on the market at a particular time.

The MEC curve shows the value of the open-space benefits *lost* upon development of an additional acre. The costs of developing a parcel consist of the benefits to nearby parcels that the land would have generated if preserved in its natural state. These benefits include scenery, wildlife habitat, recreational space, reduced congestion, flood control, and pollution filtration. For simplicity, we assume that there is no alternative use of the land, such as agriculture, that provides an additional (private) cost to development; all costs of development

Figure 1-1. A Land Market with Benefits From Preserved Natural Area



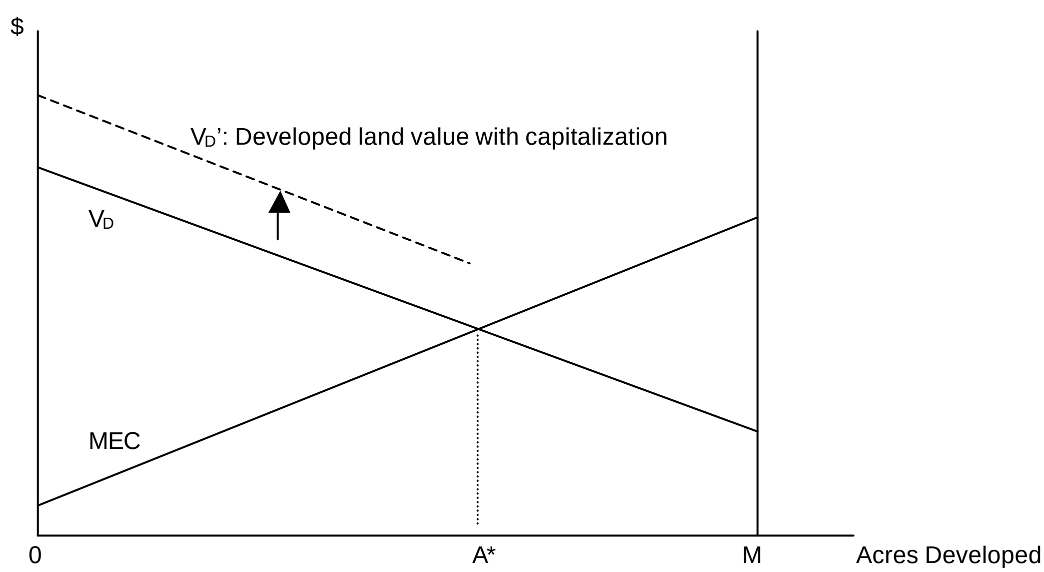
are lost benefits from preservation, which economists refer to as 'external' benefits because they accrue external to the parcel itself.

The upward-sloping MEC curve indicates that the cost of developing another acre grows as the total amount of land preserved shrinks. Put the other way, the MEC curve indicates that the benefit from preserving an additional acre falls as the total amount of land preserved increases. A key assumption implicit in Figure 1-1 is that the cost of developing an additional acre depends only on the amount of land developed, and not on the location or characteristics of the land developed. This is, of course, generally not true in practice: the characteristics and location of preserved land matters. But it is in general not possible to sort acres in decreasing order of value in residential use and increasing order of value in preserved use on the same graph. Bear with us, we will not forget that we made this important simplification.

Given conditions as drawn in the figure, a standard market equilibrium involves development of all of the land in the area, M. This despite the fact that the value of the external benefits generated by the acres on the right exceed their value in development. A key assumption in the standard market model is that when benefits are external the land owner has trouble collecting payment on their value. Neighboring land users might enjoy the proximity to the forest, but the market as usually configured does not include a mechanism to transfer some of the value of these benefits back to the owner of the forested parcel. In contrast, the land owner has little problem marketing the parcel to developers. So the market tends to encourage 'too much' of the land in the area to develop.

So, if land should be preserved, how does preservation affect the land market? Notice that each of the acres between A^* and M generate more in external benefits than the acre is worth to a residential developer. Suppose that the local jurisdiction can identify these acres and zones them for permanent preservation. If it is able to convince the participants in the land market that acres A^* through M will be permanently preserved, then proximity to the

Figure 1-2. The Capitalization of Preserved Forest Benefits



forest preserve becomes a characteristic of value on all the acres that are allowed to develop (acres 0 through A^*). The market value of these acres therefore increases; the benefits generated by the preserved land are 'capitalized' into the value of developable land, as is shown by the dashed line, labeled V_D', in Figure 1-2. As drawn, the benefits are distributed evenly across all developed acres, which, of course, may not occur in practice.

Even though the market value of the preserved land falls to zero, the net *aggregate* benefits from preservation acres A^* through M are positive. If acres A^* through M are preserved, then the total benefits generated equal the area under the MEC curve between A^* and M. The total loss of value in development is equal to the area under the V_D curve between A^* and M. Thus the net increase in total land value equals the area of the triangle labeled abc in Figure 1-1. The total increase in the value of developable land more than offsets the decrease in the market value of the land preserved.

III. Methods for Preserving Land

The analysis in Figures 1-1 and 1-2 is useful for describing the various approaches used to preserve land. Table 1-1 summarizes the general options. The options are organized according to the role of decentralized (market) versus centralized (governmental) allocation of land. An important category, of course, is a mixture of allocation mechanisms. In this section we use the diagrams in Section II to compare and contrast the mechanisms.

Table 1-1. Allocation Mechanisms and Open-Space Policies

Allocation Mechanism	Description
Market	
No intervention	Land developer preserves land on site, and/or negotiates with neighboring landowners for preservation.
Market in development rights	Jurisdiction distributes development rights in proportion to land ownership. Trades in DRs allocates land.
Regulatory	
Open-space zoning	Jurisdiction chooses and restricts development on land it considers suitable for preservation.
Purchase of land or development rights (PDR)	Jurisdiction pays land owner for the rights to develop land the jurisdiction deems suitable for preservation.
Transfer of development rights (TDR)	Jurisdiction distributes development rights, then zones land for preservation. Trades in DRs provide compensation.
Mixed market/regulatory	
Large-lot zoning	Jurisdiction restricts number of dwelling units allowed per unit land area. Preserves land on site.
Market in DRs with planning/zoning	Jurisdiction distributes development rights. Includes planning for open space in comprehensive planning process.

Market Mechanisms

Consider first the market methods of allocation of land to preservation. The first mechanism, termed 'no intervention', relies on private land developers to allocate land on site. When development begins in earnest in urban fringe areas, much of the residential development occurs in subdivisions. A developer purchases a parcel that is large relative to the size of a typical home site, plats the parcel, installs public infrastructure, and markets building lots to housing consumers or homebuilders. Subdivision development not only allows the developer to exploit scale economies, but also gives the developer control over a variety of neighborhood characteristics and amenities, including preservation of natural areas.

Critical to efficient on-site preservation in the absence of some government intervention is that the site is sufficiently large to both (1) contain land with characteristics suitable for preservation (e.g., acres in the range A^* to M in Figure 1-1); and (2) internalize the benefits from preservation. That is, enough of the benefits from preservation must capitalize into the developed building lots to 'pay for' the area preserved. In short, each development site must have characteristics similar to the market area as a whole (so that Figure 1-1 applies to the site), and conditions in the market must allow the developer to cost-effectively purchase and develop the large parcel.

An alternative to development of large parcels involves developer negotiations with neighboring landowners. Suppose, for example, that a more efficient allocation of land would result if two parcels were combined. Suppose also that the developer cannot afford to purchase both parcels; the additional financing costs exceed the additional efficiency benefits. In principle, the land developer and neighboring land owner may be able to negotiate a solution that captures and equitably divides the net financial gain from the superior land allocation among the two parcels. Obviously, the smaller the development parcels and the more numerous the landowners, the more difficult (i.e., costly) these negotiations.

The purpose of the other market mechanism shown in Table 1-1, a market in development rights, is to reduce these transaction costs. To initiate the process, the local government determines the proportion of the land in the market area to preserve ($(M-A^*)/M$ in Figure 1-1), then distributes the corresponding number of development rights to land owners. An apparently equitable approach would be to distribute development rights across land owners in equal proportion to land ownership; each land owner is given permits to develop A^*/M of his land. Each landowner can then use his permits to develop his land, sell some or all, or purchase additional. In principle, a market in development rights could develop that would allow landowners and non-landowners to trade development rights as a commodity.

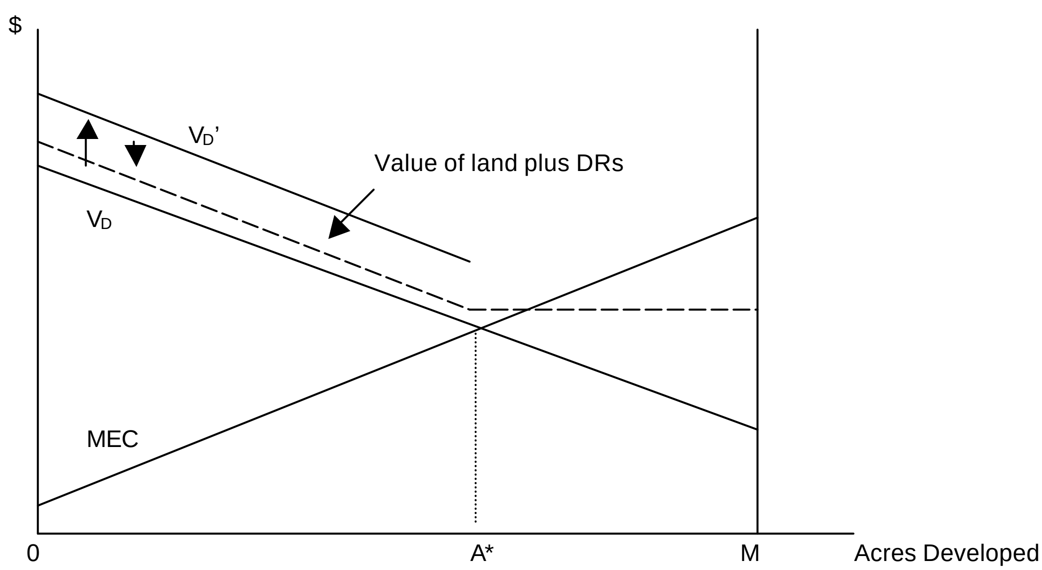
Figure 1-3 illustrates how the market in development rights would, in theory, influence the market in land. The total of A^* development rights guarantees that $M-A^*$ acres remain undeveloped. If acres A^* through M are distributed in precisely even proportion over all legal parcels, then there would be no trades in development rights; each landowner would simply use his development rights to develop that portion of his land of the most value in residential use. If variables other than value in preserved or residential use have influenced parcel boundaries (which seems likely) then landowners with a large proportion of land valuable in development will want to purchase development rights. Given a sufficiently high price for development rights, land owners with a high proportion of land of relatively low value in development will wish to sell development rights.

The price that clears the market in development rights is the market value of the acre A^* in Figure 1-2. At that price, the market value of each of the acres between A^* and M is less in development than the development right is worth. Now, on average, these landowners were distributed development rights on only A^*/M of these acres. Similarly, on average, the owners of acres 0 to A^* were distributed the rights to A^*/M of these acres; they don't need to purchase development rights for each acre, just for some of them. The dashed line in Figure 1-3 shows the *net* result. This dashed line shows the average value of land *plus* development rights across the market area. As shown, the owners of land that develops (acres 0 through A^*) enjoy some of the net benefit from preservation; the value of land plus development rights is greater than the value of land without preservation. And the owners of land preserved (acres A^* through M) share in the benefits generated by preservation through sale of development rights.

This analysis reveals the potential attractiveness of a market in development rights. The expense to the jurisdiction is potentially small: they need to identify A^* (which in practice may not be easy), distribute development rights, and in some way 'permanently' preserve the land that the market allocates to preservation. Under the conditions portrayed in the figures, the market both allocates land efficiently to preservation and distributes the net benefits equitably. In practice, the market in development rights substantially reduces the costs in preserving land created by historical land divisions.

The concerns with an 'unfettered' market in development rights derive from the fact that the market tends to preserve land of relatively low value in development. This raises two questions. First, is this land of relatively high value in preservation? If not, the market may

Figure 1-3. The Land Market with Development Rights



not allocate efficiently. Second, is the land that the market preserves located in such a way as to spread benefits effectively? The size and location of preserved tracts relative to developed tracts probably matters. The market in development rights by itself does not in general guarantee that these issues are addressed.

Regulatory Mechanisms

These concerns may justify a regulatory rather than market allocation. We list three regulatory mechanisms in Table 1-1. The allocation mechanism is identical in each case: the local jurisdiction decides which lands to preserve and on which to allow development.[2] The primary difference among the mechanisms is in terms of how the net benefits generated by the preservation are distributed.

The first mechanism listed is open-space zoning. In this case, the local jurisdiction identifies acres A^* through M and exercises the power granted them through state legislation to prohibit development on those lands. The market value of the lands preserved falls with the revocation of development rights to their value in the 'highest' allowed use. That value is 0 in Figures 1-1 through 1-3, but may be positive in practice. The result is as shown in Figure 1-2. If the local jurisdiction can in fact identify acres A^* through M, then the allocation is efficient. The difficulty is with equity: the owners of preserved lands bear the entire cost of preservation, while the owners of developable land enjoy the entire benefits.

The next method, purchase of land or development rights (PDR) treats this equity issue. Again, the local jurisdiction allocates land to development and preservation. However, rather than leaving it at that, the jurisdiction purchases at market value the development rights on acres A^* through M. This market value in principle corresponds to that shown in Figure 1-1 for those acres, in which case the owners of those acres should be indifferent between no preservation and the PDR program. In principle, the jurisdiction could raise funds by imposing a development fee or a millage on the properties that benefit from the preservation. In practice, funds from other sources could also be used to purchase development rights.

In addition to the problem of allocating land across uses efficiently, the key practical disadvantage of a PDR program is in raising sufficient money to preserve a significant amount of land. Even if the market value of developable land increases with land preservation, land owners may prefer to try to free ride and avoid taxes. Another practical issue involves determining the price of development rights. If the preservation raises the market value of 'comparable' developable parcels, then the jurisdiction may find it difficult to avoid overpaying for preservation.

The third mechanism under the regulatory heading – transfer of development rights (TDR) – is, as the name implies, similar to a market in development rights. The big difference is that the local jurisdiction, not the markets in land and development rights, allocates land to development and preservation. The TDR process begins, again in principle,

[2] The process through which that allocation decision is reached may, of course, vary across jurisdictions.

with distribution of development rights to all the landowners in the jurisdiction.[3] Then the local jurisdiction allocates land by defining zones for development and preservation. The preservation area is known as a 'sending area' because development rights are sent from that area to the 'receiving area', the area zoned for development. The key here is that if the zoning authority successfully puts acres A^* through M in the sending zone and allows the market to price development rights, then the result will be precisely that shown in Figure 1-3.

The potential 'disadvantage' of the TDR program is the converse of the disadvantage of the market in development rights: it relies on the local jurisdiction to allocate land. Some people believe that an effective public process is precisely the way land should be allocated. Many others are not so confident that public processes in practice work so smoothly. Our position is that the TDR program and an unregulated market in development rights represent two extremes. We suspect that a system intermediate to these extremes may often make sense in practice.

Mixed Market/Regulatory Mechanisms

We list in Table 1-1 two general ways in which market and regulatory mechanisms might be mixed. The first such mixed mechanism, large-lot zoning, is perhaps the most commonly used mechanism in practice. The practical advantages of large-lot zoning are clear: land is preserved on the large lots, and the costs of preservation are spread equitably over land owners. There is no need for a potentially complex system of land allocation or redistribution of costs and benefits.

There are, of course, disadvantages to large-lot zoning. First, the allocation may be inefficient for several reasons because roughly the same proportion of land is preserved on each parcel. In general, we would not expect to see the land that is relatively desirable for development (acres 0 through A^*) distributed in equal proportions across parcels. The owner of a developable parcel will try to orient building lots and the buildings themselves to take best advantage of the natural characteristics of the lot, but the required minimum for lot-size and the boundaries of the parcel constrain this effort.

Second, natural areas are preserved on private building lots, which obviously limits access by the public. Networking natural areas is difficult. And the preservation may be difficult to maintain as permanent. If the market for development in the area heats up, individual land owners will have incentive to request that the density restrictions be eased so that they can partition their parcel into additional building lots. Even with the stronger

[3] People who have experience with actual TDR programs may not see things as this simple. In practice, it is the owners of land in the sending area who are explicitly given development rights that they can sell. Purchase of these development rights by owners of land in the receiving area usually buys the right to develop at a density higher than that allowed by the zoning. These landowners typically already have limited development rights. This system becomes more complicated as the number of parameters the jurisdiction decides to manipulate (e.g., initial allowed development density in the receiving zone, the density 'bonus' that the development right buys, and the initial number of development rights) grows. We avoid these complications in the text by describing just the essence of the TDR concept. For an exhaustive description of more than twenty years experience with TDR programs see Preutz (1997).

development market, the source of the potential inefficiency is similar to that diagrammed in Figure 1-1.

Recognizing these problems, some jurisdictions offer land developers the option of clustering building lots on the site. Suppose, for example, that a 30-acre parcel is in a zone that requires lots of at least three acres in size. This form of cluster zoning allows the developer to create a maximum of ten building lots of smaller than three acres each as long as the remainder of the parcel is designated as a nature preserve. This option clearly has advantages over the less flexible large-lot zoning: it allows the developer to take better advantage of the variation in on-site conditions, and the designation of preservation areas may have more permanence, especially if that land is dedicated to the jurisdiction. It does not, of course, allow trades across parcels (it may actually make negotiations to do so more difficult), and networking open space is still a problem.

But cluster zoning does represent a logical step toward a market in development rights. The key difference is that the DR market not only allows clustering, but also variation in the proportion of land preserved on each parcel. Importantly, it offers this flexibility while continuing to distribute costs and benefits relatively equitably. The concerns, as mentioned, involve the networking of preserved areas and the possibility that the market may not preserve land of relatively high value in preserved use.

This is where the mix of regulation with market allocation may come into play. The standard TDR system puts the burden of land allocation entirely on the jurisdiction. The market in development rights in general, however, appears rather readily to allow a mix of market and regulatory allocation. The jurisdiction could choose to zone areas of especially high value in preservation and then allow the market to allocate the remainder of the open space. Or, more likely, how the market would allocate that land would influence the decisions made during the comprehensive planning process. Indeed, one would expect that implementing a market in development rights prior to full-scale development would greatly impact the process of planning not just open-space, but also the location of other zones and infrastructure. This is the aspect of the analysis that we explore in detail in Chapter 5 of this report.

IV. Summary and Guide to the Remainder of the Report

The foregoing analysis identifies both the fundamental issues involved in natural-area preservation and the general range of policy options available. The analysis suggests that two relatively innovative policies that have seen use in practice – large-lot zoning with allowances for clustering and transfer of development rights – represent logical moves toward the more general concept of a market in development rights. An 'unfettered' market in development rights has clear disadvantages. But local land markets are currently far from unfettered; the concerns that drive the current interventions in land markets are not terribly different from those associated with a market in development rights. A key question, then, is the extent to which a market in development rights fits into the general scheme of the current mixed market/regulatory allocation of land across the various urban uses in suburban areas.

The obvious shortcoming of the foregoing analysis is that the assumptions built into the model in Section II to make it tractable rarely hold with precision in practice. And the practical deviations from the model are often very important. Granted. But the model still provides a useful vehicle with which to distinguish the fundamentals of the policy options available and the various strengths and weaknesses of these options. In practice, no allocation mechanism will lack disadvantages. The key is to choose the mechanism or combination of mechanisms that provide the most bang per buck under the circumstances at hand. The remainder of this report focuses on identifying the circumstances that influence the choice of allocation mechanism.

The context is a case study of a developing area in Plainfield Township, Michigan. Plainfield Township is a roughly 36 square-mile jurisdiction that contains part of the urban fringe of Grand Rapids, Michigan. The township is currently using a variety of approaches to preserve land, though a market in development rights is not one of these approaches. Though we cannot say that conditions in Plainfield Township are broadly representative of those in developing jurisdictions (though the Township does appear to be reasonably typical), the case study is useful to illustrate the issues in a practical context. Chapter 2 describes the characteristics of land and development in Plainfield Township.

Chapter 3 describes the empirical research into the size and geographic extent of the benefits generated by preserved open space. It begins with a theoretical description of localized and more general benefits generated by preserved natural space. It then reports existing empirical estimates, derived from housing-market data, of these localized benefits; we did not find empirical estimates of the broader-scale benefits. The estimates come from analyses of the extent to which proximity to forest preserves affects the sale prices of land and houses. The chapter then reports the results of a new analysis of sales of building lots and houses in three subdivisions in the Grand Rapids area, two of which are in the study area in Plainfield Township. The chapter in sum describes what is currently known from analysis of land and house sales about the MEC curve shown in Figures 1-1 through 1-3.

Chapter 4 focuses on the characteristics of the V_D curve shown in the figures. The characteristics of this curve are important for several reasons. First, its vertical location gives a general idea of the opportunity cost of preservation; how much value to residential users is lost, on average, when land is preserved? Its slope indicates the range in the characteristics of the land and their value in development. A market in development rights will tend to preserve the land of relatively low value in development. This raises the third critical issue: how is the land of relatively low value in residential use oriented relative to land of higher value? And is the land of relatively low value in residential use of average or higher value in preservation? These questions addressed in Chapter 4.

Chapter 5 builds on the results of the analyses in Chapters 3 and 4 to evaluate the prospects for a market in development rights to play a significant role in allocating land to preservation in an area such as the Plainfield Township study area. More generally the chapter builds on the analysis presented above to describe the conditions that influence the choice of allocation mechanism. A critical piece of the analysis is a description of how the market in development rights might work in tandem with the general planning and regulatory framework in place in jurisdictions such as Plainfield Township.

CHAPTER 2

THE CHARACTERISTICS OF LAND, DEVELOPMENT, AND THE MARKET IN LAND AND HOUSES

I. Introduction

This chapter provides summary information about the characteristics of land and land development in Plainfield Township. The township consists of a square of land six miles on a side. Strictly speaking, the land within a township is unincorporated; the land can be annexed to a city. A small part of the northeast corner of Plainfield Township has been incorporated into the City of Rockford (see Map 2-1). Nevertheless, as in Plainfield Township, it is not unusual for the governments of townships in urban fringe areas to provide the full range of urban services: planning and building inspection; provision of streets, water, and sewer; tax assessment, and so on.

Plainfield Township borders on its south the City of Grand Rapids (see Map 2-2), and there is little notable change in development as one travels on arterial streets from the City of Grand Rapids northward into Plainfield Township. The township contains commercial and residential development that is essentially part of the larger contiguously developed area. As one travels farther northward within the Township the average intensity of development falls. Much of the northern portion of the Township remains lightly developed or largely undeveloped. Thus, the township contains a portion of the Grand Rapids urban fringe.

The remainder of this chapter contains two main sections. Section II describes the characteristics of land, land development, and development regulations in the Township. This section provides insight into the prospects for land preservation, and into the extent to which land has been preserved through relatively conventional methods: public purchase of space, open-space zoning, preservation on large private lots, or other private preservation. Section III reports an analysis of the land and housing markets in the Township. The market value of land for development is a key input into the analyses described in Chapters 4 and 5. The analysis of land and house sales provides considerable insight into the value of land for development. In addition, to the extent that land is preserved in relatively large building lots, an analysis of sales of houses and vacant building lots provides insight into the value home owners place on privately preserved open space.

II. The Characteristics of Land and Development

This section reports the characteristics of land and development that are relevant to a discussion of open-space preservation. The section begins with a brief description of the natural characteristics of the land. The data summarized come from a soil survey undertaken by the USDA Natural Resource Conservation Service in 1986. We then describe the characteristics of current land use and cover, and the change in land use and cover since 1978. The data come from interpretation by the Annis Water Resources Institute (AWRI) of USDA Farm Services Agency aerial photographs. We then describe, in brief, the characteristics and evolution of land development policies in the Township, with special attention to policies that promote open-space preservation. These data come from the Plainfield Township planning department.

Natural Topography

Table 2-1 shows some of the key natural characteristics of land in Plainfield Township. Though townships in principle consist of a square area of land six miles on a side, the total number of acres differs slightly from that expected. One square mile contains 640 acres, so 36 square miles should contain 23,040 acres. However, a portion of Section 1 in the northwest corner of the Township is in the incorporated City of Rockford. Moreover, the land in this area was surveyed long before the advent of satellite positioning systems; actual townships are typically not perfect squares.

Several natural characteristics are worth noting from the perspective of land preservation. First, about 4% (about 900 acres) of the total area of Plainfield Township consists of bodies of water, and another 7% (about 1600 acres) of the total area is low enough to be wet at least part of the year. The majority of this water and wetland is associated with the Grand River, which flows in a large arc through the lower half of the township. Much of the low, flood-prone areas on both banks of the river remain undeveloped. The much smaller Rogue River flows through the northwest quarter of the township into the Grand River. Plainfield Township also contains more than a dozen lakes, the largest of which covers approximately a quarter of a square mile. Most of the lakes have wetland areas adjacent to them. The lakes and adjacent wetlands provide visual, wildlife, and recreational amenities, and are relatively expensive to develop.

The northern portion of Plainfield Township tends to be hilly. About half of the township is relatively flat, most of this in the developed southern and middle portions of the township. Interestingly, almost 30% of the township is sloped at greater than 12%. Due in part to the difficulties involved in developing steep slopes, much of this land remains in forest. Some of the steep areas that tend to remain undeveloped are in ravines carved by streams.

Finally, the characteristics of soils vary across the township. About 60% of Plainfield Township is sandy, which is good for developers as it drains well and reduces the costs of trenching.

Land Use and Cover

Table 2-2 shows the amounts of land (in acres) in alternative uses in 1998 and the change in these amounts since 1978, respectively, in Plainfield Township. These data represent unusually accurate measurements of actual land use and cover because they were collected from aerial photos. Land-use data are commonly collected from tax-assessor records. The assessor understandably for tax purposes usually classifies an entire parcel under one use. For example, the assessor typically classifies as residential a ten-acre parcel covered mostly with woods but in a residential zone and with a house near the street. In the data reported here the eight or so acres of woods on that parcel are classified as forest; property lines were not taken into consideration in classifying land to uses.

Table 2-2 shows acreage in alternative land uses in 1998 in Plainfield Township and changes in land use since 1978. In 1998, a little less than half of the land area in the township was in developed uses. Commercial and industrial activities are mostly along two major arterial streets: Plainfield Ave. and West River Drive. Roughly five times as much developed land is in residential as in commercial and industrial uses combined. Almost 3800 acres were developed from 1978 to 1998; almost all coming from open fields and cropland. Note also that almost 10% of the land area in the township is in a category called 'other developed areas'. Much of this land is in a total of five golf courses; land that, at least in the short-term, can be reasonably categorized as private open space.

Over half the area in the township remains undeveloped, though less than 15% of that area remains in agricultural use. About 60% of the undeveloped area is in forest, a total that has changed little since 1978. Most of the undeveloped areas are to the north away from the City of Grand Rapids and are in hilly areas. The flatter areas in the south and center of the township are the most heavily developed. This is important from the standpoint of open space preservation because it is these hilly areas that offer both relatively high amenity values and relatively high development costs.

Residential Development

This project focuses on the impact of preserved open space on single-family residential development. We focus on residential development for several reasons. First, the amenity value of preserved open space is more of a direct concern in these townships to residential than to commercial and industrial land users. Second, most of the land that develops does so in residential use; residential development is geographically the most extensive of the developed land uses. Finally, restricting our attention to single-family residential uses simplifies the analysis considerably. This section describes the current characteristics of the housing stock in Plainfield Township. The data come from the tax assessor's database.

Figure 2-1 shows the size distribution of the houses in the Township. About 60% of the houses in the township are single-story, ranch-style houses with basements. Houses built more recently are bigger. The median house built in the 1950s has about 1100 square feet of living space, similar to the median size of those houses built in the first half of the century that have avoided demolition. Median house size increases in houses built after the 1950s not quite steadily until it reaches just over 1600 square feet in houses built in the 1990s. Newer houses also tend to have more bathrooms, bigger garages, and are built on larger lots.

Figure 2-2 provides an indication of the rate of residential development in Plainfield Township over the last century. The data include all of the detached single-family houses and condos in the assessor's database. The database contains information on about 8550 houses. The figure shows the distribution of the existing housing stock by the five-year period in which the house was built. Because some mostly older houses have been demolished over time, the distribution understates the early rate of development. Nevertheless, it seems reasonably clear from the figure that residential development began in earnest in the 1950's, and has continued at a relatively steady rate since.

Figure 2-3 shows where in the jurisdiction that new construction has gone. Specifically, the figure shows the distribution of the number of single-family dwellings in each of the thirty-six square miles that comprise the township. The number of houses in a square mile within the township ranges from 18 to 978. Sections with larger numbers of houses are in the southern part of the township (near the City of Grand Rapids) and in those toward the center of the township (the township hall is in Belmont near the center of the township). Several of these sections are essentially built out. Sections near the City of Rockford in the northeast also contain relatively large amounts of residential development. Thus, though the township has been developing for about fifty years, these numbers suggest that it still is in the middle of its development phase.

Figure 2-4 gives an indication of the amounts of open space preserved in residential lots. The height of each bar shows the number of lots within each one-tenth acre range. The number at the base of each bar shows the maximum of that range. The mode of the distribution corresponds to lots in the range of 0.3 to 0.4 acres, which is shown as 0.4 acres in the figure. For perspective, a typical city lot contains about 5000 square feet, or about 0.12 acres. Building lots of about 100 feet square, or a little less than a quarter of an acre, are common in suburban areas. Almost all of the lots under an acre in size are in residential subdivisions. Those lots above about 0.4 acres have relatively large yards. The open space in these yards can reasonably be considered as 'foreseeably' preserved. It seems unlikely that lots in these subdivisions will be further subdivided unless market conditions change considerably.

The building lots of over a half acre in size are a mixed bag. Some are in large-lot subdivisions, most of these with relatively large and expensive homes. The open space on these lots is likely to remain open. But most of the lots, especially the larger lots (those of over 1.5 acres) are not in subdivisions, but instead have been partitioned from larger parcels. Most are accessed directly from an arterial street, and public water and sewer do not serve many. It is common for a developer to purchase a relatively large lot that has access to public sewer and water mains, subdivide the original lot, and sell the new lots to homebuilders. The original house is either left where it is, moved, or demolished. In any event, it does not seem reasonable to consider the open space on the bulk of these lots as permanently preserved. The distribution of these lots is shown in Figure 2-5.

Land-Use Regulation

Planning staff in Plainfield Township made available to us both current and historic zoning maps. Plainfield had archived historical zoning maps from four time periods–1941, 1969, 1982, and 1998–and provided a map newly revised in 2000 (see Map 2-3).

Table 2-3 shows the evolution of zoning over nearly 60 years in Plainfield Township. Agriculture still dominated land use in 1941. Consistent with the data shown in Figure 2-1, Table 2-3 shows that development had begun in earnest by the 1960s. The amount of land zoned for agricultural use had been cut by half in 1982, and agricultural zoning was eliminated in 1998. All of that largely undeveloped land was put into a new category called Rural Preserve.

The Rural Preserve zone in Plainfield Township allows both agricultural activities and construction of single-family dwellings on lots of a size not less than 2.75 acres. One of the stated objectives of the zone is to reduce development pressure on the remaining agricultural land. Another is to preserve open space, which it succeeds in doing at least temporarily on large lots and on larger parcels to the extent that the zoning inhibits their development. A third objective is to reduce the pressure to extend urban public services to the area. From the standpoint of preserving open space, this kind of zoning may serve more to delay development than to permanently preserve open space.

That may be the concern driving the one major change in the new zoning map: the conversion of about half of the land in the Rural Preserve zone in 1998 to the Rural Estate zone in 2000. The Rural Estate zone has a smaller minimum lot size, 1.4 acres as opposed to 2.75. But the prospects for long-term preservation of open space may be better: these relatively small (though still large) home sites are probably less likely to redevelop at higher densities within the foreseeable future. Indeed, this zone speaks to the relatively large residential demand for more-or-less permanently preserved open space in the hilly areas of the township. The steep slopes both increase development costs and provide high-amenity value. The general prohibition of higher-density development within the zone distributes the costs and benefits of the preservation relatively equitably over the owners of land in these zones.

One other Plainfield Township zone not shown in the table, but of significance to open-space preservation is the Natural Rivers zone. This zone provides a 300-foot buffer on each side of the Rogue River within Plainfield Township (though some houses that predate the zone are closer than 300 feet). The fact that land close to the river is prone to flooding probably aided implementation of the zone. Nevertheless, the zone protects a significant amount of amenity-generating open space. Chapter 3 reports estimates of the value homeowners place on proximity to the zone.

III. The Markets for Land and Houses

A primary objective of this study is to simulate a market in land development rights. Key inputs to that simulation are data about the market value of raw land for development and about the value of environmental amenities as capitalized into the sale prices of building lots and houses. This section reports the results of analyses of the residential real-estate market in Plainfield Township using sales data made available by staff in the tax assessor's office. The analysis provides a base from which to develop the analyses reported later in the report.

Before reporting results we should talk a bit about the data. The staff in the assessor's office collects data on sales of real estate in the jurisdiction to use to inform their appraisals. The data come from forms filled out by the buyer and seller upon transfer of the property. For the most part these forms are routinely filled out and recorded. To the extent that this is so, assessor records contain information on a larger proportion of sales than do the more commonly analyzed data sets from the local multiple listing service (MLS). MLS records contain observations on only those sales listed by a realtor. As it turns out, however, the assessor misses some transactions because the appropriate forms are not always completed, and the office lacks the resources (and, for the most part, the incentive) to track down information about these sales. It appears, however, that the vast majority of routine house and building lot sales are observed.

Until recently, recording of house and lot sales was done on 5½ inch by 8½ inch cards. There is a card for every property in the jurisdiction. The card contains data about the characteristics of the property, usually a photo of the property, and the property's sales history. The records have been digitized within the last few years. All sales since 1995 have been recorded electronically. Many, but not all, of the earlier sales have also been transcribed from the cards to the electronic database. Though we recorded all of the data from the cards for each lot in the subdivisions studied in the analysis of the value of forested open space (detailed in Chapter 3), the project budget does not allow us to record sales data from all of the approximately 9000 houses and vacant properties in the jurisdiction. Instead, we analyze the data available in electronic form.[1]

The Market for Land

Vacant land for residential uses comes in several types. An important type for our purposes is the relatively large parcel suitable for development into a residential subdivision. These parcels are usually in areas zoned for residential development and have access to public sewer and water systems.[2] A professional developer may purchase such a parcel or the landowner may choose to contract with an engineering firm that assists in development. The building lots created in the development process are the second type of vacant land. These subdivision building lots are typically served with the full array of urban services. A third type of vacant parcel is a partition for a home site from a larger parcel. For example, a farmer may create one or more of these partitions (referred to as 'splits' or 'partitions') and sell them to homebuyers who are looking for a rural property. These building lots are typically large relative to subdivision lots (usually from about .5 to 10 acres in size), access the arterial street directly, and often are not served by public sewer or water systems. Many of these splits occur well before the market supports full-scale development of an area.

Consider first the sales of relatively large parcels to developers for development into residential subdivisions. The data on these sales are limited. One reason, of course, is that the moderate rate of development yields relatively few of these sales per year. Another reason is that the data that did exist on sales prior to about 1995 have been destroyed. When a parcel is subdivided into building lots the original parcel goes out of existence. The card for a non-existent parcel has little value to the assessor, so it eventually is destroyed. In principle, one

[1] We do not know how representative the digitized data for sales prior to 1995 is. An investigation would require an extensive review of the non-digitized data on cards, a review that the budget for the project does not allow. This is obviously not a concern for the analysis of recent sales as all transactions since 1995 are recorded digitally.

[2] Lack of access to public sewer or water systems does not necessarily prevent subdivision development. The jurisdiction typically requires larger lots, however, to accommodate the use of septic tanks.

could find the sale price on the deed. In practice, not only is locating the deed difficult – it is located by its map number, which, of course, goes out of existence when the parcel is subdivided – but the field for sale price is often blank.

With the assistance of staff in the assessor's office we were able to identify seven apparently arms-length sales of vacant land that have been or likely will be developed into residential subdivisions. This number of observations is obviously too small to allow the use of regression analysis. And the characteristic of each of the parcels observed varies considerably in location, topography, and public services. Each of these sales took place since 1994. We also identified several sales of large parcels with an existing older house on site. The sale prices of these properties suggest that perhaps the bulk of the value is in the land; the house could readily be removed, destroyed, or sold separately on a smaller lot split from the main parcel.

The rule of thumb that the Plainfield assessor's office staff has adopted for the market value of a standard parcel of developable residential land is $12,000 per acre. Table 2-4 shows the numbers that support this rule of thumb. Though sale price per acre obviously varies, one can see the support for the choice of $12,000. The sale prices of parcels with relatively old and small houses, shown in Table 2-5, tend to be somewhat higher. These parcels tend to be in areas with more existing development and have direct access to the arterial street and other public services. Nevertheless, there are insufficient data with which to estimate the implicit market value of the various characteristics of raw land prices.

The assessor's office in Plainfield Township also provided data on sales of vacant building lots within residential subdivisions and of vacant building sites outside of subdivisions that access arterial streets directly. The data include observations on sales from 1990 through the first half of 2000. There were a total of 271 sales of vacant subdivision building lots and 58 sales of independent lots. The subdivision lots range in size from 0.22 acres to 3.25 acres, with a median size of just over a third of an acre. The independent lots range in size from 0.23 acres to 6.54 acres, with a median size of one acre.

Table 2-6 shows the results of statistical regression analysis of the observed sale price on the size of the building lot, controlling for both general price inflation and the many general characteristics of the housing market in the township. The left-hand column indicates that a one-acre building lot in a subdivision sells on average for about $45,000 during 1998-2000. The value of the general location and public services is about $28,700. As the lot size increases, the value of the lot grows, but at a decreasing rate. It appears, for example, that housing consumers are paying on average about $7000 to upgrade from a half-acre to a one-acre lot. That additional half acre is typically all in open space. The results in the second column indicate that lot prices rose at an average rate of about $2000 per year during the 1990s.

A building lot of similar size not located within a subdivision sells for a substantial discount; a one acre lot sells on average for about $15,000 in 1990, rising to about $32,000 in the year 2000.[3] An additional acre sells for about $3800 in 1990 with no apparent diminishing marginal effect of lot size. This may reflect the value of the option to partition larger parcels into additional building sites in the future. Interacting lot size with the time trend (not shown in the table) indicates that the value of an additional acre grew by about $370 per year (the value of the parcel overall grew by about $1200 per year). This suggests that the market value of an additional acre, an acre that could presumably be partitioned and built on, is currently about $7500.

The Market for Houses

In addition to the analysis of vacant land sales, we conducted an analysis of house sales. The primary objective of the analysis is to get an idea of the trend in house prices over time; we have data on house sales that extend back to 1984. But the sales of houses also provide some insight into the market value of land. As shown in Figure 2-3, a significant minority of the houses in the Township are built on large lots. That some of these lots could be redeveloped in the future gives the land speculative value, as well as immediate value to the homeowner. Thus, we divide the total of 3,974 usable observations on house sales into two groups: those built within subdivisions and those built, usually on relatively large lots, outside of subdivisions. These houses usually access directly a two-lane arterial street, though some are accessed by private driveways from the two-lane arterial street.

Table 2-7 shows four sets of regression results. The first and third columns show analyses of house sales that occurred since the beginning of 1998. The idea is to look at the more-or-less current market values of the house characteristics available in the data. The Fed-driven increases in interest rates helped us in that the corresponding increase in mortgage rates slowed the growth in house prices over that time period.

The first two columns of results in Table 2-7 show the results of the statistical analysis of sales of houses that are NOT in subdivisions. We observe a total of 1028 sales that occurred from early in 1984 through the first quarter of 2000, with the number of sales observed growing over time. The first column of results shows the results of the analysis of the 239 recent sales in 1998 to mid-2000. The right-hand two columns show the results of the analysis of the 2946 sales of houses within subdivisions. Again, the first of the two analyses focuses on recent sales, while the right-hand column shows results for the entire data set. The dependent variable is the sale price of the house.

The idea behind the statistical analysis is that differences in house prices generally correspond to differences in house characteristics. For example, we might see a new 2000 square foot house sell for about $15,000 more than an otherwise similar 1800 square foot house. If everything else really is the same about the two houses, this observation suggests that the additional 200 square feet of floor space has a value in the market of about $15,000 or $75 per square foot. But, of course, the houses that are observed to sell within a township

[3] The small sample size (a total of 58 observations) prevents estimating a separate regression for the 1998-2000 time period.

typically vary in many respects. The idea behind the statistical analysis is to look at a large number of sales and sort out the implicit market value of these various characteristics.

So, consider first the analyses of recent sales in columns one and three of Table 2-7. The first two rows reveal the estimated market value of finished square footage in the house. The estimated value of an additional square foot of house comports closely with the current $75 rule of thumb. Including house-size squared in the analysis allows for the possibility that consumers are willing to pay progressively less for an additional square foot as the size of the house grows. These results indicate that builders are doing a good job of matching house sizes to housing consumers: the market value of an additional square foot does not appear to fall significantly with house size. The number in parentheses, known as a t-statistic, tells how confident we should be in the estimate. A bigger number is better. The rule-of-thumb cut-off for the t-statistic is generally held to be about 2.0, smaller than this and we cannot be very confident about the precision of the estimated value.

The remaining rows contain estimates of the market value of other characteristics of the house. The value of an additional square foot falls at the expected decreasing rate with the age of the house. For example, a 2000 square foot house that is one year old sells for about $1400 less than an otherwise similar new house. The squared term indicates that the rate of decline falls as the house ages. A bigger garage increases sale prices, and finished basement area increases sales prices in houses in subdivisions. Within subdivisions, a ranch-style house sells at a significant premium over multi-story houses. The time trend variables lower in the table indicate that while prices were flat outside of subdivisions, prices continued to rise within subdivisions until the last half of 1999. Rockford schools are considered to be superior, which is reflected in the premium on sales of houses not in subdivisions. There appears to be no corresponding premium, however, on sales in subdivisions that are in the Rockford school district. We suspect that the coefficients on house size, lot size, and house age pick up the Rockford effect in the case of subdivision sales.

Of interest are the estimates on the coefficients on the lot size variables. An additional acre in a *non*-subdivision lot sells for about $9300, with no significant decrease with increasing lot size. This is bigger than, but not significantly so, than the $7500 estimate from the small sample of vacant lot sales. That the marginal value of additional acres does not fall is consistent with the proposition that the value of additional acres in these lots derives from their value in future development. That this figure is less than the $12,000 per acre rule of thumb for sales of large parcels may reflect the constraints imposed on the developer by the existing house and the relatively small parcel size.

In contrast, the estimated coefficient on the lot size variable in the subdivision data is much larger – $48,000 – and the coefficient on the squared term is negative and significant. The estimated value of a one-acre building lot – about $38,000 – is not far less than the $45,000 estimate obtained using observations on vacant lot sales. The difference is probably lost in the constant term. These estimates might reasonably be considered to reflect the market value of privately held open space. A half-acre building lot is relatively big by suburban standards. The estimates indicate that an acre in a private yard in addition to the initial 0.5 acres sells for about $25,000. That value not surprisingly decreases quickly with lot size; lot value is maximized at about five acres.

Now consider the results from the full data sets as reported in columns two and four. Again, the estimated market values of the variables that measure house characteristics appear reasonable and are reasonably consistent across the data sets. We model the effect of time with both a fifth-order polynomial in continuous time (higher-order terms provide no significant additional explanatory power), and linear time trends interacted with both house size and lot size. The interaction terms on the lot size variables indicate that the value of land has increased over time, by about $700 per acre per year in non-subdivision lots, and by about $3500 per acre per year within subdivisions. The value that consumers place on a larger subdivision lot appears to have grown substantially during the 1990s! Figure 2-6 shows the trends in time for a five-year-old, 1600 square foot house on a half-acre lot both within and outside a subdivision. The subdivision house appears to have appreciated somewhat more rapidly over time, with less deviation around the trend.

IV. Summary and Conclusions

One of the purposes of this chapter is to describe the characteristics of land and land development in Plainfield Township with an eye toward implications for open-space preservation. There are a variety of interesting conclusions:

- Plainfield Township contains part of the Grand Rapids urban fringe. While about half of the township is largely developed, the other half remains in the early stages of development.
- There appears to be open space worth preserving. In addition to low-lying areas and wetlands, much of the lightly developed areas are covered in forest. These areas are hilly, which increases both development costs and amenity value.
- There appears to be considerable public and private effort underway to preserve forested open space. Low areas along rivers are preserved through open-space zoning. Large-lot zoning at least temporarily preserves land on private lots over much of the lightly developed areas. And developers have preserved significant amounts of land on private lots within subdivisions.

The other main purpose of the chapter is to analyze the markets in land and houses to get some insight into both the value housing consumers place on preserved open space and the opportunity cost of preserving land, i.e., the value of undeveloped land for development. The conclusions are as follows:

- The Township Assessor uses $12,000 per acre as a rule of thumb for the market value of land suitable for development into residential subdivisions. There is little to suggest from our analyses that this is a bad rule of thumb. Acres on relatively large building lots appear to sell in the range of $7500 to $9000, which is less than the $12,000 rule of thumb, but these properties probably offer constraints not found on larger parcels. The larger parcels observed to have sold typically sold for at least $12,000 per acre.
- At least some consumers appear willing to pay for open space preserved by developers on large subdivision lots. The analysis of observations on sales of vacant subdivision

> building lots suggests that the second half acre sells for about $7000. The corresponding figure using observations on sales of houses indicates a higher number, about $16,000. This second figure may be biased upward due to missing measurements of house characteristics; the houses on large lots may have amenities that increase their value but that we could not measure. Given that public open space arguably provides benefits to a broader range of homeowners, even the $7000 price suggests that the benefits from open space preservation may outweigh the opportunity cost.

We build in Chapter 3 on this analysis by estimating the value of proximity to permanently preserved tracts of forestland.

Table 2-1: Natural Land Characteristics in Plainfield Township

Feature	Acres	% of total	Acres	% of total
Total land area	23,141	100%	23,778	100%
Water	76	< 1%	898	4%
Wet land*(includes wetlands, lowland forests)	845	4%	1643	7%
Topographic Slopes				
Level to 6%	16,458	71%	11,284	47%
6-12%	4956	21%	3717	16%
12-18%	1188	5%	3781	16%
>18%	208	< 1%	3087	13%
Soil Textures				
Sands	8052	35%	14,149	60%
Loams	14,181	61%	5053	21%
Mucks	716	3%	726	3%
Gravels	0	0	443	2%

Sources: Water/Wet land: AWRI analysis of aerial photos; Soils and Slopes: Soil Survey of Kent County Michigan, 1986, USDA.

Table 2-2: Land Use and Cover, Plainfield Township, 1998

Land Use/Cover	Acres, 1998	% of total	Acres, 1978	Change 1978-98
Total land area	23,778	100%	23,778	0
Commercial	987	4.1%	596	391
Industrial	297	1.3%	95	202
Residential	6255	26%	3882	2373
Other developed areas	2287	9.5%	1432	865
Undeveloped	13,054	54%	16,774	-3774
Forest	7448	31%	7244	205
Open field	3565	15%	5570	-2005
Crop land	1480	6.2%	3278	-1798
Orchards/specialty	366	1.5%	545	-179
Other agricultural	66	0.3%	20	-9
Wetland	129	0.5%	117	12
Water	898	3.7%	931	-33

Source: AWRI analysis of aerial photography.
Note: Percentages may not add to 100% due to rounding.

Figure 2-1. Distribution of Housing Stock by Floor Space, Plainfield Township

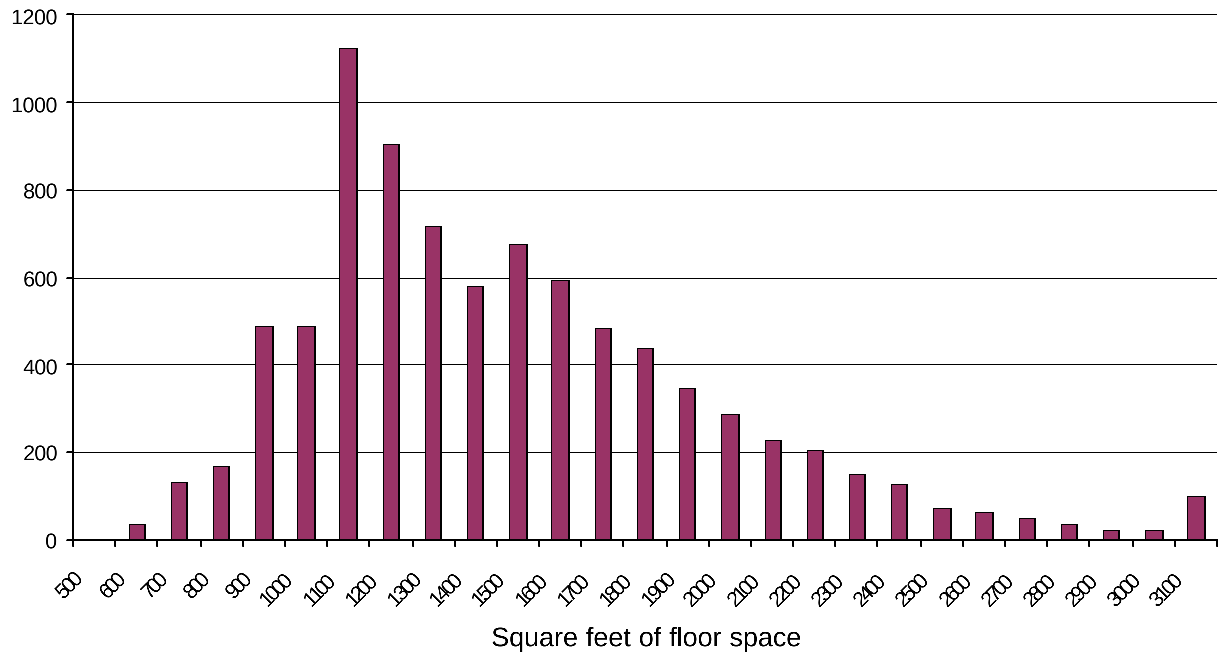


Figure 2-2. Distribution of Housing Stock by Year Built, Plainfield Township

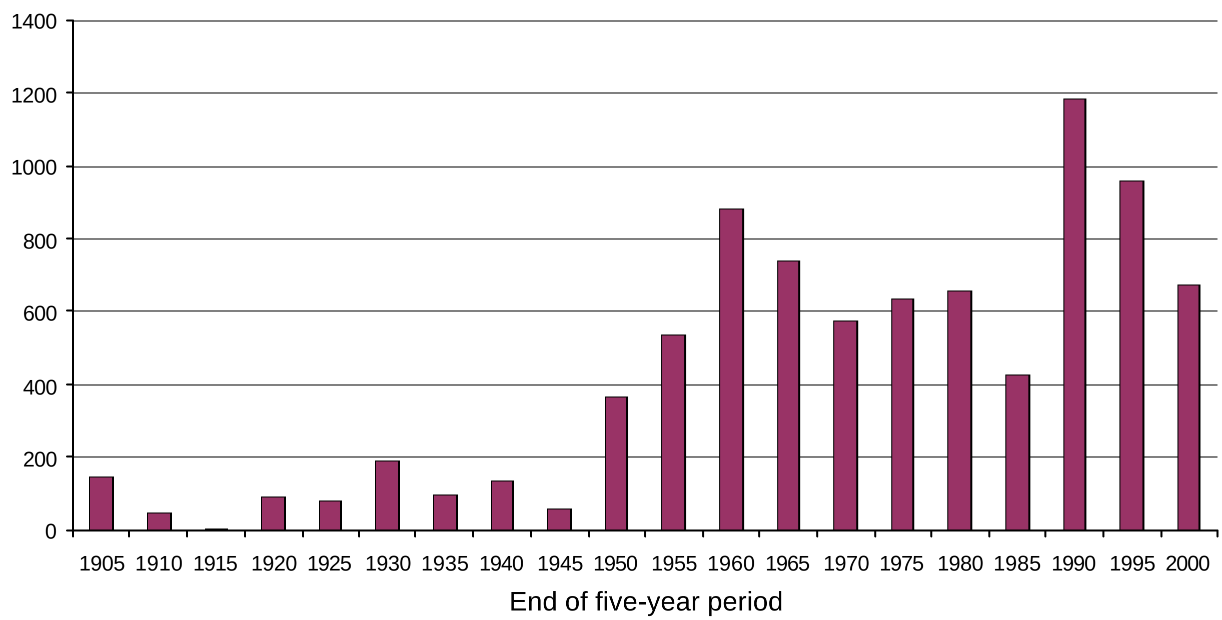


Figure 2-3. Single-Family Dwellings Per Section (i.e., per square mile)

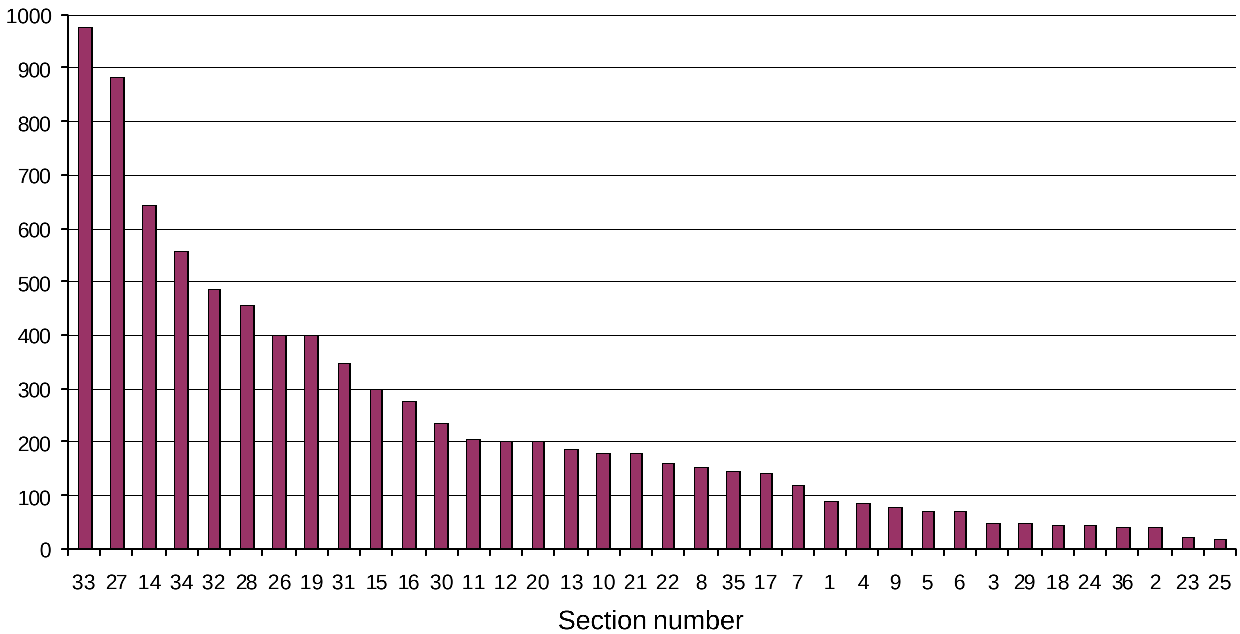


Figure 2-4. The Distribution of Building Lots by Size, Plainfield Township

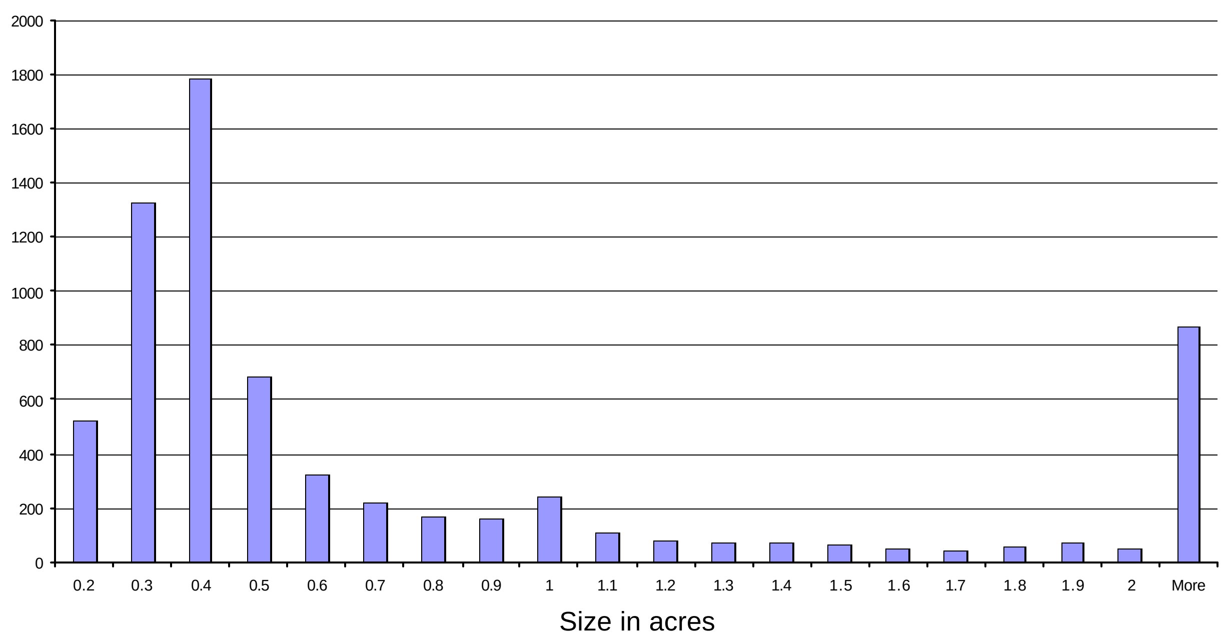


Figure 2-5. The Distribution of Lots of Two Acres and Greater

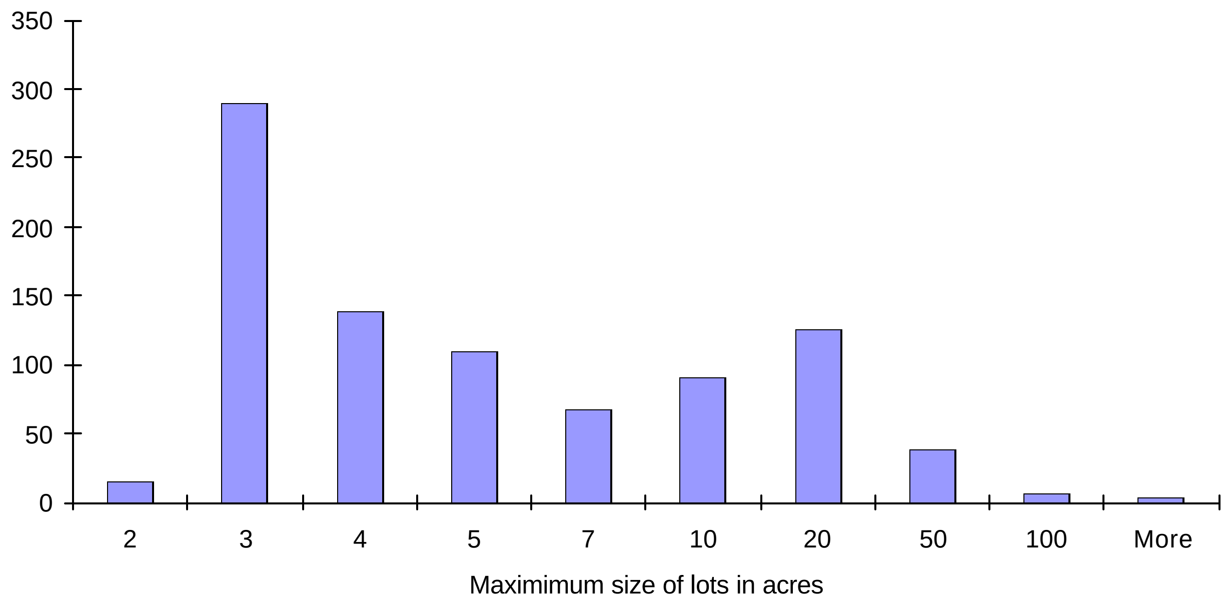


Table 2-3. Acres in Zoning Districts in Plainfield Township, 1941-Present.

Zoning District	1941	1969	1982	1998	Present
Agriculture	20,173 acres	12,644 acres	10,187 acres	0 acres	0 acres
Commercial	160	455	522	522	520
Industrial	171	563	600	600	600
Residential	2764	9663	10,401	20,655	20,658
Rural Estate*			67	67	5538
Rural Preserve**				10,187	4318

Source: Plainfield Township Zoning Maps, acreage compiled by AWRI.

*Rural Estate zoning requires that residential lots not be smaller than 1.4 acres.

**Rural Preserve zoning requires that lots not be smaller than 2.75 acres.

Table 2-4. Sale Prices of Vacant Developable Parcels

Development	Sale Price	Sale Date	Acres	Price/acre
Jupiter Estates Phase 1	$320,000		20.75	$15,422
Grandview Condos	$137,800	Jun-94	6.00	$22,967
Hanover Place	$113,400	Mar-00	9.68	$11,715
Pine Island Estates	$754,000	Jul-99	69.60	$10,833
Rockford Woods	$217,000	Sep-98	13.14	$16,514
Un-named	$80,000	Oct-98	8.00	$10,000
Un-named	$90,000	Mar-00	8.00	$11,250

Source: Plainfield Township Assessor's office

Table 2-5. Sale Prices of Large Parcels with Old and Small Dwellings

Sale Price	Sale Date	Acres	Price/acre	Year Built	Living Area
$283,500	Nov-98	40.00	$7,088	1934	720
$320,000	Nov-98	20.75	$15,422	1860	1259
$358,975	Oct-97	19.71	$18,213	1865	914
$190,000	Jan-99	14.37	$13,222	1920	1050
$127,000	Nov-99	9.74	$13,039	1935	936
$150,000	Aug-97	8.85	$16,949	1935	894

Source: Plainfield Township Assessor's office

Table 2-6. Sale Prices of Vacant Building Lots, Plainfield Township, 1990-2000

	Subdivision Lots		Independent Building Lots	
	1998-2000	1990-2000	1990-2000	1990-2000
Lot size (acres)	20,649.3 (4.46)	14,192.0 (3.91)	3799.3 (4.56)	3889.8 (1.51)
Lot size squared	-4563.4 (3.13)	-3808.9 (2.75)		-16.70 (0.037)
Years since 1/1/90		1942.3 (12.82)	1651.3 (5.30)	1651.1 (5.25)
Constant	28,710.7 (16.4)	16,727.5 (10.6)	11,228.9 (6.28)	11,160.8 (4.34)
Adj. R-squared	0.31	0.40	0.50	0.45
Number of observations	64	271	58	58

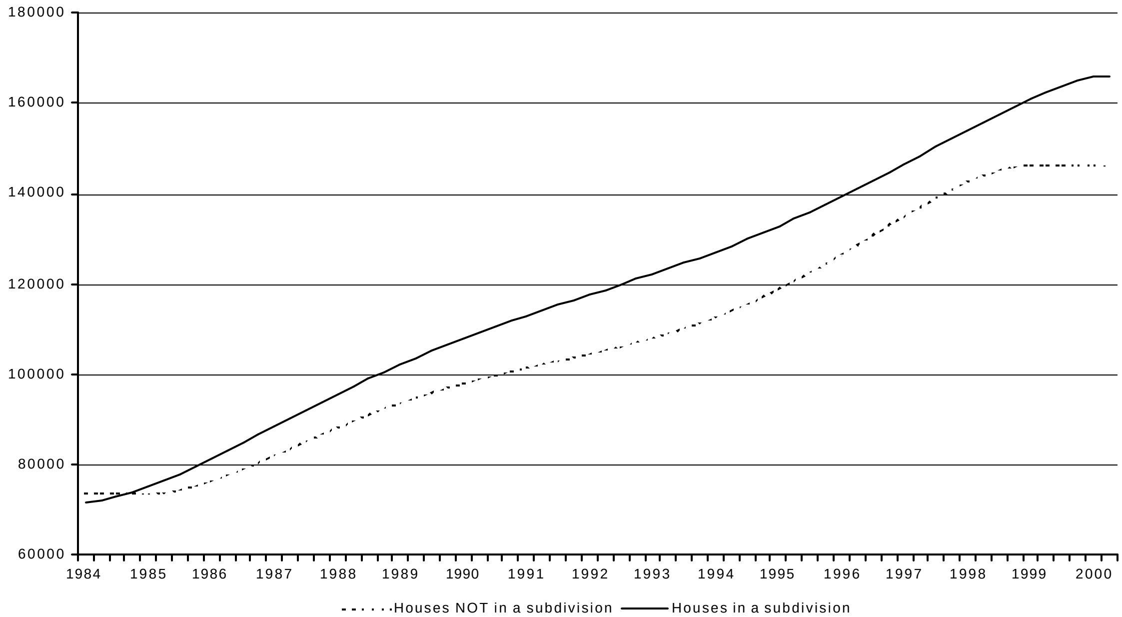
Dependent variable is sale price. Absolute value of t-statistics in parentheses.

Table 2-7. The Market for House Characteristics in Plainfield Township: 1984-2000

	Houses w/acreage		Houses in subdivisions	
	1998-2000	1984-2000	1998-2000	1984-2000
House size (square feet)	73.4 (4.33)	40.17 (5.25)	74.26 (6.61)	33.86 (7.26)
House size^2	-0.0034 (0.76)	-0.0050 (3.11)	-0.0021 (0.68)	0.0020 (1.54)
House size $\times$ time trend (in years since Jan. 1984)		2.40 (5.30)		1.93 (9.06)
House size $\times$ age at sale (years)	-0.701 (4.99)	-0.71 (14.7)	-1.19 (12.1)	-0.94 (29.2)
House size $\times$ age^2	0.0023 (2.14)	0.0038 (9.98)	0.0074 (4.93)	0.0053 (10.4)
Lot size (acres)	9347.8 (3.58)	-868.3 (0.56)	47,861.3 (6.25)	-3873.4 (0.83)
Lot size^2	-224.4 (1.11)		-9518.9 (3.92)	
Lot size $\times$ time trend		685.8 (4.27)		3371.5 (7.32)
Lot size^2 $\times$ time trend		-13.27 (1.70)		-667.9 (9.60)
Garage size (sq. ft.)	19.41 (2.44)	15.68 (5.26)	33.62 (5.77)	18.19 (8.59)
Finished basement area (sq. ft.)	3.20 (0.44)	21.67 (8.67)	23.29 (8.08)	18.77 (18.5)
Ranch style	-2069.8 (0.42)	-499.1 (0.27)	7544.1 (3.02)	6729.4 (7.55)
Rockford schools	10089.8 (1.91)	4185.8 (2.39)	-170.6 (0.071)	2347.4 (2.85)
Comstock Park schools	-115.9 (0.02)	-2541.0 (1.27)	-3672.9 (1.32)	-2353.5 (2.47)
Sale in second half 1998	1794.6 (0.29)		-2714.3 (1.05)	
Sale in first half 1999	-270.8 (0.04)		4540.3 (1.75)	
Sale in second half 1999	536.6 (0.08)		9699.9 (3.64)	
Sale in first half 2000	-3336.1 (0.38)		7076.5 (1.70)	
Time trend (continuous in years since Jan. 1984)		-15345.4 (1.89)		-4491.0 (1.07)
Time trend^2		6364.8 (2.28)		2756.7 (2.04)
Time trend^3		-1043.3 (2.60)		-463.2 (2.45)
Time trend^4		73.34 (2.85)		31.54 (2.63)
Time trend^5		-1.83 (3.04)		-0.747 (2.68)
Constant	30867.0 (1.81)	24484.1 (2.25)	16745.5 (1.75)	10603.9 (1.71)
Adj. R-squared	0.648	0.737	0.793	0.838
Number of observations	239	1028	625	2946

Dependent variable is sale price of the house. Absolute values of t-statistics are shown in parentheses.

Figure 2-6. Trend in House Prices, Plainfield Township: 1984-2000

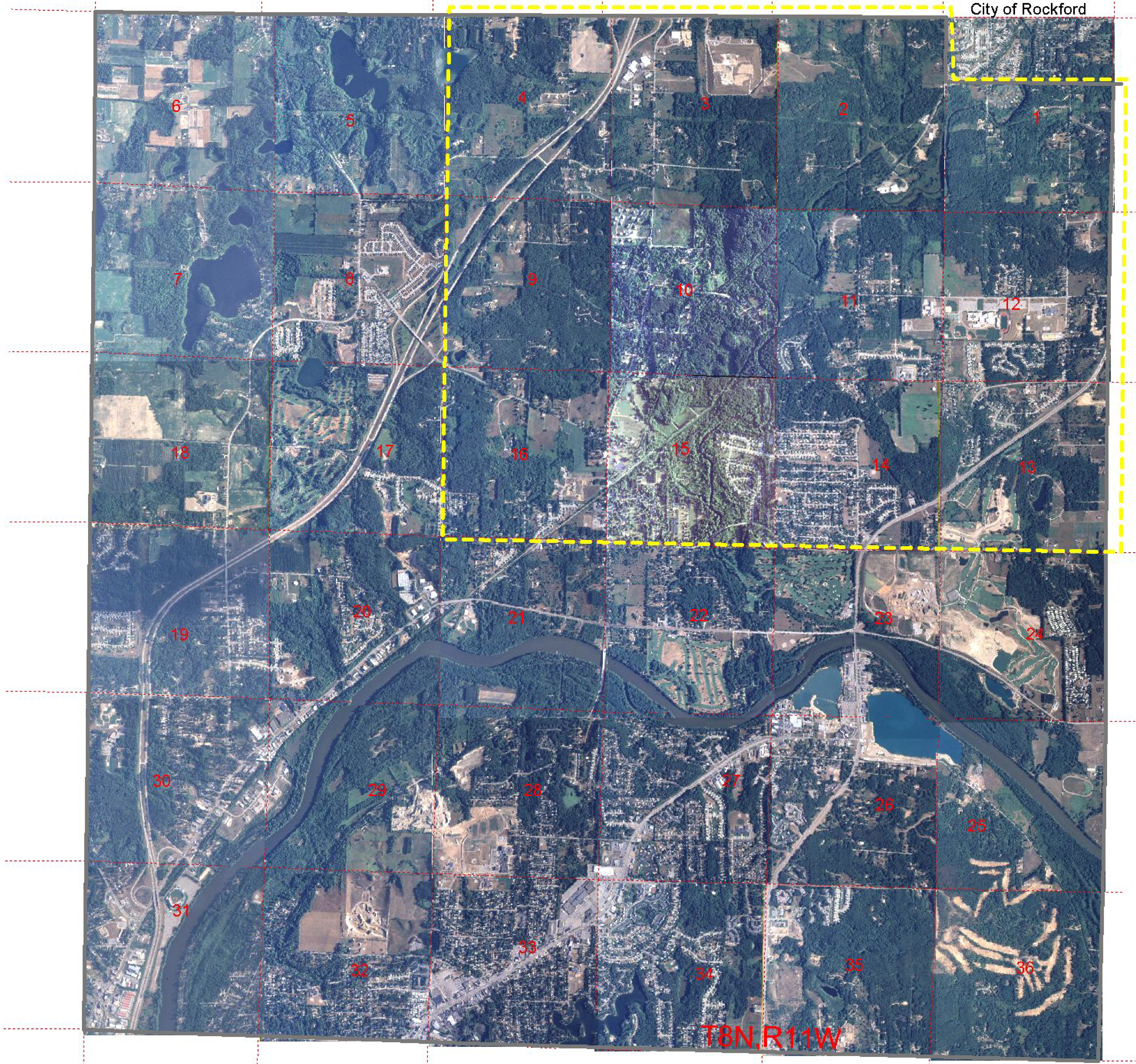


Note: Trend applies to a five year old house with 1600 square feet of living area, a 600 square foot garage, all on a 0.5 acre lot.

Map 2-1

Plainfield Charter Township - 1998

Kent County, Michigan



Study Area

Section Lines with numbers

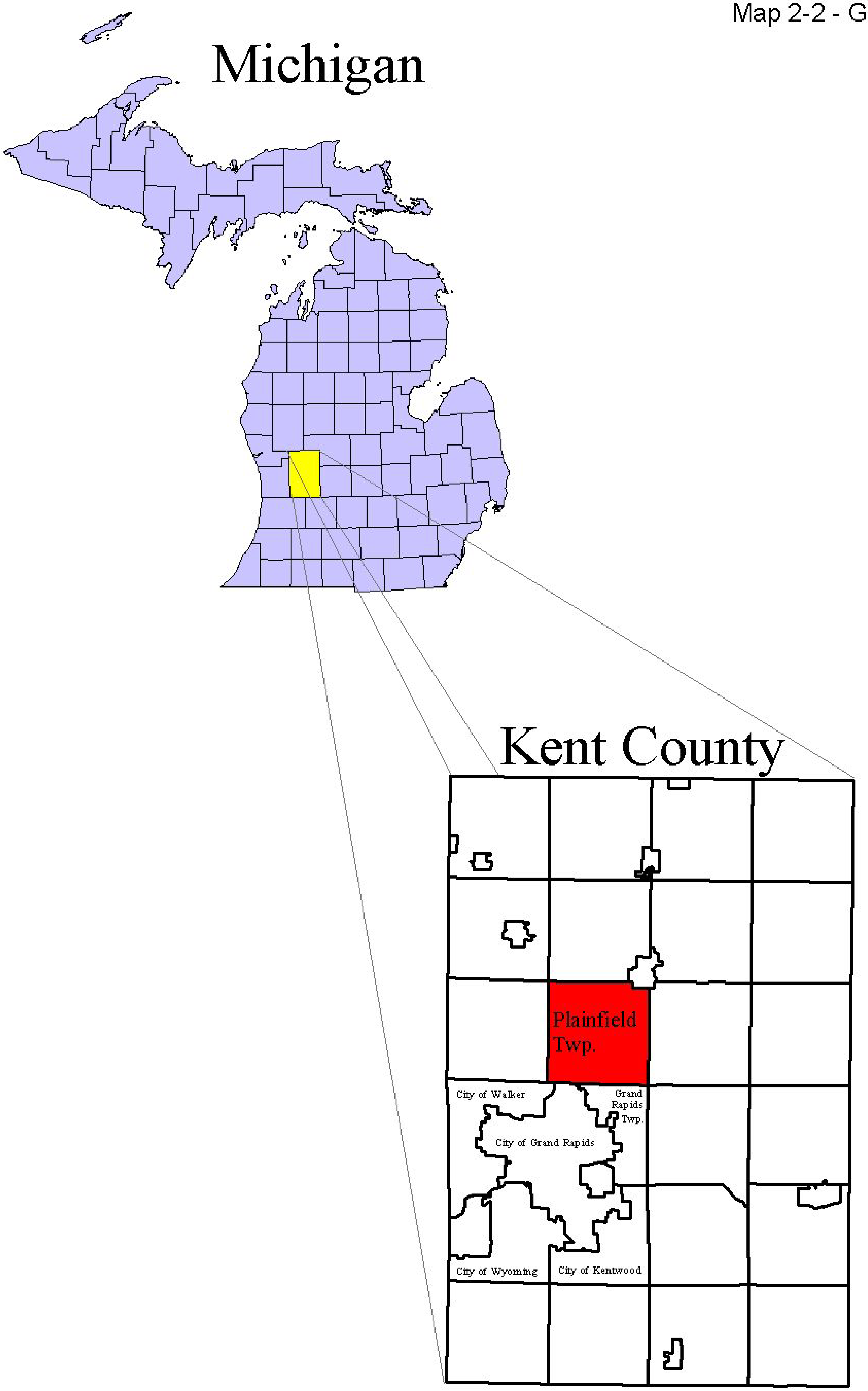
0 1320 2640 3960 5280 Feet

N W E S

Annis Water Resources Institute
Grand Valley State University

Map Prepared: August 2000

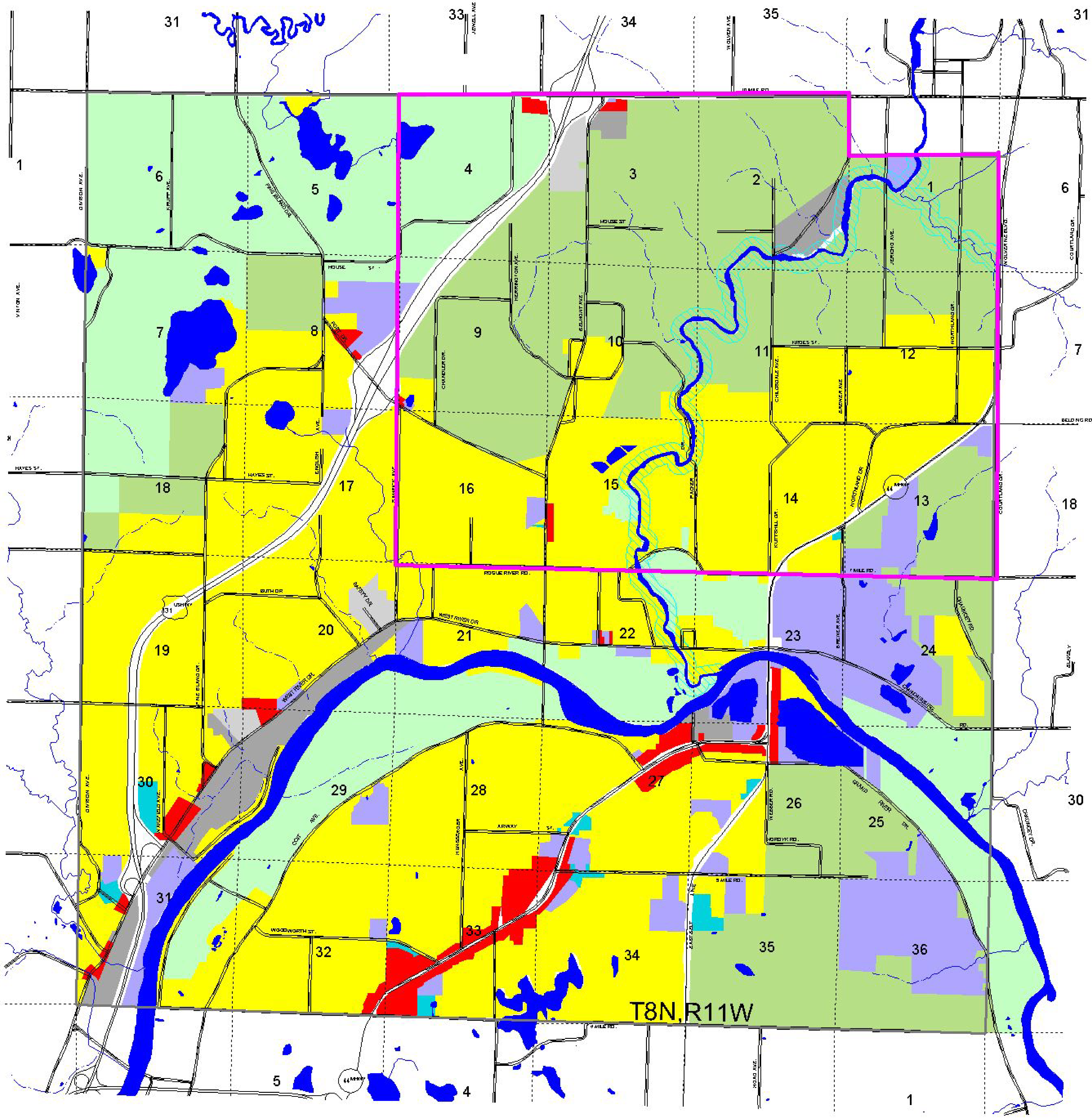
Data Source: Aerial Imagery obtained from USDA Farm Service Agency, 1999. Photo rectification and registration done by the GVSU-WRI, 1998.


Michigan
Kent County
Plainfield Twp.
City of Walker
Grand Rapids Twp.
City of Grand Rapids
City of Wyoming
City of Kentwood

Map 2-3

Zoning Districts - 2000

Plainfield Charter Township



Base Information

- State/Federal Highway
- County Road
- Section Line
- Drains/Intermittent Stream
- River/Creek
- Lake/Pond

Zoning Districts

- Commercial
- Industrial
- Offices
- Planned Industrial
- Planned Unit Development
- Residential
- Rural Estate
- Rural Preserve
- Water
- Natural Rivers - 300' Buffer

Study Area

0 1320 2640 3960 5280 Feet

Annis Water Resources Institute
Grand Valley State University

Map Prepared: August 2000

Data Sources:
Base Information: Michigan Department of Natural Resources, MIRIS 1978.
Zoning Districts: Plainfield Township Planning Department and Prien & Newhof, 2000.

CHAPTER 3

THE BENEFITS OF PRESERVING FORESTED LAND IN SUBURBAN AREAS

I. Introduction

As described in Chapter 1, the rationale for preserving natural areas is that there are benefits from doing so. Some of these benefits are local and others more widely spread. A primary practical motivation for establishing some sort of market in development rights is essentially to pay for preservation by distributing back to the owners of preserved land some of the local benefits the preserved land generates. A critical issue, therefore, concerns the nature of those benefits: How big are they? and How localized are they? The size of the benefits influences how much land should be preserved, and the geographic extent of the benefits influences the location of preserved tracts relative to development. This chapter reports the results of existing research into these questions, and presents new estimates that are obtained from data on building lot and house sales in subdivisions that border forest preserves in Plainfield Township and another subdivision in Grand Haven Township, which is also in the Grand Rapids area.

The idea behind this and many existing studies is that the value of the local benefits capitalizes into the sale prices of nearby land and houses. Housing consumers are willing to pay more for proximity to preserved natural areas. The sellers of houses, or of the land to be developed into housing can therefore extract this willingness to pay through higher sale prices. The trick is to distinguish the effect on sale price of proximity to the natural area from that of the other characteristics of the house or land. A standard approach, which is known as an hedonic price study, is to gather information about a large sample of house or land sales, and use statistical regression analysis, like that described in Chapter 2, to tease out the implicit market values of the various characteristics of the houses or parcels. The approach is considered relatively reliable because the results come from actual market transactions.[1]

There are only a few housing-market studies, which we describe in the next section, that focus exclusively on the value of proximity to preserved natural areas. All report sale price premia associated with proximity to preserved land. We found only one study that focuses exclusively on proximity to forest preserves (Tyrväinen and Miettinen, 2000). That study was carefully conducted and produced estimates that we think should be taken seriously: houses built next to the preserve command a sale price premium of about 7%, and the premium falls gradually over about half a mile. The implied total market value of benefits would clearly be substantial in a neighborhood of $200,000 houses.

[1] See Chapter 4 of Tietenberg (2000) for a useful description of the methods used to estimate the potential benefits of environmental improvements.

The new estimates reported in this chapter contribute to the existing research. There are at least two potential sources of inaccuracy in the estimates reported by Tyrväinen and Miettinen.[2] First, the data consist of a standard sample of house sales. It is difficult, but extremely important, to control for a wide variety of house and neighborhood characteristics. If, for example, the houses near the preserve have more windows or bigger decks than is typical of the other houses in the sample, and the researchers fail to measure these characteristics, then the estimate of the value of proximity will tend to be inflated. Secondly, the preserved areas in that study are elevated, which requires the researchers to control statistically for the effects of a view, which is also difficult. In addition to providing estimates using local market data, there is an opportunity to obtain more accurate estimates.

The data from these subdivisions seem well-suited to provide relatively accurate estimates. First, the forest preserves are not elevated, so houses away from the preserve generally lack a view of the forest. Second, though there is substantial variation in the characteristics of the building lots in each subdivision, there are no house characteristics to control for, and many of the neighborhood characteristics that vary in a standard sample do not vary within a subdivision. Assuming that the value of the forest amenity capitalizes fully into the value of the building lots, the building-lot data should yield relatively clean estimates of the proximity premia. The observations on house sales from the same subdivisions allow comparison of the estimates obtained from lot sales with those from house sales.

The key findings are that building lots that back onto the forest preserve command a significant premium, but that premium is highly localized. The point estimates indicate premia of at least $5800, and more likely in the range of about $7000 to $8400. These amounts represent premia of 25% to over 35% of the prices of otherwise similar lots, but only about 4% of house price. While the benefits generated by the preserved land appear substantial, they also appear to be highly localized: the building lots across the street from those that back onto the preserve appear not to command much if any price premium over lots farther from the preserve. This steep proximity gradient implies that the location of preserves relative to development matters.

The remainder of the paper consists of five sections. Section II reviews the existing empirical literature. Section III describes the empirical methods. Section IV describes the data. Section V reports the results of the analyses. And Section VI summarizes the work and contains a brief discussion of the implications for open-space policy.

II. Existing Housing-Market Studies of Forest/Natural Area Benefits

Correll, Lillydahl, and Singell (1978) point out that preserved open space provides two distinct types of external benefits to nearby households. Benefits of the first type are potentially highly localized: scenery, direct access to recreational space, direct observation of wildlife, and so on. The remaining benefits extend over a wider geography: flood control, reduced congestion, existence value of wildlife, general access to recreational space, and

[2] See Haurin and Henderschott (1991) and Knight, Dombrow, and Sirmans (1995) for good general descriptions of empirical issues in the context of hedonic house-price studies.

pollution filtration. The assumption standard in the existing literature is that competition in the markets for land and houses ensures that the value that housing consumers place on open-space benefits is capitalized into sale prices. Only the value of the local benefits is retrievable statistically, however, because the value of the broader benefits does not vary over the samples analyzed.

Figure 3-1 diagrams the simple theory that underlies all of the existing empirical work. The vertical axis shows the value that preserved open space adds to the value of a house. The horizontal axis shows straight-line distance from the edge of the preserve. B_P shows the general public goods value of the preserve that is not typically estimated in hedonic studies. The figure shows three potential hedonic distance gradients. The gradient labeled G_1 is linear in distance, which assumes that benefits fall by a relatively constant dollar amount with distance from the border of the preserve. The gradient labeled G_2 is a negative exponential in distance, which assumes that benefits fall by a relatively constant *percentage* of house price with distance. And the gradient labeled G_3 has a discontinuity beyond the lots that border the preserve; the houses that border the preserve receive almost all of the local benefits.

A growing literature reports hedonic estimates of these gradients in the price effects of distance from a nature preserve.[3] Correll, Lillydahl, and Singell (1978) is an early study.[4] The data consist of 85 sales in 1975 of existing houses each within 3200 feet of one of three tracts of open space purchased outright for preservation by the City of Boulder, Colorado. The observed sale price of the house is regressed on straight-line distance from the nearest preserved tract and a total of five house and neighborhood characteristics; the price gradient is assumed to be linear in distance, i.e., G_1 in Figure 3-1.

Analysis of the pooled sample yields a statistically significant price gradient of $4.20 per foot from the border of the preserved tract. Separating the data by proximity to each of the three preserved areas yields mixed results: a negative gradient of $10.20 per foot from tract 1, a *positive* gradient of $3.40 per foot from tract 2, and an insignificant negative gradient of $3.00 per foot from tract 3. The authors argue that conditions near tract 1 render those results the most plausible, though they point out that omitted neighborhood variables may bias upward the estimate of the slope of the gradient; the houses near the preserve may be nicer in unmeasured ways. This tract of forested land is elevated and offers views to houses farther from the preserve. No attempt is made to control for the price effects of the view.

Nelson (1986) reports the results of an analysis of vacant land sales in proximity to the urban growth boundary around Salem, Oregon. Zoning on the land outside of the growth boundary restricts land to farm, forest, and very low density residential uses. The data consist

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[3] There are also related studies. Anderson and Cordell (1985), Morales (1980), and Morales, Micha, and Weber (1983) report hedonic estimates of the value of trees as landscaping on residential sites. Doss and Taff (1996) and Mahan, Polasky, and Adams (2000) estimate the effect on house prices in Minnesota and Oregon, respectively, of proximity to wetlands. The findings in all of these papers support the reasonable proposition that at least some homebuyers value proximity to environmental amenities, and each paper cites numerous related studies.

[4] Earlier studies of related work are referenced therein.

of observations on sales of 40 undeveloped parcels that are inside the growth boundary from 1977 to 1979. The parcels average ten acres in size and are located an average of 2800 feet from the urban growth boundary. Nelson regresses parcel price per acre on a quadratic in distance from the growth boundary and other parcel characteristics. The quadratic allows the data to determine whether G_1 or G_2 is the more appropriate. The estimated coefficients on the quadratic, which are weakly significant, indicate that G_2 is more appropriate: per-acre land value falls initially at $150 per 100 feet from the growth boundary, and then slows with distance. Land value falls by a total of about $1200 per acre in the first 1000 feet from the growth boundary. This despite the fact that the current location of the growth boundary is not expected to be permanent.

Lee and Linneman (1998) estimate a time series in the distance gradient inside the expansive greenbelt around the central areas of Seoul, South Korea. As in the case of Salem's growth boundary, zoning restricts development on land in the greenbelt. The dependent variable is the natural log (which implies G_2) of an estimate of the unit price of 'high quality' residential land in each of 897 districts referred as 'dongs'.[5] Distance is measured in kilometers from the boundary of the greenbelt. The interesting result is that the estimated distance gradient grows from about 2% of estimated land value per kilometer in 1970 (just prior to the zoning legislation going into force), to a high of 18% in 1980, and back down to 4% in 1989. The authors suggest that the reduction in the price gradient results from growing public expectation that the development restrictions in the current greenbelt will be eased. The permanence of the preserve not surprisingly matters.

Tyrväinen and Miettinen (2000) is the only hedonic study we found that focuses exclusively on estimating the capitalized benefits of proximity to forested tracts that are in suburban residential areas and that can reasonably considered to be permanently preserved. Their data consist of 590 observations on sales of owner-occupied apartments in 'terraced housing' in the district of Salo in Finland in the years 1984 through 1986. The researchers focus on sales of apartments in terraced housing – apparently condominiums – to reduce bias from unobserved house characteristics. The forest preserves are on hills above the residential areas, so the researchers attempt to distinguish statistically the value of a view of the forest from the value of proximity.

The natural log of the sale price of the house is regressed on six house characteristics, the straight-line distance of the house to the nearest forest preserve, and a dummy variable that indicates whether or not the house has a view of the forest. Controlling for the quality of a view, which generates a price premium of about 5%, the sale price of dwellings falls at a rate of about 6% (with a standard error of 1.7%) per kilometer from the nearest forested area. The researchers substitute a series of dummies in distance for the continuous distance variable. The results suggest that a house located adjacent to the preserve generates a price premium of about 7.3% (standard error of 2%). The proximity effect falls statistically to zero within about 600 meters from the preserve. Gradient G_2 appears to be the most appropriate.

[5] From the description in the paper, the dongs appear to be similar to census tracts or block groups.

III. Empirical Methods

The primary objective of this study is to obtain from the building-lot data relatively accurate estimates of both the magnitude and geographic extent of the benefits associated with proximity to the border of a forest preserve. The empirical specification standard in the literature is:

$$P = a + bX + gG + g(T) + e \qquad (1)$$

where P is either the sale price of the house or land or the natural log of sale price. The vector X contains measurements of house, lot, and neighborhood characteristics that vary across the sample. The variable G represents the distance gradient, which, as shown above, may be continuous or a series of dummy variables. Finally, g(T) is a general specification of the time trend, and ε is a standard error term that includes the effects of missing house, lot, and neighborhood characteristics.

The concern in this section is with how to specify X and G given data that consist of sales of vacant building lots within a subdivision. There are a small number of readily observable lot characteristics that vary among the lots in these subdivisions: lot size, location on a corner, and location in a cul-de-sac. In addition, the lots along the border of the subdivision back onto a variety of land uses in addition to preserved forest land: arterial streets, other subdivisions, large potentially developable lots, and parks. Lot size is entered as a continuous variable, while dummies are used to control for the other lot characteristics.

The specification of the distance gradient, G, is also important. The hypothesis is that, in the absence of a view, the benefits of proximity to the forest are highly localized, i.e., that gradient G_3 in Figure 3-1 is appropriate. Consistent with this hypothesis, the developers of each subdivision appear to maximize the number of lots that back onto the preserve by locating a street that runs parallel to the preserve. This suggests a stringent test of the hypothesis: specify the distance gradient with a dummy for a location bordering the preserve, and another dummy for a location directly across the street from the lots that border the preserve. Thus $gG = g_0 D_F + g_1 D_{op}$, where D_F is a dummy for lots that back onto the forest preserve, and D_{op} is a dummy for lots across the street from the lots that border the preserve.

Data on house sales in the same subdivisions are also available. These data allow a comparison of the estimates from the building-lot data with those from a more conventional sample of house sales. Making that comparison requires estimating an equation identical to (1) with the addition of a vector of characteristics of the structure, X_S:

$$P_H = a + b_0 X_L + b_1 X_S + gG + g(T) + e \qquad (2)$$

The hypothesis, however, is that unobserved heterogeneity in house characteristics generates at least less accurate (i.e., large standard errors) and possibly biased coefficient estimates, including those on the proximity variables. The bias on γ_0 will be upward, for example, if proximity to the preserve encourages investments, such as windows and decks that are not observed.

IV. Description of the Data

The data come from three single-family developments, two of which are in the central part of Plainfield Township. The other is in Grand Haven Township, which is in the western part of the Grand Rapids, Michigan metropolitan area. Both townships provide the full array of urban services. Each subdivision borders a tract of permanently preserved forested land.[6] This is obviously a small sample of subdivisions that cannot be considered representative of all such subdivisions in the area. The cost of data collection was the key factor in the decision to look at just three subdivisions. Despite the small sample of subdivisions, the total sample of sales (431 lot sales and 486 house sales) is not especially small. Moreover, the small geography yields an unusually high *density* of sales.

The sales and characteristics data come from the local tax assessor's office. Importantly, the prices analyzed are transactions prices not assessor estimates of property values. An advantage of assessor data relative to data from the local multiple listing service (MLS) is that the assessor probably sees a higher proportion of the transactions that occur; only those sales brokered by real-estate agents appear in MLS data.[7] A disadvantage of tax-assessor data, however, is that the assessors reliably collect information only on the set of house characteristics that they consider when estimating the property's market value. For example, the number of bedrooms in the house is not always recorded because it is not considered when making property assessments.[8]

The remainder of this section describes the characteristics of the subdivisions.

Forest Park

Map 3-1 shows the layout of Forest Park. The numbers printed in each lot show the sale price of the building lots observed to have sold and the year of sale. The subdivision consists of a northern square area and a southern stem. The west side of the northern area borders Hofma Preserve. The west side of the southern stem borders Hofma Park. Both the preserve and park were donated to the township in the 1930s by a prominent local family. The township maintains sports fields in the park, while the preserve is just that; the view fom the houses on lots that back onto the preserve is of dense deciduous forest. The forested land is

[6] It is possible, of course, that any forested land may eventually develop. These preserves appear to be permanent. We cannot unfortunately test the value of whatever uncertainty remains about future development in these areas.

[7] Interestingly, the assessors acknowledge that they miss some sales because the paperwork required by law was not completed and filed at the time of sale. The assessors generally lack the resources to follow up on these transactions.

[8] The assessors do not consider the number of bedrooms because their experience is that the number of bedrooms does not significantly affect sale prices. The number of bedrooms is, however, recorded on a large proportion of the observations on house sales in the sample. Consistent with assessor perceptions, including number of bedrooms in a hedonic analysis of this sub-sample yields an insignificant estimate on the coefficient on number of bedrooms.

not elevated, and there is no easy access to the preserve by foot from houses across the street from those bordering the preserve.

The characteristics of development vary on the subdivision's other borders. To the north and southeast are other subdivisions of similar vintage and quality. The deep lots in the northeast part of the subdivision contain a low area with a creek fed by a spring in the middle of the subdivision. The houses are built on the front of these lots, and the low area in the back is effectively preserved in forest. To the east of the northern part of the subdivision is a two-lane arterial street. The area to the east of the southern portion of the subdivision consists mainly of relatively large home sites. This area is zoned for standard suburban residential development and will likely develop more intensively in the future. There is an arterial street to the south of the southern portion of the subdivision.

Tables 3-1 and 3-2 provide summary statistics. Table 3-1 shows characteristics of each subdivision and about the dummy variables used in the analysis. The first building lots were sold in 1989 in the southern portion of Forest Park. The last lots sold in early 2000 and the last few houses are currently under construction in the northeastern part of the subdivision. The assessor observed 207 sales on the 230 lots. Some lot sales are not observed either because the developer built the house (and, therefore, did not sell the vacant building lot) or the assessor did not receive and process the usual paperwork. In addition, 194 house sales are observed. Fewer house sales are observed than lot sales because most of the lots were sold directly to housing consumers, who then contracted with builders to construct the homes. Sales of houses are observed when the original owners decide to sell. The sample of house sales consists of all house sales observed, not just those on lots also observed to have sold.

Table 3-2 provides summary statistics for characteristics of the lots and houses in the sample. There clearly is considerable variation in lot and house sale prices and characteristics, variation that belies the homogeneous feel to the subdivision as one drives through. Lots range in size from about one third to five-thirds acre, and sale prices range from $14,000 to almost $50,000.[9] Similarly, houses range in size from 1200 square feet to almost 3000 square feet, and sale prices range from $83,000 to $333,000. The empirical specification clearly must pick up the sources of this variation to yield accurate estimates of the gradient on the forest premium.

Rogue River Woods/Highlands

Map 3-2 shows the plat of Rogue River Woods subdivision (hereafter called River Woods). The forested area on the west consists of the 300 foot buffer between development and the Rogue River that is preserved under Michigan's Natural Rivers Act. The preserve is probably permanent not only due to its designation but also because much of the land in the buffer is low, with the potential for occasional flooding. The subdivision borders on its south a single-family subdivision developed in the 1970s in lower-priced housing. On the north and east, in contrast, the subdivision borders relatively large (several acres or more) residential properties that are largely forested at present, but may develop at higher density in the future.

[9] Lot sizes are shown in Table 3-2 in thousands of square feet. One acre is equal to 43.56 thousand square feet.

Map 3-3 shows the layout of Rogue River Highlands (hereafter called River Highlands). The subdivision, which is to the south and west of River Woods, borders the forested buffer along the Rogue River on its north and west. The lots on the east are separated from an arterial street by a roughly 300 foot wide park and cemetery. There are relatively large lots zoned for residential development that surround the southern stem of the subdivision. A roughly 200 foot wide right-of-way that runs east-west divides the subdivision into northern and southern units. Though the local electric utility owns the right-of-way, the right-of-way currently is vacant, and homeowners appear to use the space for storage and recreation.

Tables 3-1 and 3-2 show characteristics of the subdivisions, building lots, and houses. River Woods is similar to Forest Park, though River Woods developed a few years earlier, and lot prices are somewhat higher. House sizes are also similar across the two subdivisions. River Highlands is older and developed over a longer time period than did the other two, in this case from 1978 through 1994. The southern portion of River Highlands developed earlier, though there are some later sales there.

V. Results

The results of estimating equation (1) for each subdivision are shown in Table 3-3. Estimates are reported with both the transactions price of the lot and the natural log of price as dependent variables. So, in the first column of results for each subdivision, the top number (that not in parentheses) shows the estimated implicit market price for each of the lot characteristics shown at the left. The bottom number (that in parentheses) is, as in Chapter 2, the t-statistic, which indicates how confident we should be in the estimate shown above it. The bigger the t-statistic the better. The second column of results for each subdivision shows the same estimates, but this time in terms of percentage of lot price. For example, an estimate of 0.0320 indicates an implicit market price of about 3.20% of lot value. Table 3-4 similarly shows the results of estimating equation (2).

Lot Sales

Consider first the estimates of the coefficients on the dummy for a lot that 'borders preserve'. The estimated proximity premia shown in Table 3-3 are highly significant (i.e., have big t-statistics) and are similar across the subdivisions. Looking only at those results, the point estimates of the premia for direct access to the preserve range from about $5800 to about $8400. These estimates represent price premia of from about 19% to 35% of lot price, which suggests that the proximity premium is not properly viewed as a relatively constant proportion of lot price.

The estimated coefficients on the dummy for a lot across the street from the preserve measure the spatial extent of the forest amenity. The coefficient estimate corresponding to Forest Park is positive, but only weakly significant. In contrast, that in River Woods is negative and significant. This negative estimate in River Woods may be explained by topography. The various dummy controls exclude the area that are on the rise behind the lots that are across the street from those on the woods. Therefore, the estimates on the dummy variables represent premia and discounts relative to the average price of the lots on the rise.

These elevated lots offer some view of the woods; the lots across the street from the preserve that lack a view sell, therefore, at a discount. Thus, the premium on a lot that borders the preserve may really be about $1959 larger than that indicated by the coefficient on the 'borders preserve' dummy: the forest premium may be as high as about $7800 in River Woods. These results suggest that the forest amenity is highly localized, with little if any benefit extending to lots across the street from the preserve.

The estimates on the control variables are also of interest. Consider first the estimates on the variables that measure within-subdivision variation among lots. The coefficients on the lot size variables in Forest Park and River Woods have expected signs and are jointly significant. There appears to be no effect of lot size in River Highlands, which is not surprising because the lots not on the forest vary relatively little in size. The coefficients on the cul-de-sac and corner dummies are either insignificant or have the expected signs.[10] Not surprisingly, the relatively large lots that back onto the low and wet area in Forest Park sell for a substantial premium, about $9500. This privately owned forestland appears to sell at a premium roughly similar to that associated with direct access to the public forest preserve to the west.

The estimated effects of other land uses at the borders of the subdivision vary. A lot in Forest Park that borders an arterial street sells for the expected large discount, while there is no effect in River Highlands. Only two lots in River Highlands border the arterial street, and the arterial streets around Forest Park carry considerably higher traffic volumes. The lots that back to a neighboring subdivision in River Woods sell for a large discount, which is not the case in Forest Park. The difference is that the subdivision to the south of River Woods consists of older and considerably lower-valued housing. There is little effect of proximity to large, potentially developable lots. The effects of proximity to a park are positive, but not strongly significant.

The estimates on the time trend are of obvious importance as controls. The results from a cubic in time are reported in the table because experimentation indicates that even in River Highlands a cubic controls for time as effectively as any other simple specification. The results suggest that lot prices are nearly linear in time in both the Forest Park (at $2000 per year) and River Woods (at $3700 per year). This constant growth is consistent with the falling rate of general price inflation over the period of lot sales. Estimated price inflation is smaller in Forest Park perhaps because many of the lot sales occurred during the recessionary period of the early 1990s. Importantly, differences in the empirical specification in time, including higher-order polynomials and yearly dummies, had little impact on the estimates of the forest premia.

Further experiments with alternative specifications showed little effect on the principal results. Pooling the data across subdivisions is soundly rejected. Outliers, especially those on lots that border the preserve, naturally have some effect on the estimated forest premia. As one would expect from the small standard errors on the estimated forest premia, however,

[10] Lusht (1997) reports mixed findings in his review (in Chapter 4) of the empirical estimates of the market value of corner and cul-de-sac locations.

excluding the outliers does not strongly affect the estimates on the forest premia.[11] Neither a time trend nor lot size interacted with the forest dummy is significant in any of the specifications. The lack of an effect of lot size is not surprising as access to the forest effectively increases lot size. But even in River Highlands the forest premium is relatively constant over time. Random sub-samples of the data generate similar results.

In sum, it appears that a building lot that backs onto a forest preserve sells for a premium of at least $7000 that differs little across the subdivisions. It also appears that the amenity effects of proximity to the forest dissipate quickly with distance from the preserve. There is little evidence for a continuous price gradient associated with distance from the preserve. The developers of each subdivision seem to recognize this by building a street parallel to the border of the preserve to maximize the number of building lots that back directly onto the preserve.

House Sales

Table 3-4 reports the results of estimation of equation (2). Before discussing these results, note that few of the sales (approximately 20% in Forest Park and River Woods) are of houses that are newly constructed. Some of the vacant building lots were purchased by a builder who constructed a 'spec' house. However, most of the lots in these subdivisions were purchased by the housing consumer who contracted with a builder to construct a 'custom' house. Though the lot sale is observed, the sale of the newly constructed house is not observed. The sale is subsequently observed only if the homeowner later decides to move and sell the house. This explains the smaller number of house sales than lot sales observed in the two newer subdivisions.

Again, consider first the estimated coefficients on the dummy for a lot that 'borders the preserve'. In Forest Park and River Woods the point estimates of the forest premium reported in Table 3-4 are more than double those obtained from the building lot data. The standard error estimates are several times larger. Interestingly, the premia reported in percentage terms are remarkably consistent with the corresponding estimate of about 7% reported in Tyrväinen and Miettinen (2000). These results support the plausible hypothesis that unobserved heterogeneity reduces the precision of, and probably biases, estimates obtained from observations on house sales. Surprisingly, the estimates from River Highlands suggest that there is no forest premium there.

The estimates on the house size variables may be picking up the forest effect in River Highlands. The estimated coefficients on the house size variables indicate that the value of a square foot added to a 2000 square foot house is about $54. While this marginal value decreases with increases in house size in Forest Park and River Woods, as one would expect, the marginal value grows in River Highlands. Indeed, a cubic in house size appears to fit the

[11] The biggest outlier is in River Highlands, a large lot that borders the preserve in the northern portion of the subdivision that sold for $20,000 in 1993, considerably less than one would expect. There is also significant variation on sale prices of lots on the preserve in River Woods, even within a year. The largest is a sale in 1994 for about $10,000 higher than expected.

data from River Highlands. It seems likely that houses on the lots that border the preserve in River Highlands differ considerably from those on the other lots in the subdivision.

The hypothesis that unobserved house characteristics create bias can also be investigated more directly. Suppose that the lot-value model reported in Table 3-3 is reasonably accurate. These results can be used to predict the value of the lots in the house-sales database. Subtracting the predicted value of the lot from the observed sale price of the house and lot together provides relatively clean estimates of the value of the structure by itself. These structure values can then be regressed on the dependent variables shown in Table 3-4. The results are consistent with those shown in Table 3-4: in Forest Park and River Woods, the structures on lots that border the preserve command premia that average about $7900 and $8900, respectively. The t-statistics are low (about 1.3), however, which indicates that the unobserved characteristics of these structures vary considerably. These results further support the hypothesis of heterogeneity bias in the house-price estimates, and also indicates that the controls for lot characteristics in the house-price regressions are working reasonably well.

VI. Summary and Conclusions

The key findings are several. First, consistent with previous results, building lots located in close proximity to the border of the preserve command a significant sale price premium. The results suggest a premium that is fairly consistent across the subdivisions, conservatively in the range of about $7000 to $8400. These premia appear, however, to be considerably more highly localized than those reported previously. This may reflect the lack of a view of the forest, or may reflect a specification bias in previous studies. The analysis of house sales in the same subdivisions suggests that unobserved heterogeneity might bias upward or at least reduce the precision of estimates obtained from observations on house sales.

So, how do these results potentially impact an open-space preservation policy that uses a market in development rights to distribute the benefits of the program? First, they suggest that preservation of more forested space seems well warranted in Plainfield Township. From the local jurisdiction's perspective, the cost of preservation is reasonably approximated by the market price of undeveloped land. If the land market is competitive, then the sale prices of developable parcels reflect the value of land for residential development net of all development costs. Going back to the last part of Chapter 2 we saw that undeveloped land is selling in Plainfield Township in the range of about $10,000 to $15,000 per acre. If close proximity to preserved land generates a price premium of $7500 per lot, as these estimates suggest, then the benefits need only accrue to two lots to be directly worthwhile.

Second, that the local benefits of proximity appear rather highly localized indicates that relatively small tracts of networked open space would have a much greater aggregate effect on nearby land values than would preservation of relatively large, contiguous tracts. The large number of smaller tracts means more boundaries along which to develop. There's an obvious benefit to a lot of developable land that borders a preserve, sort of like the benefits from the winding Michigan coastline. If preserving land requires the purchase of development rights, then attention must be paid to the amounts of local benefits generated. This is not, of course, to say that large contiguous tracts should not be preserved – there may be very good reasons for doing so – it's just that there will be fewer local benefits to tap to pay for the preservation. We discuss this in more detail in Chapter 5.

Important to note is that these estimates represent a lower bound for the social value of preserved forestland. In addition to the scenic and privacy benefits the forest provides to home owners on neighboring lots, a forest network potentially provides a variety of broader benefits: general scenic benefits, flood control, wildlife corridors, and recreation. These are the benefits labeled B_P in Figure 3-1. The estimated benefits reported here do not include these broader benefits; they only include estimates of the local gradient, G_3. In some cases, the recipients of these broader benefits may be called on to support preservation efforts.

Note also that these estimates reflect the marginal market value of proximity to preserved open space given the total amount of land in proximity to a forest preserve. Go back to Figure 1-1 in Chapter 1. What we've done essentially is try to get an estimate of the MEC curve. Since only a small amount of land has been preserved, our estimates are most likely at the right-hand side (i.e., the high side) of the MEC curve. If more land is preserved, then the correspondingly greater supply of land adjacent to a preserve would presumably result in a lower value, on the margin, of proximity to the preserve. If there were a considerably larger number of building lots with direct access to a forest preserve, the premium on those lots would probably be smaller. That is, we move leftward along the MEC curve as more land is preserved. Of course, an area with a generally high level of environmental quality may well attract a large number of households who value it; the MEC curve might not be very steep. We don't however, have the data to measure that slope.

Figure 3-1: Alternative Specifications of the Proximity Gradient

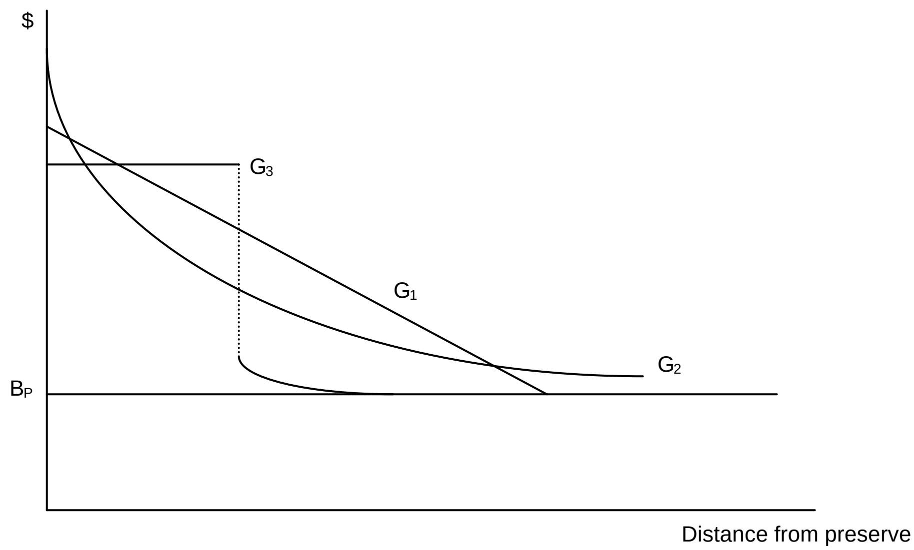


Table 3-1: Characteristics of Subdivisions

	Forest Park	River Woods	River Highlands
Subdivision size (acres)	165	120	85
Years developed	1989-2000	1987-2000	1978-1994
Lots in subdivision	230	150	135
Lot sales observed	207	126	98
House sales observed	194	121	171
Sales of lots that back onto preserve	13	22	19
Sales of lots across street from preserve	6	17	11
Sales of lots on a cul-de-sac	10	12	20
Sales of lots on a corner	25	8	11
Sales of lots on a creek	36	NA	NA
Sales of lots on an arterial street	12	NA	2
Sales of lots that back to a subdivision	37	13	NA
Sales of lots that back to large lot	24	25	10
Sales of lots that back to a park	22	NA	7
Sales of lots that back to a right of way	NA	NA	15

Table 3-2: Characteristics of Building-lots and Houses

	Mean	Std Deviation	Median	Minimum	Maximum
Forest Park					
Lot sale price	$24,667.9	$7149.7	$23,900	$14,200	$49,000
Lot size ('000s of sq. ft.)	26.3	10.9	23.5	15.2	72.3
Lot sale date	Apr 1993	2.15 yrs	Jun 1993	Feb. 1989	Jan. 2000
House sale price	$173,997.2	$44,522.1	$169,000	$83,000	$333,000
House size (sq. ft.)	1924.5	423.1	1870	1200	2954
House sale date	Dec 1995	2.58 yrs	Apr 1996	July 1989	Apr 2000
Bathrooms	2.47	0.47	2.5	1	3.5
Age at sale (years)	2.62	2.21	1.76	0	9.20
Garage size (sq. ft.)	620.3	145.3	576	410	1272
River Woods					
Lot sale price	$33,367.5	$10,673.5	$30,900	16,900	$62,500
Lot size ('000s of sq ft)	32.7	12.3	23.1	13.1	77.5
Lot sale date	Oct 1989	2.30	Jan 1989	Jan 1987	Feb 1998
House sale price	$199.721.4	$52,962.5	$192,000	$99,500	$400,000
House size (sq. ft.)	1990	473.8	1936	1264	3659
House sale date	Dec 1992	3.68 yrs	Jul 1992	Jun 1987	Mar 2000
Bathrooms	2.72	0.62	2.5	1.5	4.5
Age at sale (years)	4.79	3.55	3.96	0	12.8
Garage size (sq. ft.)	641.9	140.9	596	484	1122
River Highlands					
Lot sale price	$16,961.2	$7571.7	$14,000	$5000	$37,450
Lot size ('000s of sq ft)	18.3	9.58	15.3	10.7	58.2
Lot sale date	Jul 1985	4.2 yrs	Apr 1986	Sep 1978	May 1994
House sale price	$105,744.7	$42,303.3	$100,000	$45,600	$279,900
House size (sq. ft.)	1478.0	368.3	1366	1100	3898
House sale date	Apr 1989	6.02 yrs	Mar 1989	Mar 1978	Dec 2000
Bathrooms	1.99	0.56	2	1	3.5
Age at sale (years)	6.08	7.75	2.89	0	19.68
Garage size (sq. ft.)	574.0	90.8	568	400	932

Table 3-3. The Determinants of Building-lot Prices

Subdivision	Forest Park		River Woods		River Highlands	
Dependent variable	Price	Ln(Price)	Price	Ln(Price)	Price	Ln(Price)
Borders preserve	8442.11 (9.99)	0.3110 (8.79)	5822.24 (6.73)	0.1856 (7.49)	7207.48 (5.24)	0.3501 (4.18)
Across from preserve	2192.69 (1.70)	0.0927 (1.71)	-1959.05 (2.03)	-0.0413 (1.49)	997.47 (0.83)	0.0911 (1.24)
Lot size (‘000s of s.f.)	142.61 (1.12)	0.0064 (1.22)	117.47 (1.01)	0.0031 (0.92)	-58.52 (0.28)	0.0021 (0.16)
Lot size squared	-2.23 (1.36)	-0.0001 (1.34)	-0.72 (0.52)	0.0000 (0.43)	0.50 (0.16)	0.0000 (0.11)
On a cul-de-sac	-312.69 (0.30)	0.0139 (0.32)	-51.38 (0.05)	0.0153 (0.48)	1953.99 (2.00)	0.0908 (1.52)
On a corner	406.32 (0.54)	0.0257 (0.81)	-3105.62 (2.34)	-0.1343 (3.53)	-2114.82 (1.70)	-0.1557 (2.05)
Backs to creek	9539.94 (6.77)	0.3278 (5.55)				
Borders arterial street	-6059.86 (5.80)	-0.2640 (6.03)			93.84 (0.03)	0.0892 (0.47)
Backs to subdivision	-145.35 (0.24)	-0.0080 (0.32)	-5826.06 (5.20)	-0.2361 (7.35)		
Backs to large lot	2442.94 (2.78)	0.0916 (2.49)	523.98 (0.51)	0.0270 (0.92)	-96.48 (0.06)	-0.0598 (0.57)
Backs to park	1683.44 (1.65)	0.0687 (1.60)			1178.73 (0.80)	0.0684 (0.76)
Backs to right of way					1401.37 (1.24)	0.1217 (1.76)
Time trend (in years)	1673.41 (1.69)	0.0917 (2.21)	4282.48 (4.26)	0.2227 (7.73)	-2469.05 (2.40)	-0.1573 (2.51)
Time trend squared	73.68 (0.37)	0.0019 (0.23)	-18.18 (0.08)	-0.0220 (3.27)	395.23 (2.85)	0.0280 (3.31)
Time trend cubed	-4.97 (0.40)	-0.0004 (0.70)	-4.47 (0.30)	0.0010 (2.31)	-11.30 (2.06)	-0.0010 (2.87)
Constant	11,721.43 (4.07)	9.4899 (78.62)	19,054.06 (9.09)	9.8686 (164.20)	14,132.91 (3.95)	9.3926 (43.11)
Number of observations	207	207	126	126	98	98
Adjusted R-squared	0.828	0.806	0.908	0.914	0.798	0.769

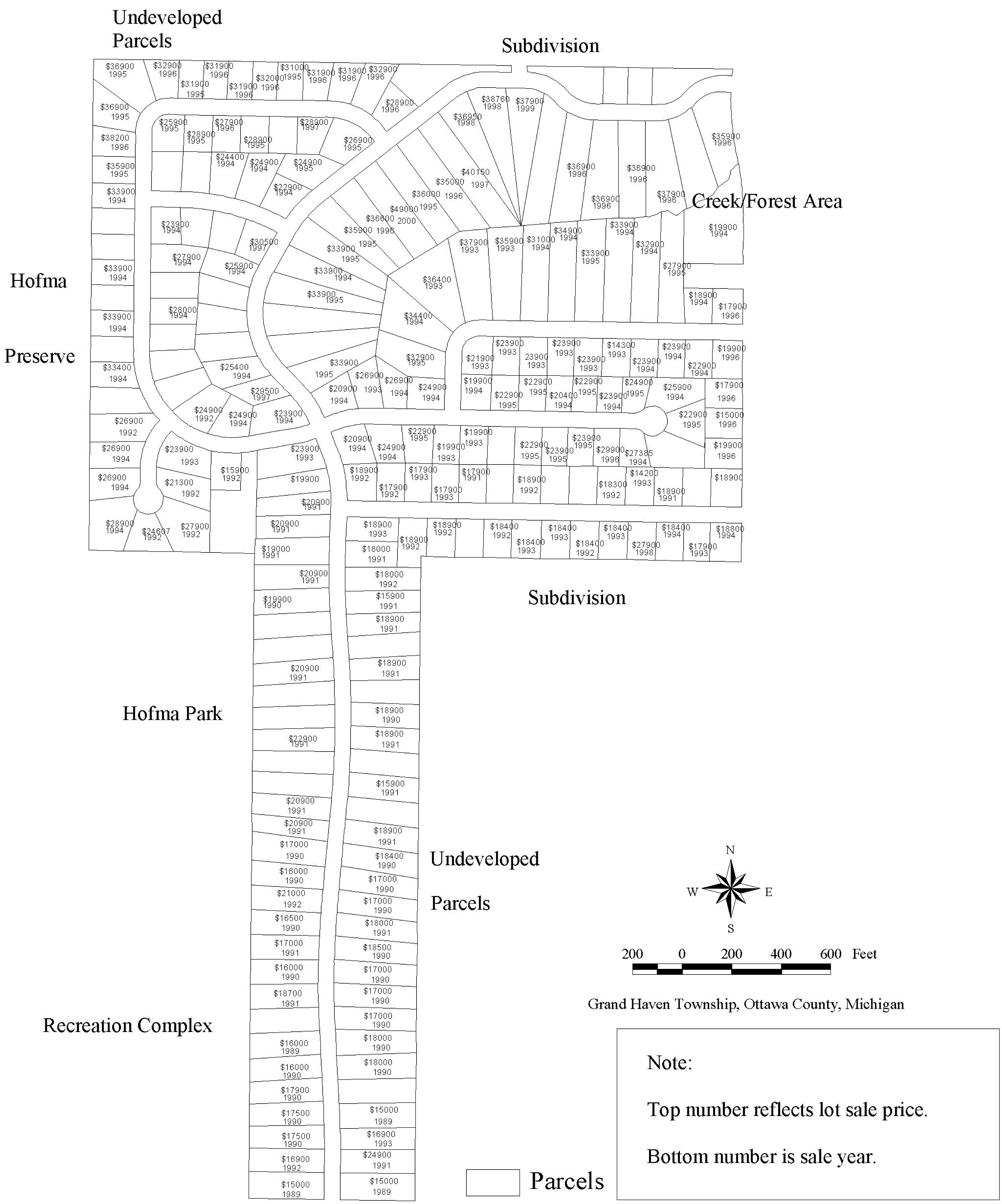
Absolute value of t-statistics appear in parentheses

Table 3-4. The Determinants of House Prices

Subdivision	Forest Park		River Woods		River Highlands	
Dependent variable	Price	Ln(Price)	Price	Ln(Price)	Price	Ln(Price)
Borders preserve	15,961.82 (2.24)	0.0667 (1.74)	13,717.03 (2.36)	0.0843 (2.96)	6262.43 (0.99)	0.0884 (1.81)
Across from preserve	1726.93 (0.22)	0.0106 (0.25)	14,148.31 (2.31)	0.0882 (2.94)	-5998.75 (1.27)	-0.0477 (1.30)
Lot size ('000s of s.f.)	131.55 (0.17)	0.0008 (0.20)	-1141.99 (2.36)	-0.0048 (2.04)	-526.39 (0.64)	-0.0014 (0.22)
Lot size squared	-2.19 (0.23)	0.0000 (0.09)	13.64 (1.22)	0.0001 (1.04)	11.42 (0.90)	0.0000 (0.31)
On a cul-de-sac	8901.71 (1.16)	0.0418 (1.01)	-11,248.65 (1.62)	-0.0424 (1.25)	8645.51 (2.24)	0.0567 (1.89)
On a corner	-15,768.47 (2.72)	-0.0844 (2.71)	-4472.74 (0.61)	-0.0173 (0.48)	8888.19 (2.15)	0.0785 (2.45)
Backs to creek	28,517.12 (3.47)	0.1144 (2.59)				
Borders arterial street	-14,134.86 (1.55)	-0.0667 (1.36)			-5464.11 (0.49)	0.0018 (0.02)
Backs to subdivision	3054.05 (0.66)	0.0016 (0.07)	-21,335.72 (3.97)	-0.1281 (4.88)		
Backs to large lot	8924.05 (1.94)	0.0461 (1.87)	563.89 (0.07)	-0.0029 (0.08)	-822.40 (0.20)	-0.0349 (1.08)
Backs to park	11,300.09 (1.81)	0.0472 (1.41)			2329.59 (0.44)	0.0028 (0.07)
Backs to right of way					-4011.45 (1.05)	-0.0100 (0.34)
House size (sq. ft.)	129.40 (3.70)	0.0011 (5.76)	93.49 (3.01)	0.0006 (3.69)	-12.49 (0.43)	0.0002 (0.90)
House size squared	-0.02 (2.36)	0.0000 (4.34)	-0.01 (1.51)	0.0000 (2.49)	0.02 (2.42)	0.0000 (0.61)
Number of baths	10,484.72 (3.16)	0.0555 (3.11)	12,342.21 (3.76)	0.0661 (4.12)	6581.07 (2.23)	0.0566 (2.47)
Ranch style	16,406.32 (3.39)	0.0968 (3.72)	29,772.13 (5.40)	0.1205 (4.47)	15,560.57 (3.51)	0.1209 (3.52)
Age at sale	-2755.58 (2.51)	-0.0119 (2.02)	-4840.21 (4.26)	-0.0194 (3.49)	-2586.60 (6.92)	-0.0132 (4.55)
Time trend (in years)	11,397.80 (1.51)	0.1037 (2.55)	14,265.26 (2.22)	0.1318 (4.19)	-518.15 (0.23)	0.0229 (1.31)
Time trend squared	-804.45 (0.62)	-0.0077 (1.10)	-1498.77 (1.38)	-0.0154 (2.91)	313.71 (1.24)	0.0028 (1.42)
Time trend cubed	51.81 (0.76)	0.0003 (0.91)	73.37 (1.38)	0.0007 (2.55)	-4.56 (0.57)	-0.0001 (1.42)
Constant	-85,036.76 (2.29)	10.1270 (50.74)	-39,335.92 (1.04)	10.8114 (58.67)	23,927.41 (0.77)	10.4270 (43.07)
Number of observations	194	194	121	121	171	171
Adj. R-squared	0.832	0.852	0.870	0.875	0.840	0.876

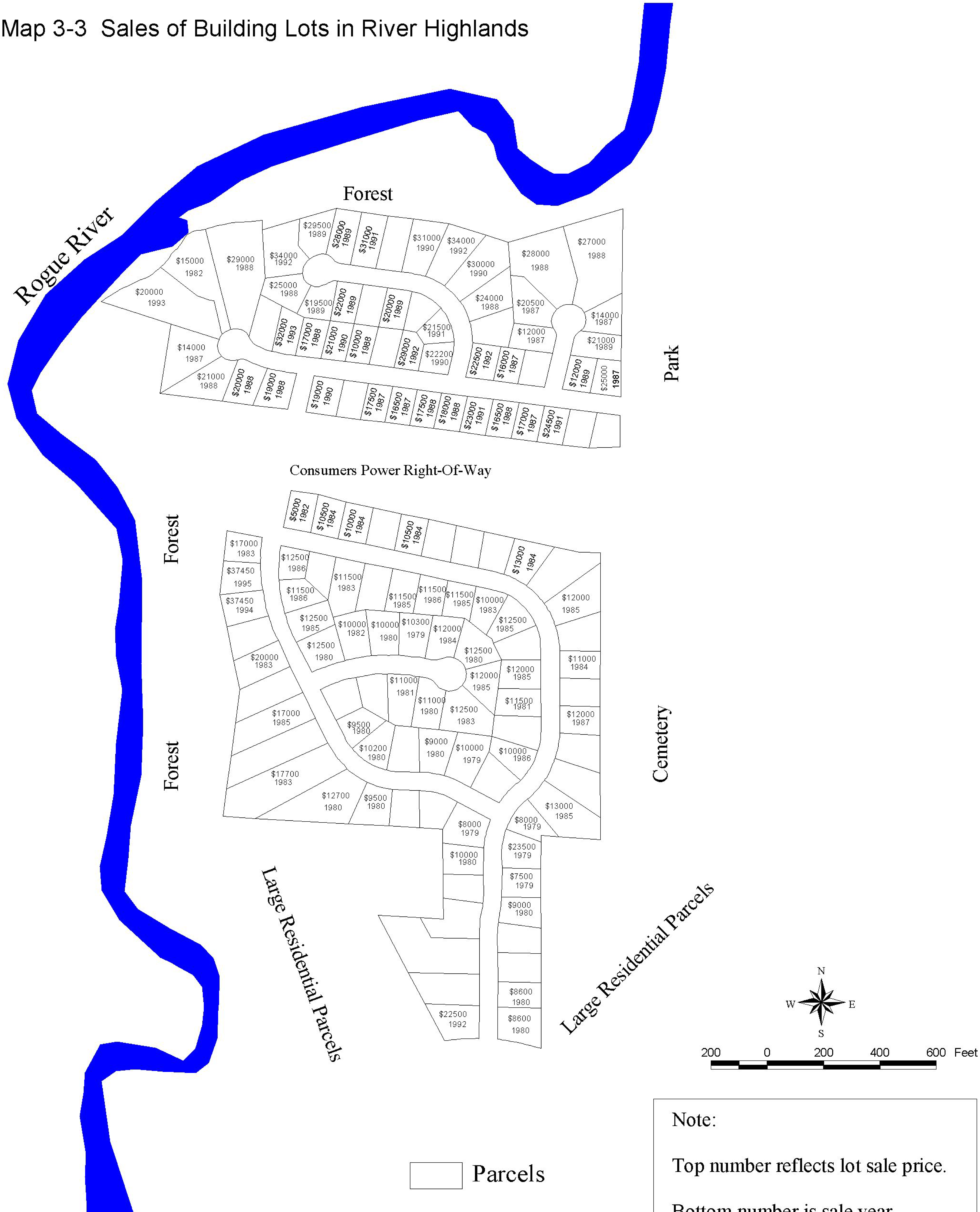
Absolute value of t-statistics appears in parentheses.

Map 3-1 Sales of Building Lots in Forest Park



Map 3-2 Sales of Building Lots in River Woods

Map 3-3 Sales of Building Lots in River Highlands



Plainfield Township, Kent County, Michigan

Note:

Top number reflects lot sale price.

Bottom number is sale year.

CHAPTER 4

THE COSTS OF PRESERVING FORESTED LAND IN SUBURBAN AREAS

I. Introduction

We reported in Chapter 3 what currently is known from studies of housing-market transactions about the value housing consumers place on the benefits generated by forested land preserved in suburban areas. A key finding is that close proximity to a forest preserve in Plainfield Township currently appears to raise the sale price of subdivision building lots by at least $6000 to $7000; housing consumers clearly appear willing to pay for proximity to preserved forest land. How this price would change with larger amounts of land preserved is unknown. But a program that preserves a significant amount of forested land would likely attract housing consumers who value it. And there are broader-scale benefits to preservation that are difficult to measure; it seems likely that some households would be willing to pay a premium to live in a generally nice area even if they are not on a lot that borders a preserve. At a purely practical level, tapping this willingness to pay is critical making a preservation program work.

A key issue is how much preserved land this willingness to pay could in principle buy. The cost of preserving land in forest is its value in its next-best use. For the Plainfield study area (see Map 2-1) the next-best use is typically single-family residential. As reported in Chapter 1, undeveloped land suitable for standard residential development in Plainfield Township sells in the range of about $10,000 to $15,000 per acre. At its simplest, preservation of an acre of forest can in concept be 'paid for' if that acre generates benefits that exceed its value in development. So, using the rough numbers we've generated, an acre of forest preserve could be paid for if it generates an average of $7000 in benefits to each of two building lots. This does not seem implausible. The tricks are in choosing how much land to preserve in total, determining which acres of land to preserve versus develop, and in how to transfer consumer willingness to pay into actual payments.

That's where the market in development rights comes in. But an understanding of how such a market would work depends on having a more complete picture of how the value of land for residential development varies over the market area. Not every acre is average. Developing that picture is the purpose of this chapter. Specifically, we build a simple model of the value to a residential developer of undeveloped land in the Plainfield study area. While Chapter 3 reports on the benefits of preservation, this chapter reports on its costs. The results feed directly into the policy analysis in Chapter 5.

The remainder of the chapter consists of four sections. Section II describes the rationale behind our land-value model. Specifically, it describes how the characteristics of land affect its value. Section III describes how we obtained our estimates of the value of those characteristics. Section IV describes the results of our modeling exercise, which includes maps that show the patterns of estimated land values. These patterns are extremely important to our analysis of policy in Chapter 5. Section V concludes the chapter.

II. The Determinants of the Value of Undeveloped Land

A major simplifying assumption in this chapter is that the land in the market area – the market area being that area over which the preservation program is applied – if allowed to develop would develop solely in single-family residential use. This is obviously unlikely in the extreme. Even in predominantly residential areas, some land is typically in non-residential use: neighborhood commercial or schools, for example. However, single-family residential tends to dominate in areas considered for preservation programs, and the general analysis could be applied to other land uses. The simplification does not, therefore, cost much, and it allows us to focus on the fundamentals.

The standard analysis of the value of land begins with the proposition that the value of a parcel of land depends on a variety of characteristics:

- Natural characteristics: soils, slope, drainage
- Parcel size and configuration
- Distance from urban centers
- Public policy: taxes and fees, public service quality
- Market-area demographics
- Proximity to externality-generating resources: arterial streets, parks/open space, commercial/industrial land uses

The rationale is that a land developer when preparing a bid for a particular parcel in a particular jurisdiction either explicitly or implicitly considers the impacts of all of these factors on his revenues and costs. Successful land developers tend to be those who most accurately can gauge the market value of these various characteristics.

But the analysis differs considerably when looked at from the position of the local government looking to establish land development policy in a largely undeveloped area. Many of the characteristics that the future purchaser of a particular parcel will take as given are variables that the local jurisdiction has control over prior to full-scale development. The local jurisdiction obviously will determine public tax and expenditure policies. Decisions about policy, including open-space policy, will influence the demographics of the housing consumer attracted to the jurisdiction. Some externality-generating resources, such as existing arterial streets, are taken as a given by the local government. Others, such as future streets, the location of commercial/industrial areas, and parks and open space, the jurisdiction has at least some control over. Even distance from urban centers is not completely predetermined because the jurisdiction may work to encourage development of a commercial area.

Because these decisions affect the value of land to a developer, it's useful to consider the issues faced by the jurisdiction prior to development of the market area. Often, landowners who wish the jurisdiction to adopt development policies that will enhance the value of their land, among possibly other objectives, populate the market area. To keep things simple, we'll assume that the objective of the local government is to adopt land development policies that more-or-less maximize the aggregate value of the land in the market area. These policies concern the characteristics of public services, private land development, and amenities such as preserved open space. The key here is that the local jurisdiction thinks about all of these things jointly in its comprehensive planning process.

The drivers of these deliberations are ultimately relatively few, for example:

- The characteristics of development in other jurisdictions in the metro area that are, in a sense, competing for households.
- The natural characteristics of the land, which affect both the costs of provision of public services and the value of the land in development, given those services.
- The existing public infrastructure in the market area, especially arterial streets.
- The existing patterns of land ownership.

We'll address each of these in turn.

Through its decisions about the variety of land development policies, the jurisdiction influences the market niches that land developers will target. The jurisdiction may well recognize that different parts of the jurisdiction are relatively well suited to different niche markets. The hilly and wooded areas in the northern parts of Plainfield Township potentially offer amenities that the township is apparently trying to exploit with the Rural Preserve and Rural Estate zoning. These areas might also be suitable for other types of land preservation techniques, such as a market in development rights. The extent to which development in these areas attracts customers from the target niche depends not only on local policies but also on the supply of similar housing in other parts of the metro area.

The land's natural characteristics obviously play an important role in how the land develops. Relatively flat terrain with good drainage offers the advantage of low costs for both provision of public services and construction of dwellings. However, more variable terrain offers a variety of amenities that household’s value. Steep slopes, bodies of water, or low and wet areas may increase development costs while offering important environmental amenities. Soils and water tables also affect development costs. As these natural characteristics are typically difficult to alter, they influence directly both land values and public policies, which feed back to influence land values.

Existing infrastructure also influences development. In the undeveloped areas of Plainfield Township two-lane arterial streets generally were built along section lines forming a grid with one-mile squares. These streets until recently provided access to farms and farming communities as indicated on the zoning maps shown in Chapter 2 (see Map 2-3). The section lines defined original legal parcels, and street access influenced subsequent land divisions; many of the larger parcels remaining are in the central parts of square-mile sections. As land develops, the jurisdiction will more likely improve these streets rather than relocate them; they will remain arterials.

The characteristics of the developable parcels in the market area also play an important role in policy. Parcels that are small from a development perspective are common in areas such as Plainfield Township that have only over the course of decades made the transition from rural to urban. Farmland owners prior to full-scale development often create home sites with direct access to the arterial street either for sale or to provide room for family members. Rural residential zoning may restrict the number of these 'splits' allowed, and require that these splits are large, sometimes not smaller than ten acres in an attempt to minimize the impact of residential development on agriculture. Over time this process tends to create a large number of relatively small developable parcels. The median parcel size in the Plainfield study area is about 11.5 acres.

A large number of relatively small parcels encourage more intensive land development regulations because land developers have less direct control over neighborhood characteristics. In the River Woods subdivision, for example, which is on a relatively large parcel, the developer appears to have used relatively small building lots to create a buffer between the existing subdivision to the south and the rest of the development. Small parcels limit this ability to create buffers. They also limit the extent to which the developer captures through higher lot prices the benefits of on-site land preservation, which strongly discourages preservation. That most developable parcels are small tends to raise landowner support for restrictive zoning and development codes to reduce the likelihood of an undesirable land use on a neighboring site.

Some form of a market in development rights, however, reduces the problems associated with relatively small parcels and fragmented ownership in preserving open space. Development rights to buy and sell reduce the constraints faced by the developer of a particular parcel: development rights to land on site that is poorly suited to development (relative to other land in the market area) can be sold, and development rights can be purchased to develop a larger portion of a parcel with desirable characteristics. Thus, while parcel boundaries continue to constrain the design of the subdivision, the market in development rights decreases the constraints on land preservation.

The upshot of all this is that a land-value model appropriate for a study of a market in development rights is relatively simple, taking into account only those variables that the jurisdiction takes as given early in the planning process:

- A base value that reflects the areas position in the metropolitan market
- Natural characteristics that influence development costs and neighborhood amenities
- Proximity to existing arterial streets (or other externality-generating resources that cannot readily be altered).

The next section describes the numbers we used to build that model.

III. The Market Value of Developable Residential Land: Empirical Evidence

The purpose of this section is to gather evidence on the market values of the characteristics that make up the total market value of a unit of land. These data are used to calibrate a simple model of land values in a portion of Plainfield Township. That model requires, as does any model, the use of a variety of simplifying assumptions. We first describe these assumptions, and then report evidence about the value of characteristics.

Setting Up the Model

To keep data collection to a manageable size we have chosen a study area within Plainfield Township that consists of about one-third of the land area in the Township. As shown in Map 4-1, the study area consists of twelve contiguous sections in a three mile by four-mile rectangle. Map 4-2, which shows more-or-less current parcels overlaid on an aerial photo-mosaic, suggests that some of the study area is currently developed.[1] For example, both River Woods and River Highlands subdivisions are in the southeast corner of the study area. There is also a mobile home park, a school, and a landfill existing in the study area, as well as subdivisions and low-density residential development. For simplicity, and consistent with our assumption that the jurisdiction that considers implementing a market in development rights does so well prior to full-scale development, we ignore the existing development and include the land occupied by the development as if it were undeveloped.

The study area is for the most part representative of the hilly and still wooded areas in the northern half of the township. As shown in the current zoning map of Plainfield Township in Chapter 2 (Map 2-3), much of the study area is zoned Rural Estate, which restricts development to large building lots, though there is the possibility of negotiating smaller-lot clusters with preservation of contiguous tracts of open space on the site. Map 4-3 shows the topography of the land in the study area and the location of existing arterial streets and highways. Given the topography and current zoning, this area appears to be a reasonable candidate area for a market in development rights.

As the value of land to a residential developer depends on several parameters set by the jurisdiction, we have to make assumptions about those parameters. In making these assumptions, we try to put ourselves in the position of the jurisdiction prior to development. The objective, recall, is to adopt policies, including open-space policies, which will enhance the value of land in the market area in single-family residential development. Specifically, we assume that:

- All the land in our study area is zoned for single-family residential use, and the tracts that develop do so in single-family, detached dwellings.
- The jurisdiction commits to extending public water, sewer, and drainage systems and improving arterial street access in a timely way to the areas that develop. The

[1] The parcel lines were digitized from maps produced by Rockford Map Publishers, Inc., located in Rockford, Illinois. These parcel maps show only relatively large parcels; subdivisions boundaries are shown and labeled as consisting of 'small tracts'. Out of a total of about 370 parcels, about 30 contain development in the form of 'small tracts'.

developer brings each of these services to the building lots within the development.[2]

- The zoning authority sets minimum and potentially maximum density (e.g., lot size) requirements. We assume that density is set at about two to three houses per gross acre within the developed areas within subdivisions.[3]
- The jurisdiction restricts the now-common practice of building houses on lots that access the arterial street directly; we assume that local subdivision streets access all building lots.

Some of these assumptions would obviously either be very difficult to implement in practice – such as service extensions on demand – or be potentially inefficient, such as restricting the entire area to detached single-family residential. But there are significant advantages to keeping the model simple at this stage, and the assumptions are not entirely inconsistent with practice.

The Market Value of Land Characteristics

This section describes the development of the models we use to generate estimates of the value of land for residential development in the Plainfield study area. The idea behind the model is straightforward. We start with a base value that reflects the general market conditions in the township. We then add estimates of the implicit market value of the land characteristics that influence land values as reported in the literature and by the landowners and developers in the area. Importantly, we obtained the estimates of the values of these characteristics from the assessor, developers, and others familiar with conditions in these markets; the estimates are to a large extent judgmental. We use these estimates because there simply are far too few arms-length transactions in this market to use a hedonic land-price model to obtain reliable estimates of the value of land characteristics. We use results from the empirical literature to the extent that they exist.

In preparing a bid for an undeveloped parcel, the land developer essentially works backward from expected revenue from lot or house sales, subtracting expected development costs and a margin that reflects the risk involved in the project. Both the sale price of the developed lots and the costs of development depend on the characteristics of the land. We interviewed local developers to identify those factors that both affect costs or revenues and that vary within the twelve-section study areas. We also asked the developers to estimate the effect on parcel price (or on their willingness to bid) of marginal changes in each of these variables. This section describes these key characteristics and prices.

The following variables comprise the simple model that generates estimates of land in standard single-family development:

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[2] The jurisdiction also sets standards for the characteristics of infrastructure within the subdivision. The details are not important here.

[3] This assumption is consistent with building lot sizes of about 12,000 to 18,000 square feet, which is common in these areas.

- *Soils*. Developers prefer sandy soils because local regulations require that the developer backfill with sand the trenches dug to accommodate sewer and water lines. Moreover, sandy soils allow better drainage, which reduces the cost of water-proofing basements. Developers report that sandy soils are worth $2 to $3 thousand per acre.
- *Slope*. Developers prefer gentle slopes, ideally 5-10 degrees, as consumers like walk-out basements. A gentle slope is worth $3 to $5 thousand per acre. Steep slopes, in excess of 25 degrees, substantially increase costs.
- *Tract size*. A larger parcel both allows the developer to exploit scale economies and increases the overall risk of the project. Because the costs of partitioning a parcel appear to be low, and the tracts are generally big enough to develop, we assume that per-acre price is not influenced by parcel size.[4]
- *Elevation*. Areas in which the water table is close to the surface make construction of basements, which housing consumers like, costly to provide. Seasonally wet areas raise development costs in a variety of ways.
- *Tract shape*. In general, the more square the better. But the effect is small except for extremely narrow parcels, and is hard to measure with the software. So we ignore it.
- *Access/utilities*. Developers are willing to pay more for parcels with direct access to arterial streets and sewer and water mains. We assume that, as part of the overall planning and capital-improvements process, the local jurisdiction will provide arterial street access to developable parcels.
- *Noise*. An arterial street imposes noise and safety costs on the residents of homes on lots adjacent to the street. Most developers take steps to minimize the impact of traffic externalities on lot values, but there is a cost, which is reflected in the value of the parcel, developers report that cost at about $5000 per acre. The estimates reported in Chapter 3 indicate a sale-price discount of about $6000 for a lot that borders an arterial street; the discount of $5000 per acre may be low.

Given all the assumptions and developer input, the key variables in the land-value model boil down to soils, slopes, and proximity to an arterial street. We have assumed away many of the variables that in practice affect the bid on a particular parcel at a particular time: neighboring land uses, distance from public services, and any parcel-specific requirements for on and off-site improvements. As argued earlier, these simplifications appear warranted in this context. The resulting model provides both a reasonable estimate of the range of values in the market area, and the patterns of those values across the market area. These are key inputs to the simulation of a market in development rights reported in Chapter 5.

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[4] There is literature on this topic. See, for example, Colwell & Sirmans (1993) and Thorsnes and McMillen (1998).

IV. Estimated Land Values in the Plainfield Study Area

The key assumptions in setting up a model of land values concern the variables that matter, and their market values. We are more confident about the important variables – general market conditions, soils, slopes, and noise – than about the values of those variables. From the standpoint of the allocation of land via a market in development rights, it's the pattern of these characteristics across the study area, rather than their values, that matters. The market tends to preserve land of relatively low value in development, i.e., land that is steep (or flat), lacks sandy soils, and is close to an arterial street.[5] A key issue is whether these lands naturally contribute to networks of open space and the extent to which they generate relatively high environmental benefits. We can investigate this by generating maps.

We would, of course, also like to generate estimates of land values so that we can get a feel for how a market in development rights would work financially. The good news is that we have pretty good evidence about what, on average, developable land is worth in Plainfield Township. Using the information in Tables 2-4 and 2-5 in Chapter 2, we can with some confidence position in the vertical dimension the V_D curve of Figure 1-1 in Chapter 1. Estimating the slope of the V_D curve is, however, trickier given the rather imprecise estimates available of the key characteristics of land. Our solution is to take the developer estimates somewhat seriously, but make adjustments sufficient to leave the variation in estimated land prices similar to the actual variation in per-acre land prices shown in Tables 2-4 and 2-5. We think that the resulting mean and variation in the estimated land values are reasonable, that the tracts with relatively high estimated value really would have relatively high market value (though this ranking is probably far from perfect), but that the actual estimated values on specific tracts are probably not highly accurate.

That said, we think that the exercise not only sheds light on the how a market in development rights would actually work in this study area, but also on the process by which a jurisdiction might proceed to investigate the prospects for a market in development rights. When we talked to developers and land owners we had to admit that the whole thing was hypothetical. Though they gave generously of their time, they undoubtedly gave the issue not much more attention than its hypothetical nature warranted. That would change when a jurisdiction began to plan earnestly to implement such a market; we suspect that better data about the market values of land characteristics would become available. Thus, we'll proceed with the understanding that the value data are not terribly accurate, but that an illustration of the process has value.

One additional issue remains: to what tracts of land do we apply the data? Our first inclination was to estimate the value of existing legal parcels. Their value would vary by the

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[5] One can complain that land, especially small parcels, that border an arterial street command relatively high prices, often greater than $20,000 per acre. The reason for the high price is the low development cost; the buyer does not have to build an access road. For simplicity, we are assuming that all development occurs in subdivisions that are large relative to an individual home site, and that the jurisdiction provides arterial street access to the site. If the developer has to build internal streets to access all building lots, including those that back onto the arterial street (which is typically the case), then the sale-price discount on these lots makes the raw land near the street less valuable.

amounts of each characteristic on the parcel. We rejected this approach for several reasons. First, that exercise is relatively difficult. Second, as argued earlier, the ability to buy and sell development rights reduces considerably the importance of parcel lines on land preservation. Third, the focus on parcels detracts from the primary objective of looking at the broader patterns of land characteristics. Finally, as a practical matter, individual landowners would tend to pay awfully close attention to the estimates of the value of their parcel; estimates that we admit probably aren't very accurate.

As an alternative, we broke the study area into tracts based on land characteristics. Using a GIS program, we overlaid spatial data coverages of slopes, soils, and proximity to arterial streets. The lines defining areas of similar slope, soil, and proximity define the boundaries of tracts. Thus, all the land in each tract has similar characteristics, and therefore similar market value. This makes sense even though land is often sold in its existing legal configuration because the developer of the parcel will tend to sell development rights to the land on the parcel that is of relatively low value (which is part of a tract as we have defined it), and, conversely, purchase development rights for land that is of relatively high value. The market will encourage development or preservation of these tracts as such, regardless of existing legal parcel boundaries.[6] Map 4-4 shows that the parcel boundaries reflect the original square survey grid much more than the pattern of natural topography of the land.

Of course, Map 4-4 is not very informative by itself. It is more informative to look at a series of maps that show the pattern of each land characteristic separately. Map 4-5 shows the land within 200 feet of arterial streets. It's no surprise that these areas form a network, and sometimes developers preserve them; though not common, it's not difficult to find developments in which the developer chose to leave a buffer of forest between the arterial street and the first building lot. And, in practice, preserving this land may provide significant benefits not only to homebuyers but also to drivers and cyclists. The total land area within this 200-foot buffer is about 20% of the total in the study area.

Map 4-6 shows the land in the study area that is either steep or flat, which comprise about 28% of the study area. The steep land comes in two varieties: that in ravines that contain creeks or that in steep, elevated hillsides. Importantly, both of these are relatively costly to develop and offer relatively high environmental benefits. The ravines are associated with wet areas, and the steep slopes provide views, which the empirical evidence suggests, that household's value. The flat areas are cheap to develop (and, therefore, often developed), but are less valuable than moderate slopes to developers. It is not clear that the environmental value of flat forested areas is lower than that of moderately sloped forested areas. Also very important to note is the distribution of slopes; the pattern begins, at least, to form a natural network.

That network expands with the addition of non-sandy soils. Map 4-7 shows the location of sandy versus non-sandy soils. About 31% of the study area lacks the sandy soils that

[6] That said, there is no doubt that the costs associated with buying and selling development rights, identifying high-value from low-value land, and adjusting parcel boundaries to better accommodate standard streets and lots inhibit the precision with which our model would apply to reality. Still, taking this admittedly extreme approach seems to make much more sense in this context than the other extreme approach of working with parcels.

developers value. But much of this area overlaps areas with undesirable slopes. Map 4-8 overlays the non-sandy soils on the slopes coverage. The area that has both undesirable slopes and non-sandy soils comprises about 42% of the jurisdiction (i.e., about 58% has both good soils and slope). Importantly, the combination further contributes to a natural network pattern. If these are indeed the areas that a market in development rights would tend to preserve, then it would appear that such a market may have value in preservation efforts.

At least two cautions are in order. First, we have picked our boundaries somewhat arbitrarily. Choosing different slope values, different soil compositions, or different road buffers obviously affects both the amount of land in each category and to some extent its pattern. Presumably, these issues would be investigated more fully as part of the planning process leading to policy. Second, the patterns in natural characteristics found here may not generalize: an area of similar size elsewhere may have little variation in land characteristics. And even in places where there is variation, the characteristics may not network well. Nevertheless, it is not surprising, and may be relatively common, to find the kind of natural networking illustrated in the series of maps.

So, how does this variation translate into land values? Figure 4-1 plots acres of land in the study area in descending order (like the V_D curve) of their estimated value. The plot is jagged because all the acres in a tract with (relatively) homogeneous characteristics receive the same value. The larger the number of characteristics considered, the smoother would be the plot. This plot is our estimate of the V_D curve in Figure 1-1. The average estimated value of land in the study area is about $12,900 and the range of estimated values is evident on the graph. The acres of lowest value are those close to an arterial street, that lack sandy soil, and that have a slope that is undesirable for development. The acres of high value have all the characteristics that are desirable in development (see Map 4-9).

Now, how accurate are these estimates? We think that the vertical position and the general shape of the curve are reasonably accurate. The ordering of the specific units of land, however, is probably less accurate; the ordering is sensitive to the market values we place on each characteristic. How valuable is sandy soil or a perfect slope relative to proximity to the arterial street? In practice, distance from an arterial street may work to diminish land value due to the additional cost of building access to it.[7] So, the shape and location of the land-value curve are probably roughly right, and the acres to the left are generally of higher value than those to the right, but the precise ordering is almost certainly off. Nevertheless, these estimates can give us quite a bit of insight into the functioning of a market in development rights, insight that we describe in the next chapter.

V. Summary and Conclusions

The purpose of this chapter is to report the results of our effort to estimate the V_D curve of Figure 1-1 for the land in the study area, and to look at the configuration in space of the

[7] In practice, development tends to work inward, away from the arterial street due to the cost of building access roads. We've essentially assumed that having to wait for that process has no effect on the value of land near the center of sections.

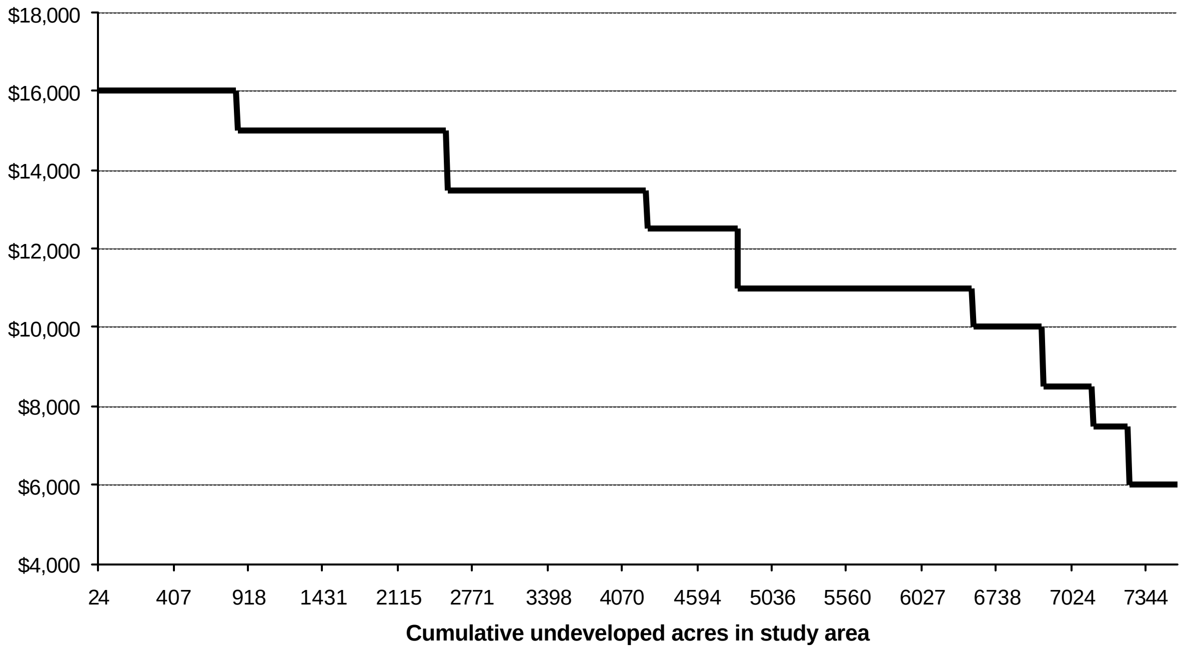
land that a market in development rights would tend to preserve. Getting a feel for the value of land is important because it represents the costs of preservation. Getting a feel for how the land of relatively low value in residential use is distributed across space is important both because we need to assess the value of that land in preservation, and because the results of the analysis in Chapter 3 indicate that networks of preserved land interspersed with developed land will tend to generate in aggregate greater local benefits. These are the benefits the development rights market taps to pay for land preservation.

Conducting the analysis requires an identification of the land characteristics that matter in this context. We argue that the appropriate set of characteristics are those over which neither the local jurisdiction nor the future land developer has much control prior to the onset of development: location within the metro area, natural characteristics of the land, and existing infrastructure that is unlikely to be moved. We asked developers to identify the natural characteristics that affect their bids for land, and asked them also to estimate the monetary value of these characteristics in development. We combined these estimates with the sale prices of developable parcels that we observed to sell in Plainfield Township to build a simple model of land values in the study area. The model predicts the value of tracts defined by their characteristics.

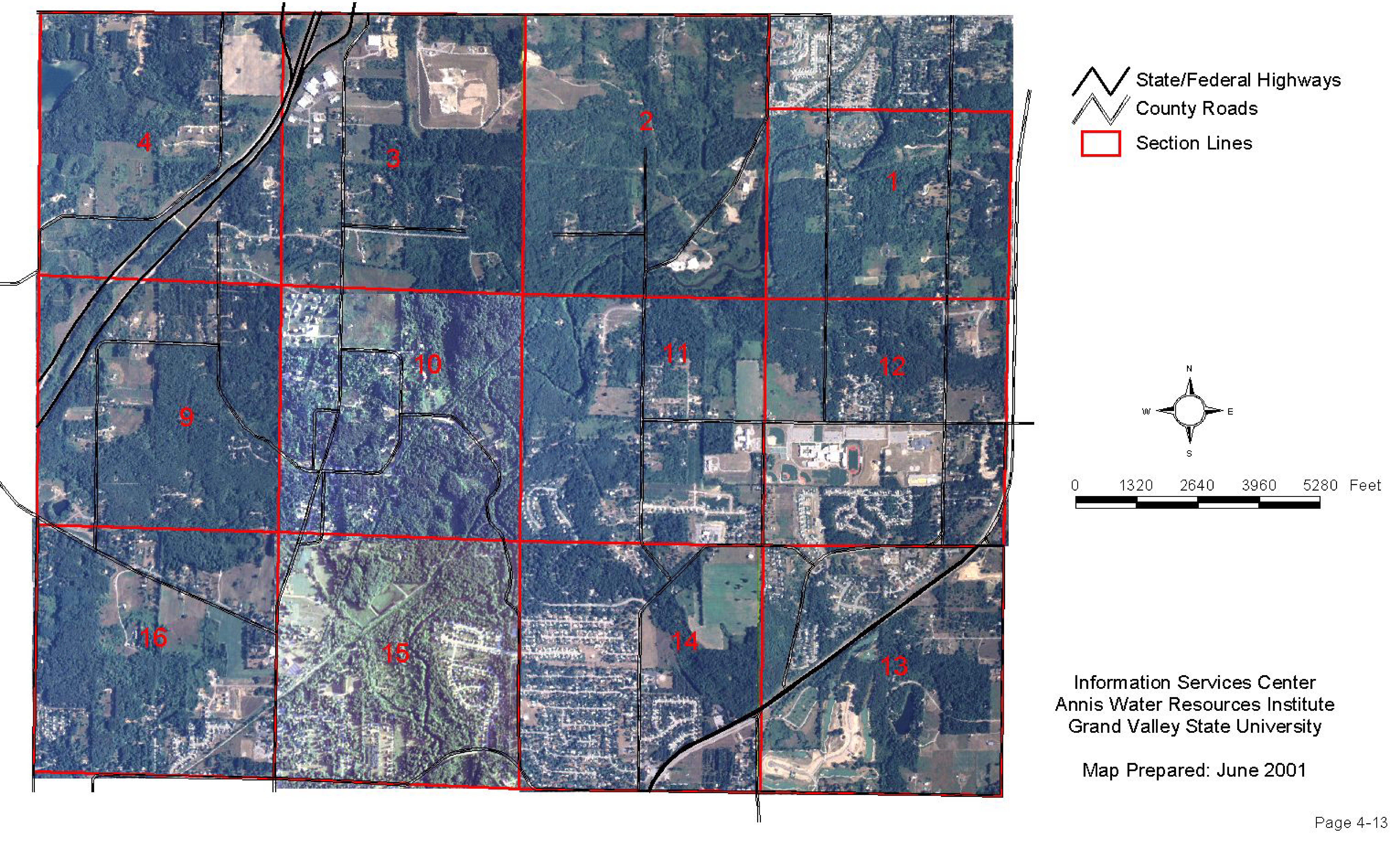
The results of the land-value model, which are shown in Figure 4-8, appear reasonable in general. We discuss the shortcomings of the estimates, which are significant, but we argue that the estimates are probably sufficiently accurate to serve as a reasonable guide for estimating the financial aspects of a market in development rights. We show in a series of maps the spatial distribution of the land of relatively low value in residential development. The maps indicate that these lands form at least the foundation for a connected network of forest preserves. The areas predicted to be preserved by the market also appear to contain land of at least average value as a generator of environmental benefits. These findings suggest that a market in development rights may be a useful tool for land preservation in this area.

These findings are, of course, specific to this area. There are, however, undoubtedly many other areas with similar characteristics. We turn in the next chapter to the conditions under which a market in development rights might in general be desirable relative to the various other tools for open-space preservation as described in Chapter 1. We then use the results of the land value model to describe the financial characteristics of a market in development rights in the Plainfield study area.

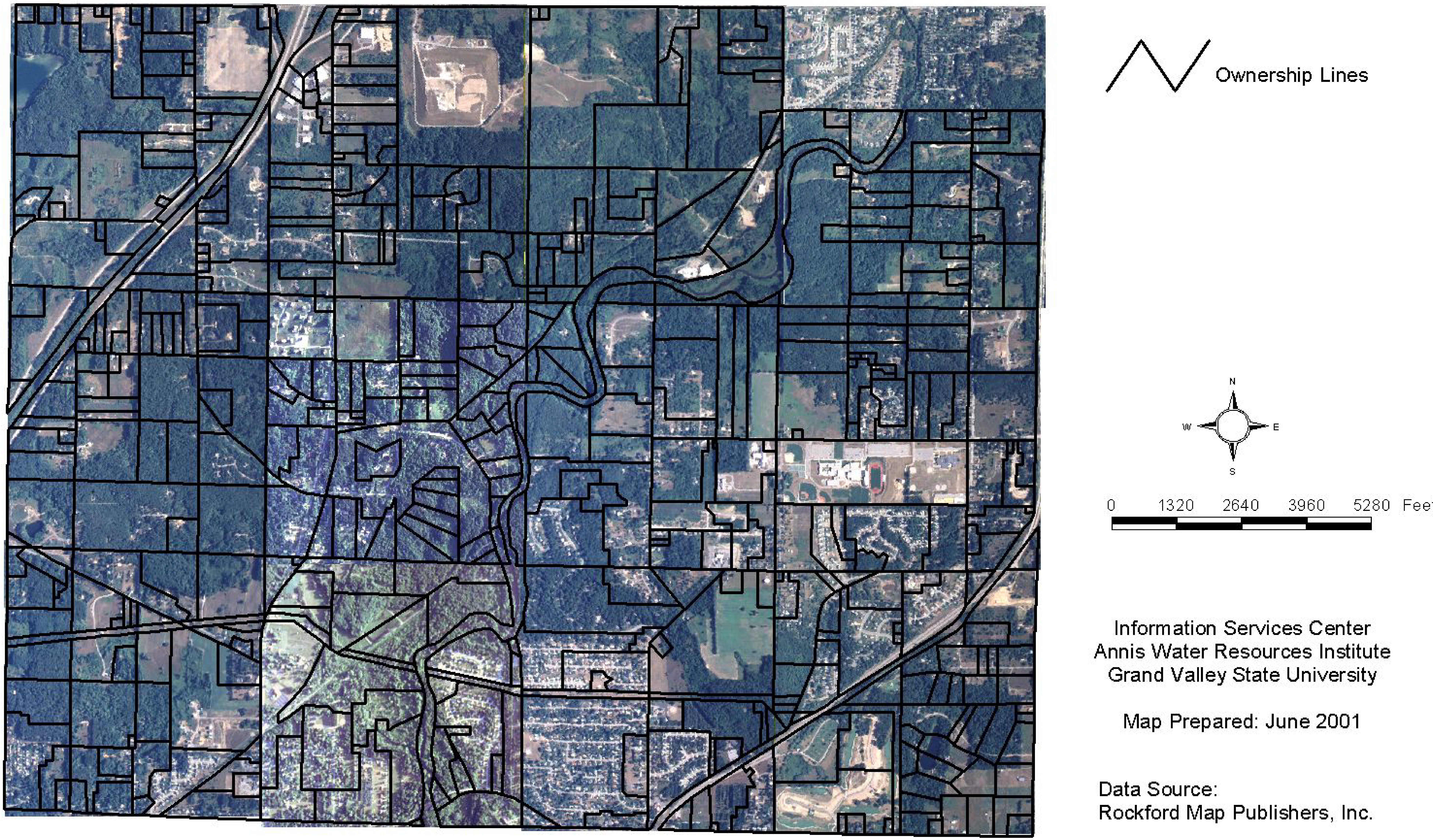
Figure 4-1. Estimated Per-Acre Land Values in the Plainfield Study Area



Map 4-1 Location of Study Area within Plainfield Charter Township



Map 4-2 Aerial Photo Mosaic with Ownership Lines for 1996

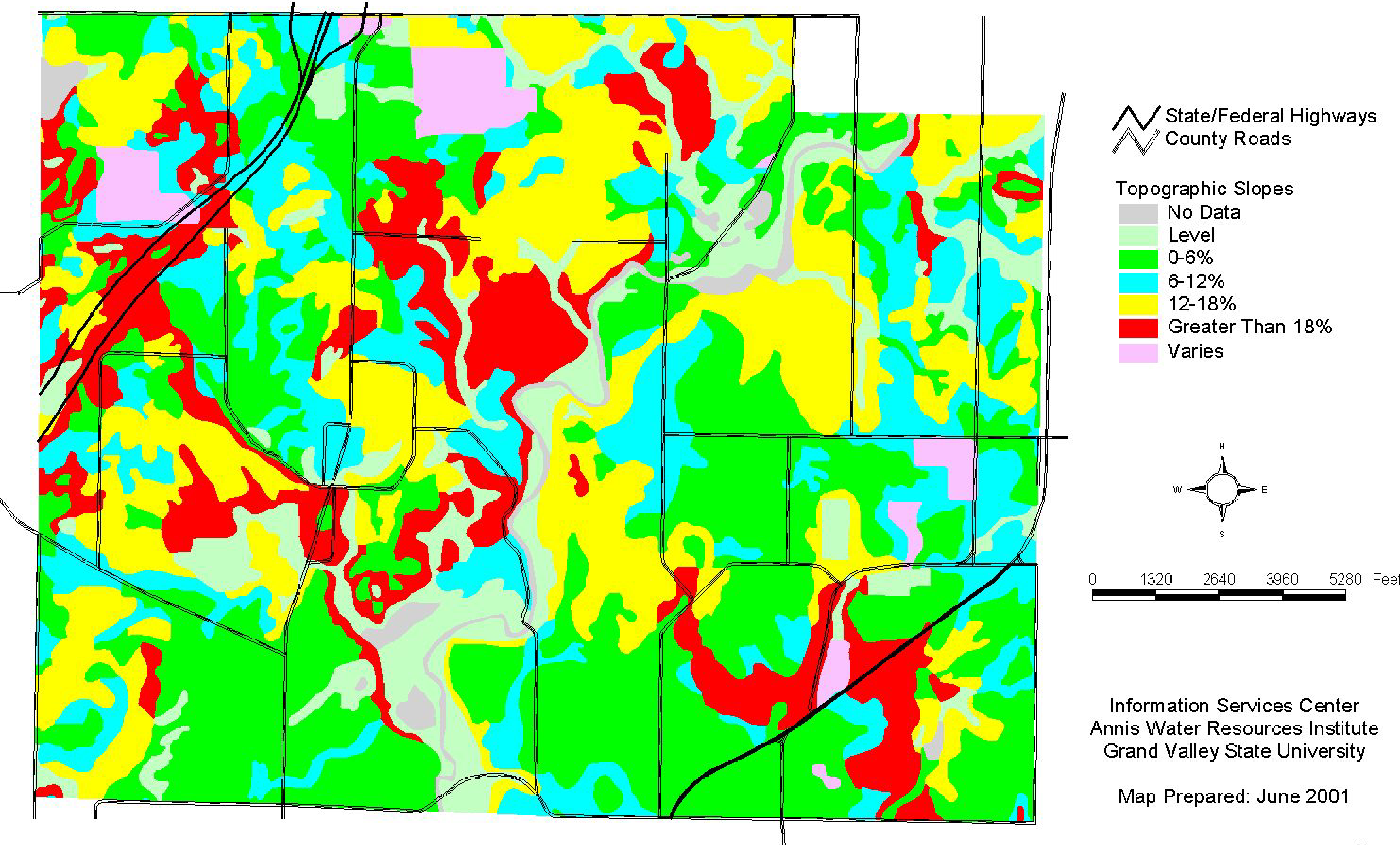


Information Services Center
Annis Water Resources Institute
Grand Valley State University

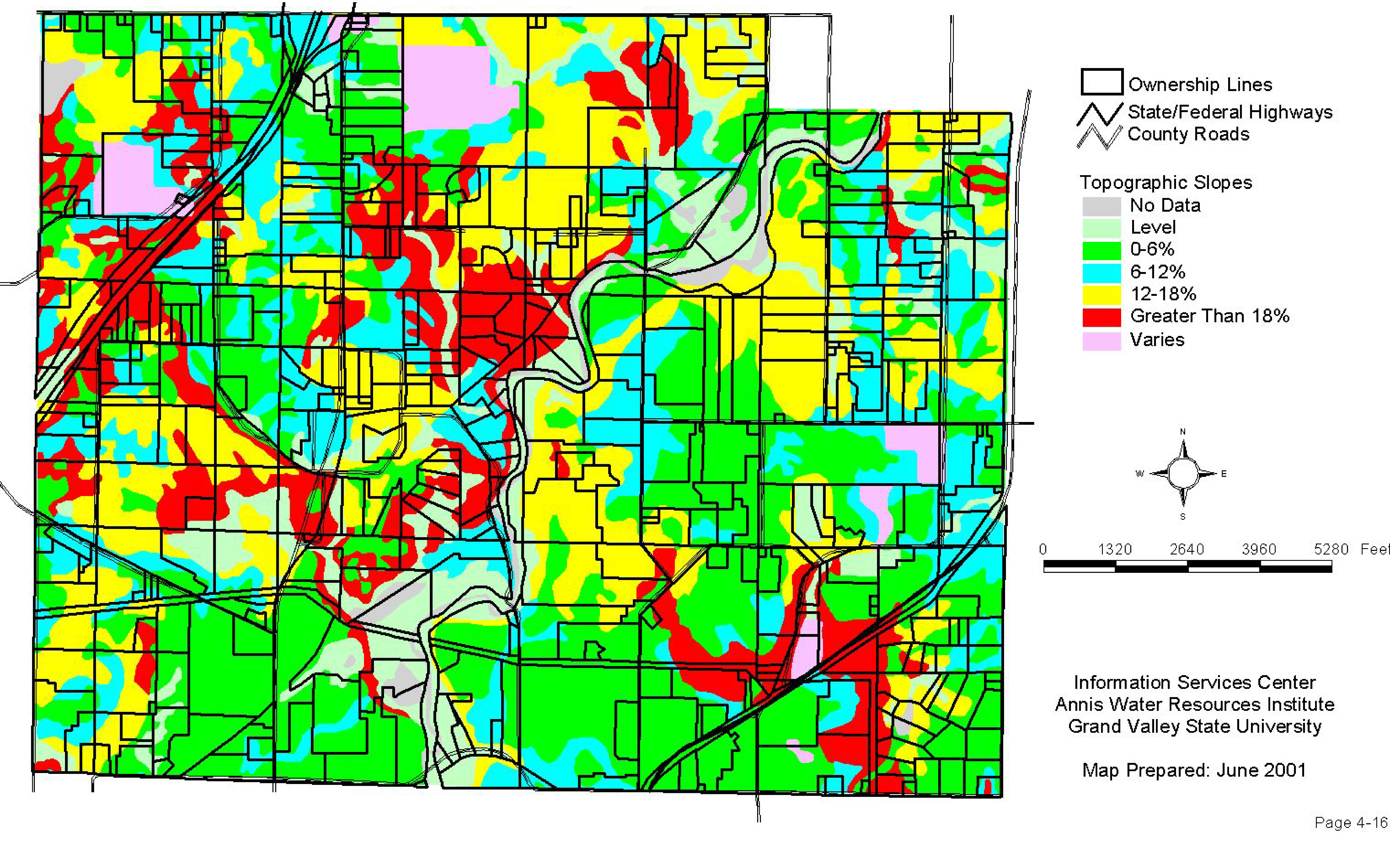
Map Prepared: June 2001

Data Source:
Rockford Map Publishers, Inc.

Map 4-3 Topographic Slopes with Arterial Streets and Highways



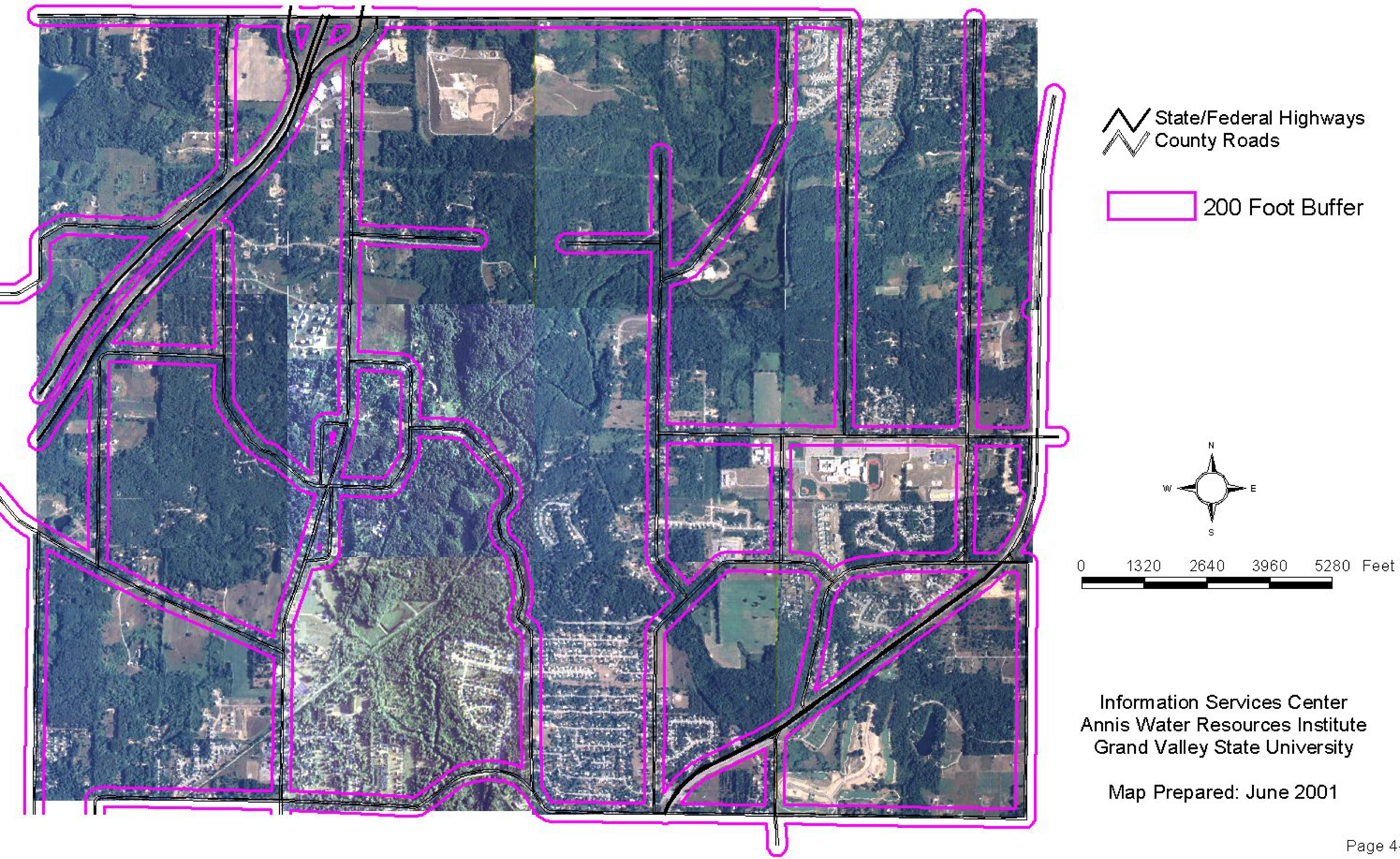
Map 4-4 Topographic Slopes with Ownership Lines 1996



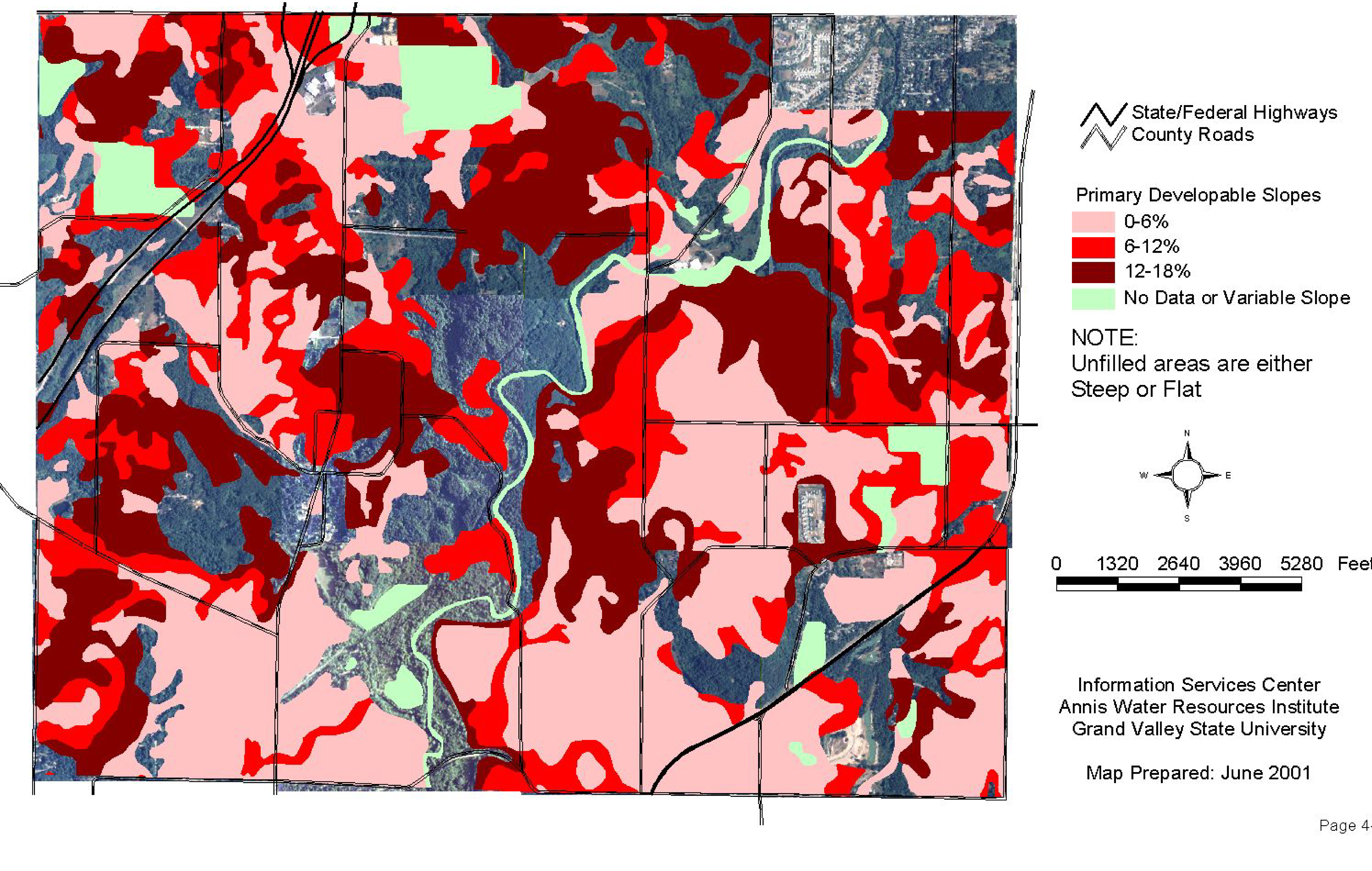
Information Services Center
Annis Water Resources Institute
Grand Valley State University

Map Prepared: June 2001

Map 4-5 Arterial Streets and Highways 200 Foot Buffer

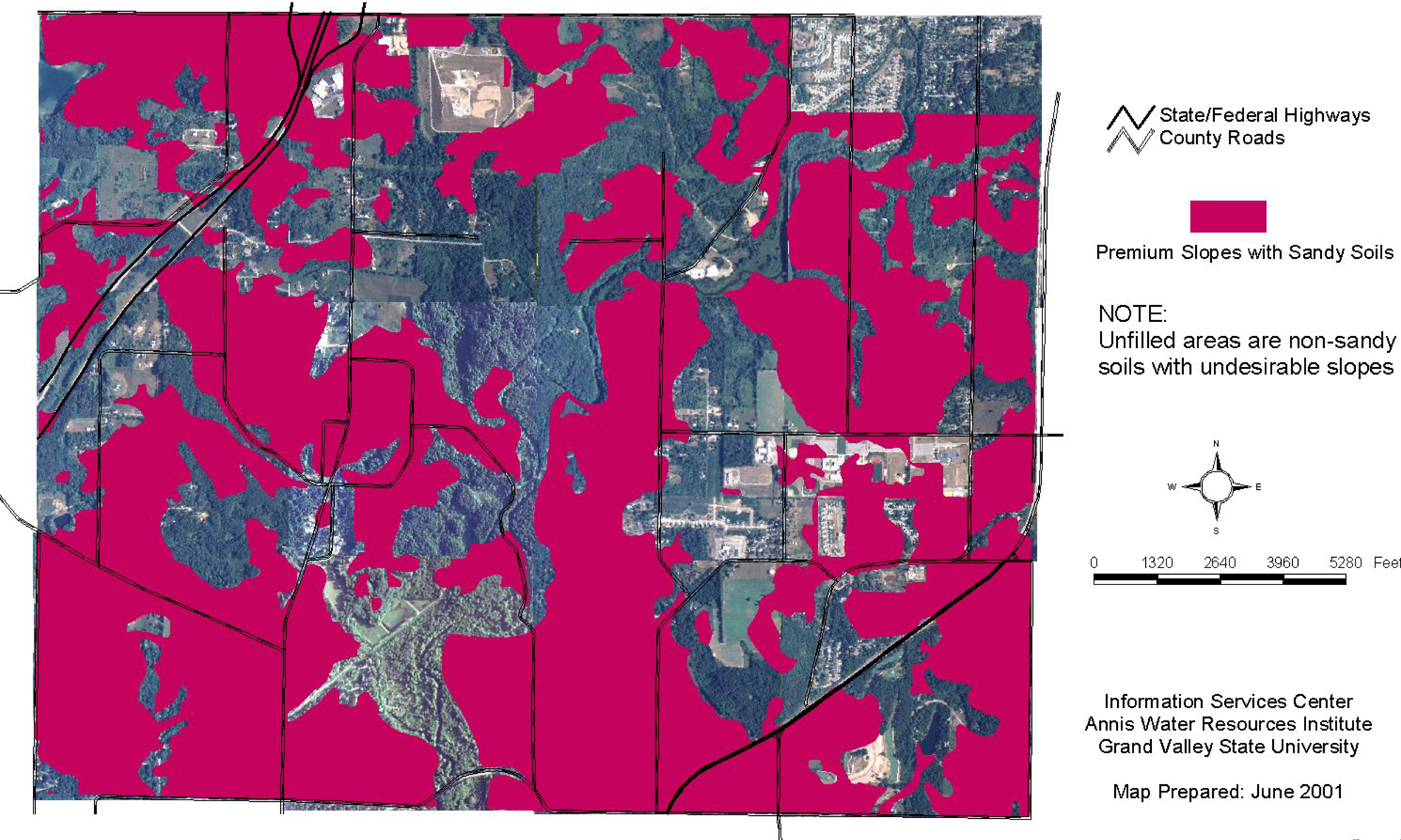


Map 4-6 Primary Developable Slopes and Steep or Flat Land

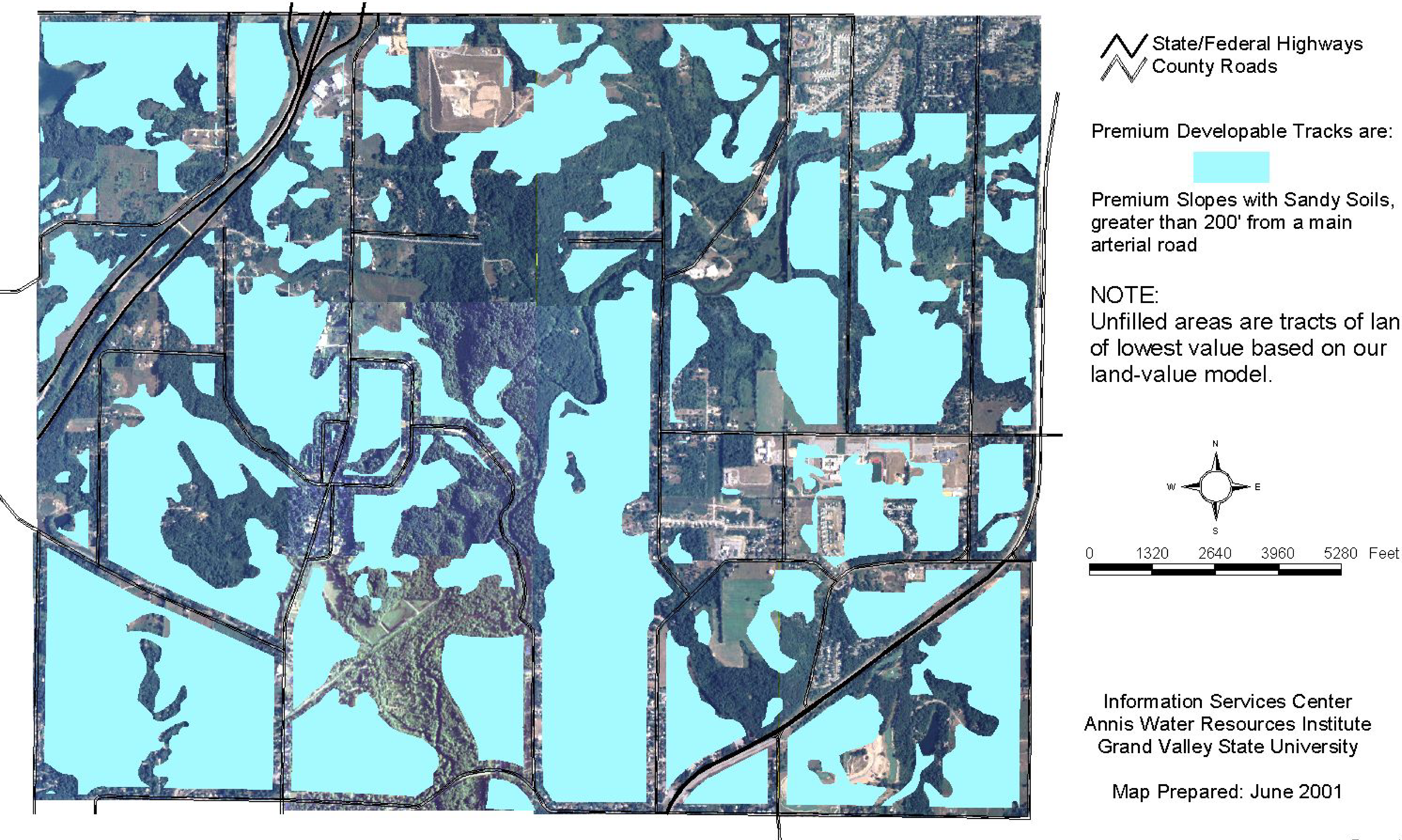


Map 4-7 Sandy and Non-Sandy Soils

Map 4-8 Primary Developable Slopes with Sandy Soils



Map 4-9 Premium Developable Tracts



CHAPTER 5

THE PROSPECTS FOR A MARKET IN DEVELOPMENT RIGHTS

I. Introduction

Recall that in Chapter 1 we set the stage for our analysis by developing a simple model of a residential land market in which preserved land generates external benefits. We used that model to identify and describe a range of general mechanisms, shown in Table 1-1, with which to allocate land to preservation versus development. Many of these mechanisms are in use, and it is common to see land preserved in a single jurisdiction using two or more of these methods simultaneously. In Plainfield Township, for example, land is preserved by private developers and landowners, by the jurisdiction using open-space zoning, and via a mix of private and public effort using large-lot zoning. We state toward the end of Chapter 1 that an important objective of this report is to describe the conditions that should influence the choice of policy mechanism.

The focus, of course, is on the conditions that might favor the use of a market in development rights. We noted that a couple of policy tools that currently see use – large-lot zoning with the option of cluster development and transfer of development rights (TDR) – represent innovations in the direction of a more general market in development rights. TDR programs involve regulatory allocation of land (like open-space zoning), but attempt to distribute more equitably the net gains from preservation. Cluster development treats both this equity issue, and provides the land developer flexibility in the allocation of land. The logical next step is a market in development rights in which the market plays a role not only in the distribution of net benefits, but also in the allocation of land to preservation versus development. The questions are: Under what conditions does it make sense to expand the role of the market in land allocation? and How can this role be expanded in the context of the current practice of land-development policy?

We tackle these issues in this chapter in three sections. Section II draws on the material presented in the first four chapters to identify the key factors that influence the choice of a policy tool for land preservation. The objective then, is to identify conditions in the land market that allow us to choose among the alternatives in Table 1-1. One outcome of this exercise is a determination of the conditions under which a market in development rights might make sense as a mechanism with which to allocate land to preservation.

Not surprisingly given the discussion in Chapter 4, conditions in the study area in Plainfield Township appear to approximate those under which a market in development rights might work. In Section III, we take the estimates of land value reported in Chapter 4 to simulate the allocation of land by a market in development rights. We report estimates of the market-clearing price of development rights, and how the market affects land values and distributes the implied net benefits from preservation. Importantly, this simulation indicates how big the benefits from preservation have to be to warrant (i.e., to pay for) varying amounts of land preserved.

This simulation exercise reveals both the potential strengths and weaknesses of a market allocation of land to preservation. In general, any land preservation policy will be implemented in the broader context of land development policy and planning. In Section IV we argue that a key advantage of a market in development rights – at least when conditions are generally favorable – is that the system potentially integrates readily into the current mixed-market allocation of land across developed uses. The intuition is simple. As with other land uses preservation generates benefits. In contrast with other land uses, the owner of the preserve cannot easily collect on those benefits. The market in development rights changes that. The implication is that preservation can be treated like any other land use in the presence of a market in development rights.

II. The Factors That Influence the Choice of Preservation Policy

The purpose of this section is to identify the characteristics of the local land market that influence the choice of policy tool with which to tackle land preservation. To do this, however, we first need to be clear on what the overall objectives of land development/preservation policies are. Importantly, policy objectives can differ across jurisdictions. For our purposes, we need a simple set of objectives that are common in practice, if not ubiquitous. The framework that we provide can readily be modified in the presence of objectives in addition to those that we describe.

Not surprisingly, we choose some rather practical objectives. However lofty the language in planning documents and policy discussions, experience indicates that practical economic considerations usually drive practical policy. Let's go back to the setting of Chapter 4: decisions about development policy prior to the onset of large-scale development. The jurisdiction consists mainly of landowners. These landowners understand that the jurisdiction is on the verge of developing, and they want to make the best of it. At the simplest level, making the best of it means putting in place land development policies that generate the largest net benefits for future users of developed land. As usual, the land market capitalizes these net benefits into the market prices of developable land. Good policy means greater wealth for these landowners. We take this as the basic driving objective.[1]

Usually, a general objective leads to more specific objectives. Experience and the analysis depicted in the figures in Chapter 1 suggest three somewhat less general objectives needed to achieve the most general one:

- *Efficiency in land allocation*. As shown in Figure 1-1, acres A^* through M are worth more in preservation than they are in development. The net benefits from preservation are equal to the area of the triangle abc. In general, land allocation decisions, whether between development and preservation or between residential

[1] We recognize both that objectives vary among landowners, and that the model objective can change over the course of development. Nevertheless, given that any analysis of policy requires simplifying assumptions, these appear reasonable, at least as a start.

and industrial, should capture these benefits. Moreover, the jurisdiction needs to choose the level and quality of various public goods and services to maximize the net (discounted) benefits generated.

- *Equity in the distribution of net benefits.* The really rough discussions at public meetings often revolve around the 'fairness' of a policy or of a specific land-use decision. Even if a policy generates net benefits, implementing that policy often depends on finding a way to distribute those benefits equitably.
- *Low administrative costs.* Implementing policy has costs. These costs, which are known in economics as transactions costs, reduce the net benefits generated by the policy. The choice of a regulatory (centralized) versus a market (decentralized) allocation mechanism often hinges on their relative administrative costs. The general rise of the market system is a result, in part, of the market's ability to reduce transactions costs.

Taken together, these objectives give us a framework with which to evaluate the general policy tools available within the relevant context. A key issue that permeates, and often confounds, discussions of policy is the need for making trade-offs. We cannot stress this enough. Realistically, the practical objective is almost always not to pick a costless tool (though it would be lovely if one were available), but to pick a tool that generates the greatest net benefits. There are situations in which large benefits require large costs. In general, each tool will in practice involve some trade-offs among the foregoing objectives. None of them will generally be perfect. The trick is to accept the costs and identify the tool that yields the greatest net benefits.

The next task is to identify the kinds of variables that define the context. For example, why is it that Plainfield Township currently uses more than one tool for land preservation? Our answer is that different tools best meet the above objectives in different situations. We would like to identify a short list of the key variables that influence the choice of tools. We proceed in the context of the policy tools described in Table 1-1. Table 5-1 reproduces Table 1-1 except that the descriptions of policy tools are replaced by a short list for each policy of the key conditions that warrant its use. To avoid repetitiveness, some of the conditions that overlap mechanisms are shown only once. We work through each policy in turn.

Consider first the market mechanisms. The key idea here is that the market will preserve land if the developer can capture most of the local benefits of preservation through higher building lot and house prices. Developing a large parcel facilitates this, but it takes a strong market to allow cost-effective financing of development of a large parcel. The market in development rights treats these problems in areas in which developable parcels tend to be small, and the market relatively slow. In either case, the market will have trouble networking privately preserved open space. It helps if the natural characteristics that affect land value are oriented spatially in a way that facilitates networking. Nevertheless, the benefits of networking to each landowner must outweigh the costs of necessary negotiations with other landowners (i.e., transactions costs) for the market, by itself, to get the job done.

Table 5-1. Conditions That Warrant Choice of Policy Tool

Allocation mechanism	Key conditions for choice of mechanism
Market	
No intervention	• Large development parcels available (or low land assembly costs) • Relatively strong market for development
Market in development rights	• That land naturally forms networks and is oriented to generate benefits to development • Land of low value in developed use has high value in preserved use
Regulatory	
Open-space zoning	• Land of relatively high value in preserved use is readily identifiable • That land has low value in development
Purchase of land or development rights (PDR)	• Preservable land has high value in development • Benefits accrue over a wide area or over an area already developed
Transfer of development rights (TDR)	• Land of relative value in preservation also is relatively valuable in development • Benefits accrue over undeveloped area
Mixed market/regulatory	
Large-lot zoning	• Land with characteristics suitable for preservation is distributed equally across parcels • Land preserved on private lots is valued more highly than land preserved in public networks
Market in DRs with planning/zoning	• Land characteristics favors a market in DRs • Jurisdiction can facilitate networking of preserved space and guarantee preservation of high-value lands

The last condition, that land of relatively low value in residential use should have relatively high value in preservation, deserves further comment. This condition is *not* required if parcels are large. The developer of a large parcel is in the position to properly trade off value in residential versus preserved uses. Because much of the benefits generated by preserved land spill over onto neighboring parcels, the developer of a small parcel will concentrate less on preservation value and more on the value in residential use; the preserved land will mostly be that with relatively low value in residential use. Thus the requirement that this land is reasonably valuable in preservation in the context of a market in development rights.

Next consider the conditions that affect the choice of a regulatory policy. The first one, that land of relatively high value in preservation is readily identifiable, is a critical one. The key costs of a centralized allocation mechanism are those of collecting and processing information, crafting a regulatory allocation, and enforcing that allocation. These costs, which are a form of transactions costs, can be high for an autarchy, and higher yet in the context of an open and democratic decision-making process (note that most large firms aren't very democratic). It's these costs that support the use of market allocation mechanisms. Nevertheless, there are situations in which the land that should, from a purely economic perspective, be preserved is reasonably easy to identify, though that may be the case less often than it appears.[2]

The main difference between the three regulatory approaches in the table is in how the preserved land is 'paid for'. Under zoning, the landowner bears the cost of preservation. Thus, zoning meets the equity criteria only when the land zoned for preservation has low market value in development. Publicly preserving land that has high value in development usually requires purchase at market prices of the land or development rights.[3] The local government can raise funds to do so through any regular taxing mechanism, though some form of tax on land, such as a property tax or development tax, seems reasonable because the benefits of preservation capitalize into the value of developed or developable land.

A transfer of development rights (TDR) program raises money for preservation when the land that receives the benefits of preservation is undeveloped. In principle one could just as readily implement in undeveloped areas a purchase of development rights (PDR) program as a TDR program. Land is centrally allocated under both systems, and money for preservation can be raised from the same sources. The advantage of the TDR program is that a market in DRs reduces the costs associated with transfers of cash. An advantage of the PDR system from the standpoint of the owners of developable land is that, in principle, the aggregate transfer of funds is generally smaller than that under a TDR program. The price of all DRs under a TDR system in principle equals the most expensive DR under a PDR system.[4]

Finally, the mixed market/regulatory tools. As we discuss in more detail later in the chapter, the applications of what we have categorized under 'market' and 'regulatory' would almost always in practice involve a mix of market and regulation. But that mix may well be more subtle, more implicit than explicit, than that involved with the two tools listed explicitly as mixed market/regulatory.

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[2] It may be the case that land with relatively high value in preservation also has high value in development. Economic efficiency alone may dictate development.

[3] We use the term 'usually' because landowners complain with vigor about unfair zoning mainly when they have come to believe that they in fact own the development rights. In some areas, in contrast, landowners have come to understand that they probably do not in practice have the right to develop wetlands or other areas that the community has made clear its dedication to preserve. This understanding eventually capitalizes into the value of the land for development; developers bid on the land with the knowledge that they probably must preserve some of the parcel. Open-space zoning may be politically viable as a means to preserve land with value in development when this kind of capitalization has occurred.

[4] In practice this may not be the case. See Thorsnes and Simons (1999) for a more detailed description.

The key advantages of large-lot zoning are equity and relative ease of administration. At its simplest, the zoning authority places a maximum density constraint on the land in the preservation zone. The system seems equitable because the same density constraint applies to all land in the zone. The system may also be efficient if land suitable for preservation is evenly distributed over parcels and preserved land is more highly valued in private lots, or on communal land around clustered lots, than in publicly accessible networks of open space. Land allocation is decentralized to the extent the landowner can decide where on the parcel to place houses, and whether or not to cluster.

The market in development rights potentially increases the efficiency of land allocation (and, therefore, the aggregate value of land) when land suitable for preservation is distributed unevenly over parcels, and when networks of open space are desirable. Indeed, one important function of the local government is facilitating creation of this network. Of course, within this network of open space, there may be advantages to other public infrastructure, such as bike paths and nature trails. And, of course, the characteristics of other public infrastructure must also respond to the characteristics of the preserved space. And, as noted, the market may not preserve some areas highly suited to preservation. We discuss these issues in detail in Section IV of this chapter.

In the meanwhile, we provide a feel in the next section for the financial characteristics of a market in development rights in the study area in Plainfield Township.

A Simulation of a Market in Development Rights in the Plainfield Study Area

A key conclusion from the model of a market in development rights described in Chapter 1 (in Figures 1-1 to 1-3) is that an 'unfettered' market in DRs will tend to allocate to preservation land of relatively low value in residential uses. This makes sense when you consider the incentives faced by the owner/developer of a parcel. If he is initially given the right to develop 60% of his land, he'll look closely at how the characteristics of the parcel vary with respect to value in residential uses. If it all looks good relative to the market price of a development right, he'll buy more DRs. If little of it looks good, he'll sell DRs. The developer considers the relative *benefits* generated by the preserved land only to the extent that they accrue to the developable parcels on site. If developable parcels are relatively small – which they probably are given that the DR market is in use – then owner/developers will in general focus more on the costs of preservation than on the benefits.

The key input, then, to an analysis of the functioning of the market in development rights is a model of the value of land in developed use, such as that described Chapter 4. Given a choice of the overall amount of land to preserve, we can appeal directly to the model to simulate which tracts of land the market in DRs will tend to preserve: the relatively low-valued land. We showed how these areas are distributed spatially in the series of maps in Chapter 4. Assuming that the basis of the model is reasonable, i.e., that we accurately identified the variables that affect land value, the good news from these maps is both that these lands begin to a form a network, and they appear in general to be of at least average value in preservation.

The next step is to use these estimates to investigate the financial aspects of a market in development rights. Return to Figures 1-2 and 1-3 in Chapter 1. The jurisdiction chooses the proportion of land in the market area to preserve, ideally A^*/M. The benefits from preservation capitalize into the market value of developable land. The market-clearing price of a development right is the value of development on the A^*th acre: each acre of higher value in development warrants purchase of a DR, each acre worth less in development encourages sale of a DR. While our land-value model gives us an estimate of V_D, our knowledge of the MEC curve is relatively scant; we can only feel confident that the right-hand side of the MEC curve is at least $14,000 to $16,000 assuming that one acre of preserved land generates benefits to at least two building lots. The slope of the remainder of the MEC curve is unknown.

So, we still lack some of the information needed to apply the market model of Chapter 1 to the Plainfield study area. We don't know A^*. And we don't know the area of the MEC curve between A^* and M, which is equal to the total benefits of preservation that are capitalized into the price of developable land. That is, we don't know how much the V_D curve shifts up as a result of the preservation program. This represents a frustrating lack of information, information we don't have because it is very difficult to estimate.

We can, however, proceed with a simulation of the DR market. Since we don't know A^*/M, we arbitrarily choose several candidates: preserve 30%, 40%, and 50% of the land in the study area. Note that the location of A^* is defined by the intersection of the V_D and MEC curves: the A^*th acre has the same value in preservation as in development. Thus, assuming in each case that we picked A^* accurately, then we know the benefits generated by the A^*th acre. Now, according to the figure, that *marginal* acre generates lower benefits than all the other 'infra-marginal' acres to its right. Thus, the minimum value of the total benefits generated, assuming we picked A^* reasonably well, is A^*'s value in development times the total number of acres preserved. This estimate of the total benefits generated allows us to calculate a lower bound on the benefits per developed acre (how much the V_D curve shifts up) and, therefore, the market-clearing price of a development right.

The results are shown in Table 5-2. Consider first the numbers in the first column of results. Preserving 30% of the land in the study area amounts to about 2250 acres preserved. Going back to our land value model depicted in Figure 4-1, and going 2250 acres from right to left yields a market value of $11,000 in residential development; all of the acres preserved have estimated market values of $11,000 or less. If it makes economic sense to preserve an acre worth $11,000 in development, then the benefits generated by that acre, and every other acre preserved, must be at least $11,000. So, the total amount of benefits must be at least $24.7 million ($11,000 per acre times 2250 acres preserved). Spread these benefits over the 5250 acres allowed to develop, and their value increases *on average* by about $4700 ($24.7 million divided by 5250). This, of course, amounts to about $2350 per house if land develops at an average of two houses per gross acre.[5]

[5] A 'gross' acre includes not only the building lot, but also the land occupied by streets and other non-housing land uses. The assumption of two houses per gross acre probably implies building lots of about $15,000 square feet, which is larger than the median subdivision lot in Plainfield Township, but not atypical in suburban areas.

Table 5-2. Estimated Financial Impacts of the Market in Development Rights

Proportion Preserved	30% Preserved	40% Preserved	50% Preserved
Acres Preserved	2250	3000	3750
Marginal Benefit Generated	$11,000	$12,500	$13,500
Minimum Total Benefit	$27.4 mil	$37.5 mil	$50.6 mil
Avg Per-Acre Capitalization	$4714	$8333	$13,500
Avg Per-House Capitalization	$2357	$4166	$6750
Market-Clearing Price of DRs	$15,714	$20,833	$27,000

These results indicate that preservation of 30% of the land in the market area could be 'paid for' by sale of development rights if, on average, the preservation program raises building-lot prices by $2350. This obviously compares favorably with the estimates of $7000 to $8000 reported in Chapter 3. Of course, far less than 30% of the land is currently preserved in Plainfield Township, so the supply of building lots close to a preserve is small, which bids up the price of that proximity. Moreover, the results reported in Chapter 3 suggest that the direct proximity effect is localized. Nevertheless, it does not seem like a large stretch to think that building-lot prices would generally rise by about $2500 in an area in which 30% of the land is committed to preservation in a network of forests.

The numbers change as a larger proportion of the area is preserved. Average per-building-lot capitalization rises to about $4200 to preserve 40% of the land, and higher yet to $6750 to preserve 50% of the land. To put this in perspective, the price of subdivision building lots of roughly $15,000 square feet would have to rise from about $35,000 to about $40,000 to pay for preservation of 40-45% of the total land area. Houses on lots of this price typically sell in the range of $200,000. So, on the remaining 4500 or so acres allowed to develop, the market would have to attract about 9000 households willing to pay, on average, a roughly $5000 premium for general proximity to the preserved network. The market-clearing prices of the right to develop an additional acre would be high: about $21,000. But the price reflects both the opportunity cost of and benefits generated by the preservation effort. Sale of development rights clearly provides compensation for preservation.

Unlikely to be lost on land owners is that raising the market value of the development rights they own entails attracting home buyers who value the amenities on offer. Those home buyers will be interested not only in environmental amenities, but also in the quality of the full range of public services and neighborhood characteristics. Indeed, the orientation of the open space will influence the range of development policies considered by the jurisdiction. We consider these issues in the next section.

IV. Land Development Policies and the Market in Development Rights

So far in this chapter we have described the conditions under which use of a market in development rights might be warranted as a relatively effective, efficient, and equitable means with which to preserve natural areas. Much of the area in the Plainfield Study Area appears to meet these conditions. Our simulation of a development rights market in the area indicates that the local benefits required to 'pay for' preservation are not out of line with what the admittedly scant empirical literature suggests is reasonable. A key question that remains concerns how a market in development rights at least in principle fits within the common process of land-development regulation.

Our argument is that it fits rather neatly, at least as well as more commonly used preservation tools. The key insight is that the market in development rights makes preserved land productive both generally and for the owner of the preserved land. Open-space zoning, for example, may not dramatically reduce a landowner's wealth if he has development rights to sell. This suggests that the local government may be able to consider preservation much like it does other land uses: residential, commercial, industrial. In this section, we describe what that might mean in practice.

It's useful to frame the discussion by beginning with a description of how economists' thinking about zoning (and land-use regulation generally) has evolved. Zoning has typically been viewed in the economic literature as a stand-alone type of local government regulation (see, for example, Crone (1983)). It is usually modeled as setting some kind of constraint that restricts use or density. This makes sense because it comports closely with what one sees in a standard zoning ordinance. Zoning 'binds' when the buyers and sellers in the market would rather have configured land use in a way that the zoning restricts; they want commercial instead of the zoned residential, or they want smaller building lots than that allowed.

Empirical researchers have set out to determine whether zoning does very often bind. The concern is that since the local zoning authority is so local, it might be difficult in practice to resist the forces of the market. Evidence of binding zoning is a discontinuous jump or drop in land values at zone boundaries. Commercial land near a major arterial or freeway intersection, for example, usually commands higher prices than residential land. The value of the land to commercial users, however, usually drops quickly with distance from the arterial street or intersection. The market would tend to allocate land to commercial uses until its value to commercial users fell to its value in residential uses. The value of land on each side of the land-use boundary would be about the same. If it wasn't, the boundary would tend to move as landowners sold to the higher bidder. A standard condition for equilibrium in the land market is that land values don't fall or jump much at land-use boundaries.

Whether land values jump or drop at zone boundaries can be tested using the kinds of regression techniques that appear elsewhere in this report. The results of land-market studies conducted in the 1970s and 1980s are mixed, but many report evidence of land-value differentials at zone boundaries. Maybe the zoning authority typically exercises more clout than many economists would expect.

More recently, empirical researchers began to wonder if testing statistically for land-value differentials isn't more complicated than the early researchers saw. The problem is a common one in statistical research: unobserved differences in the characteristics of land. Perhaps the land zoned for lower-intensity development, which had lower market values, was zoned that way because of characteristics that the researcher couldn't observe. In this case the estimate of the jump in land values at the zone boundary would be biased because the zoning variable picks up (proxies for) the effects of the missing control variables.

Would it be the case that the estimated land-value differentials would persist with more careful analysis? More recent analyses (e.g. McMillen and McDonald (1991) and Pogodzinski and Sass (1994)) suggest not. It seems likely that the vast majority of the run-of-the-mill zoning that dominates the landscape does more-or-less follow the market. The market in practice has a big influence on practical regulation. The evolution over time of the zoning map in Plainfield Township is quite consistent with this view.

But that doesn't mean that zoning doesn't have an impact on the allocation of land and improvements. We think that zoning matters in at least two ways. First, zoning should probably not be thought of as a regulatory exercise separate from other aspects of land-development policy. In planning principle, zoning should be consistent with a broader well-defined plan for development and the provision of public goods and services in the jurisdiction. The relationship between zoning and the comprehensive plan in practice varies considerably across jurisdictions. But whether the guiding light is more implicit than explicit, it guides not just zoning, but also the characteristics of other public infrastructure and services that affect land values and development. In measuring the effects of zoning statistically researchers typically take as given the characteristics of these other public goods and services.

There is another critical role of the comprehensive plan and the planning process. Prior to development, the value of land is determined by its value in resource use, usually agriculture. In the areas around Plainfield Township these values range from less than $2000 per acre to maybe $5000 per acre. Development leads to higher land values, among other things. The value of some land, such as that near major arterial streets, will grow more than that of other land. Who gets the big windfall? The comprehensive planning process helps determine that. Landowners begin to see how the area is likely to develop, which gives them an idea of what their land might be worth when it comes time to sell to a developer.

The other aspect in which zoning matters concerns the distribution of another kind of windfall. In practice, both comprehensive plans and zoning ordinances usually evolve over time; its creators may see the plan as a vision for future development, but the vision is typically blurry. A more reasonable way to think about the comprehensive plan is as a rough guide that gives the general direction for policy. That policy gets defined more clearly through the day-to-day negotiations that take place in planning offices and at zoning commission meetings. The planning boards in most developing townships meet regularly, often once or twice a month, to consider proposals from landowners and developers to budge a little or a lot on the zoning and other development regulations.

These negotiations play a critical role in the allocation of real estate resources. Landowners typically come in with proposals for regulatory changes that will benefit them. Sometimes the proposed changes impose costs on neighbors. The proposal is usually rejected if these costs outweigh the benefits to the landowner. The negotiations get more interesting when the benefits of the proposed changes outweigh their costs: the proposed change has net economic value. The negotiations then involve how to spread these net gains (the equity factor). For example, a change in zoning from residential to commercial on a parcel on the border of the commercial zone may lead to a higher sale price, but commercial development as proposed would reduce the value of residential land nearby.

If there are net gains to the proposed change, then in principle the winners can more than compensate the losers. The proposer would, of course, prefer not to make such compensation. But he would also rather keep part of the net gain than none of it. The trick, and it usually is tricky, is how to accomplish the negotiations that are required to divvy up the net gains. Somebody needs to facilitate those negotiations.

The zoning board appears to be in a uniquely potent position to carry out this exercise. They defined the problem in the first place when they adopted the zoning map and ordinance. They have the legal power to change the regulation or to leave it as it is. They will make some kind of decision that affects the allocation of resources. And they have the opportunity to collect the information they need to make a good decision from the people who have that information: the parties affected by the proposed change. They call a public meeting, and everyone who cares about the proposal can have his say.

In many cases, this form of mediation probably results in a refinement of the regulatory framework that generates considerable net benefits (i.e., greater economic efficiency). The real trick is finding legal and acceptable ways to share these gains. Many times this involves concessions by the landowner or developer requesting changes in the regulation. For example, a rezone from residential to commercial may be approved if the developer agrees to design changes that improve the aesthetics of the development and safeguard the security of nearby neighborhoods. He may agree to make off-site improvements or dedicate part of the site to the public as parkland. In principle, there are many ways to accomplish this. And the zoning board, given its regulatory powers, may be the best group around to mediate these negotiations.

So what does all this have to do with a market in development rights for land preservation? First, consideration during the comprehensive planning process of using a market in development will greatly impact many decisions about land-development policy. The process will generate not only a tentative allocation of land to natural uses, but also include decisions about the characteristics of public infrastructure and services, and the characteristics of zoning and subdivision and building codes. Yet, this process will not differ fundamentally from what currently occurs in the context of the allocation and regulation of developed land uses. The market in development rights allows policy makers to think about natural uses like it does developed uses.

After that initial planning process, and the tentative allocation of land across uses, including permanently preserved natural uses; the day-to-day negotiations that refine the plan begin. Of course, the market plays a critical role in the initial allocation of land because landowners care about the value of land and development rights. The market further plays a role in the refinement because individual landowners and developers will propose changes that they think will result in a net economic gain. Those gains will be exploited to the extent that mediation results in an equitable way to share them. In short, the market in development rights allows the jurisdiction to treat preserved land like it does other land uses. This seems to be a significant advantage relative to some of the other preservation tools.

V. Summary and Conclusions

This chapter concludes the report by assessing the conditions under which a market in development rights may be a useful tool with which to pursue preservation of natural areas in a developing jurisdiction. The chapter begins with an analysis of the factors that influence the choice among the various tools available for preserving land. A market in development rights appears appropriate where developable parcels are relatively small and the land market relatively slow; land of relatively low value in residential use is of relatively high value in preservation; these lands are located in a pattern conducive to the creation of open-space networks; and there is no strong reason for preserving large contiguous tracts of land. Though these conditions certainly are special, they may not be rare. In general, the choice of policy should depend on the local conditions.

We find that the prospects for a reasonably efficient market in development rights appear to be good within the Plainfield study area. Our simulation of the land and development rights market indicates that the average house-price premium required to justify a significant proportion of land preserved, e.g., 40%, is on the order of $4000 or about 2% of the price of a typical new house. Much of the benefits generated by preserved open space are probably highly localized, but it seems likely that a program that preserves this much land in networks would generate significant benefits even to households not located in close proximity to the preserved land. The rolling terrain offers opportunities for the local government to negotiate the preservation of networks of open space. Importantly, these conditions may not be rare in the fringe areas of growing mid-size metropolitan areas.

The third section of the paper discusses how consideration of a market in development rights would affect the general process of planning and land-development regulation. Our key conclusion is that the market in development rights would allow the local jurisdiction to consider permanent preservation much as it does other productive land uses. Though the comprehensive plan and land-development policy would be greatly affected by the opportunity to preserve networks of natural areas, the general process of policymaking and regulation may not be much affected. All this taken together suggests that a market in development rights could be a useful tool with which to facilitate the practical allocation of land to permanently preserved uses.

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