STUDY OF METHODS FOR GREENWAY ACQUISITION IN CITY PLANNING

A Thesis

by

SVEN TROY GRIFFIN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2005

Major Subject: Rangeland Ecology & Management

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Approved as to style and content by:

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ABSTRACT

Study of Methods for Greenway Acquisition

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This study highlights the importance of incorporating greenways in city planning and addresses issues related to their acquisition. It documents what comprises greenways and why they are beneficial for the smart growth of a city. The research compares and evaluates methods of land acquisition by conducting a literature review and by analyzing the practices at the study site of the City of College Station, Texas. Combining the best-fit method with GIS modeling, a ranking system has been developed and used to identify likely greenway locations in College Station as a case study. Results indicate the validity and feasibility of this ranking system.

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CHAPTER I

INTRODUCTION

Greenways are corridors of undeveloped land in a city setting. They include vegetation belts, creeks, rivers, floodplains and other natural features along public infrastructures. Public infrastructures consist of utility networks, roadways, rail corridors and other constructs that facilitate public usage of green space (College Station, 1999; Flink and Searns, 1993; Little, 1990). Greenways are increasingly recognized as an integral part of these infrastructures.

Greenways augment infrastructures as well. For example, they enhance citizen's mobility by enabling more pedestrian and bicycle safe areas. They provide linkages between neighborhoods and existing parks adding venues for community networking and recreational opportunities. Greenways enhance scenic views, increase awareness of historical areas, and protect ecologically sensitive areas within the city setting where they exist (College Station, 1999; Little, 1990). These networks also facilitate urban infrastructure redevelopment, such as abandoned railways and roads (Marcus and Francis, 1998).

Ecological benefits of greenways range from protecting biological diversity of species to abiotic benefits. By fostering connectivity, genetic stagnation is alleviated through reduction of island population and the resulting inbreeding (Little, 1990; Noss,

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This thesis follows the style of Environmental Science and Policy.

1987). Greenways benefit other ecological processes by helping sustain water quality, abate pollution, deter soil erosion and facilitate the exchange of energy and nutrients within the system (Jongman, 2003; Noss, 1987).

Establishment of greenways at the local level is considered to be one of the most important steps toward creating a foundation of larger ecological networks and is the focus of this research (Jongman, 2003). The emphasis of the study is to analyze current practices of local jurisdictions in the planning and acquisition of greenways so as to develop best-fit methodologies adaptable to local needs. For this purpose, the City of College Station, Texas, was chosen as the study site.

College Station is a desirable study site for three reasons. It has an established greenways master plan and has begun acquiring land for greenways. Second, it has datasets required for modeling development impacts within GIS on proposed greenways. Finally, College Station has the ability to amend its land use policies within the Unified Development Ordinance (UDO). Integration of greenways into the UDO will enhance the ecological integrity of greenways within the city's development planning.

Currently the city is acquiring land for greenways in an ad hoc way. For example, properties for greenways are purchased after the commencement of development. This practice leads to increased cost that may handicap future purchases of lands designated in the Greenways Master Plan. As a result, designated or targeted properties may be excluded from acquisition, causing a breakdown in greenway connectivity.

This study assessed urban development patterns relating to future growth and their impacts on proposed greenways. In this context, the adequacies of various land

acquisition techniques currently practiced were evaluated and compared. The research helps to improve planning and implementation of greenways in city settings in general and for College Station. This is accomplished by comparing and contrasting each method so that communities can assess their needs to the functions of each process.

CHAPTER II

LITERATURE REVIEW

Greenways have tremendous impacts on a local community. These impacts can be broadly classified according to environmental, economic and social considerations on the community's quality of life. Due to these factors, greenways are increasingly being incorporated into urban planning, design and development practices. Thus, determining the appropriate method or methods for protecting greenways based upon local requirements is increasingly important.

2.1 Environmental Impact

Fragmentation, one of the most important issues related to environmental quality, is defined as the level of connectivity or contiguousness of a linear system regarding the health of the environment (McGuckin and Brown, 1995; Ndubisi et al., 1995; Searns, 1995). Due to fragmentation, degradation of plant and animal populations has occurred, riparian areas are degrading, and environmental processes are failing (Jongman, 2003).

There are several causes associated with loss of greenway connectivity. Foremost is the advancement of urban sprawl into undeveloped land (Baschak and Robert, 1995). For example, between 1982 and 1997 the amount of developed land in the United States increased by thirty-four percent while population grew only seventeen percent (Benedict, 2002). Such a dramatic increase in land consumption to support urban development has directly resulted in increased fragmentation (Jongman, 2003).

Fragmentation also results in reduced biological diversity of plant and animal which results in stagnation of the local gene pool (Baschak & Robert, 1995; Benedict and

Edward, 2000 ; McGuckin and Brown, 1995; Jongman, 2003; Linehan et al, 1995). As areas are fragmented they create island populations that no longer have access to genetic material outside the immediate locale (McGuckin and Brown, 1995; Linehan et al, 1995). Island populations are increasingly susceptible to the extinction of plant and animal populations from disease and/or fire (Jongman, 2003; Linehan et al., 1995). These problems resulting from fragmentation will continue to reduce species diversification if the issue is not addressed (Dawson, 1995).

Increasing connectivity, on the other hand, raises the genetic diversification of local species (McGuckin and Brown, 1995). This is due to the increased ability for new plants and animals to move into an area so as to prevent inbreeding (Noss, 1987). In addition to creating connectivity the increased size of greenways has been shown to be positively correlated with species diversity (Geoghegan, 1997).

Connectivity can be enhanced by preventing development in specified locations. In areas where this is impractical because of development pressures or pre-existing conditions, other methods can be utilized. For example, tunnels may be constructed under roadways to facilitate movement of smaller animals. For larger animals, underpasses beneath roadways that allow passage across road networks may be used. Aquatic species can similarly be transported over infrastructure through the use of fish ladders allowing them to move across elevation changes (Jongman, 2003).

Riparian areas in greenways are an intricate component to the environment, reducing them negatively impacts its ability to mitigate environmental processes (Benedict and Edward, 2000 ; Benedict, 2002; Cook, 1991). This is especially important for the City of College Station greenway program is comprised predominantly by riparian

vegetation. The functions it performs are stabilization of stream and riverbanks, filtration of air and water pollutants, and mitigation of flooding and storm water runoff.

Many pollutants can adversely affect water and air quality. Nonpoint source pollution carried by runoff such as pesticides, nitrogen phosphorous, and carbon are filtered by riparian vegetation prior to entering streams (Benedict and Edward, 2000 ; Lin, 2002; Lindsey, 2003; Noss, 1987). These systems store much of the nitrogen, phosphorous and carbon that otherwise would leave the system (Lin, 2002; Searns, 1995). For example, phosphorous is removed by uptake and storage by plants, microbial immobilization, and by binding to the soil (Mander et al., 1995). Nitrogen also is removed by the uptake and storage by vegetation, microbial immobilization and being captured by the soil (Mander et al., 1995). Lastly, carbon is sequestered by plants, preventing it from being converted to carbon dioxide. All these factors adversely affect water quality (Ahren, 1995). Riparian areas also reduce air pollution by filtering them out by way of vegetation (Benedict and Edward, 2000 ; Mander et al., 1995; Searns, 1995). Air pollutants can also be trapped in precipitation, which can enter waterways by way of runoff (Searns, 1995).

Riparian areas can also mitigate flood damage if they are not straightened and paved to encourage quick drainage of urban areas (Berke et al., 2003; Searns, 1995). If streams and riverbanks are allowed to remain, natural erosion of the banks would be reduced (Lin, 2002; Mander et al, 1995; Searns, 1995). To help accomplish this greenway should encompass at least the one hundred year floodplain to allow for natural meandering of waterways. Additionally the uses permitted in the area should be able to tolerate periodic flooding, for example neighborhood parks (Searns, 1995). This flood

damage is also reduced if riparian areas are left in a natural state (Ahren, 1995; Lindsey, 2003; Searns, 1995).

2.2 Economic Impact

Quantifying the value of greenways is difficult to determine, however, several attempts have been made to understand the economic impacts generated (Tajima, 2003). For example, areas surrounding neighborhoods have been shown to have an impact upon property values (Geghagen, 1997). Greenways and the associated uses have positive impacts on property values as evident in the data in Figure 1 (Allen et al., 1985; Breffle et al., 1998; Geoghagen et al., 1997; Tyrvainen and Miettinen, 2000). The increase in property value has been linked to the natural amenities and aesthetics greenways provide (Cook, 1991). Real estate market research has shown a positive return for trees located within riparian greenways (Grey and Deneke, 1978). The increase in property value not only benefits owners, but also local government that receives increased property tax revenue (Correll et al., 1978; Crompton, 2001).

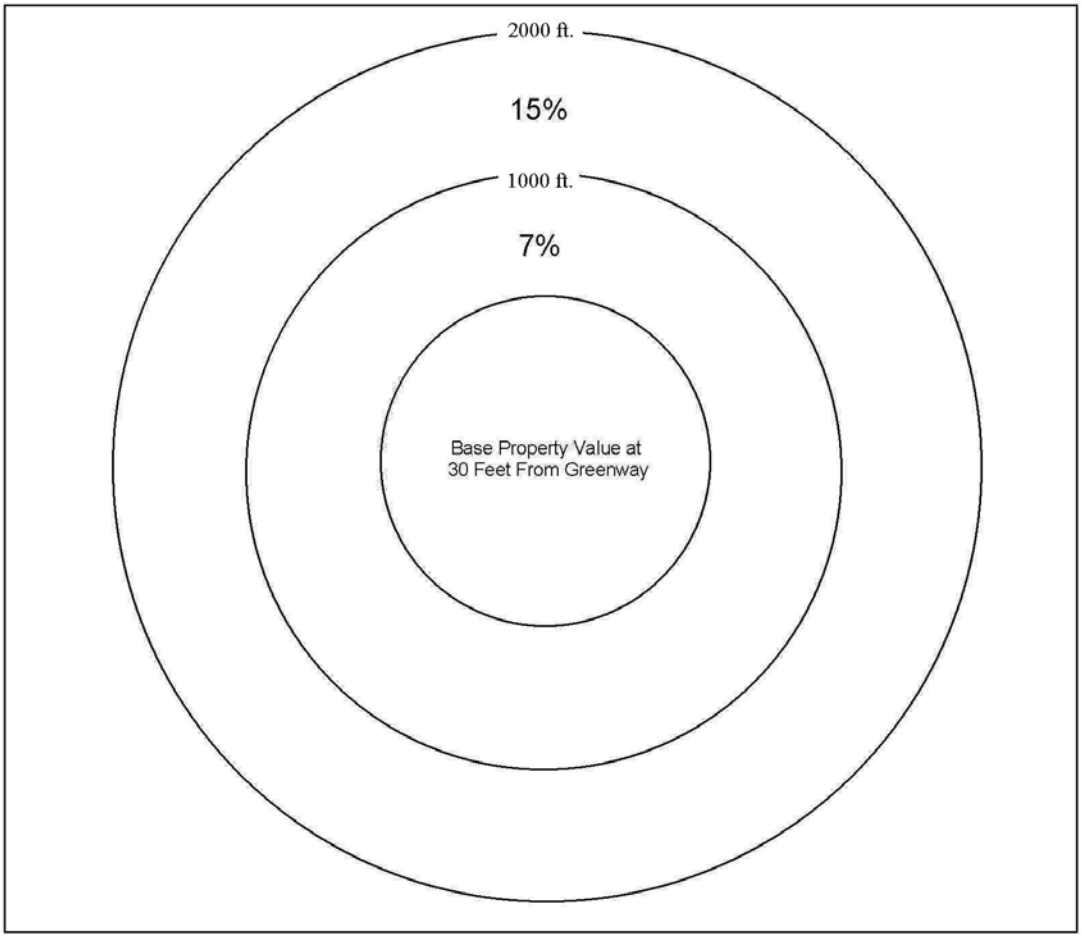

Figure 1: Distance from Greenways and Property Value Impact. The Figure depicts the average percent price decrease in residential property values as distance from greenways increases. The decrease is derived from subtracting the market value from property located thirty feet or less from the greenway as distance increases. Thus, property located one thousand feet away from base could expect to be seven percent less expensive.

Another economic benefit to greenways is the cost savings generated by the cleaning of environmental pollutants and reduced infrastructure costs. Greenways can clean water, air, and filter nutrients from runoff that negatively impact the environment (Benedict, 2002; Crompton, 2001; Lindsey, 2003). These pollutants have been shown to have a negative financial impact on property values and related recreational services, such as fishing (Harrison and Rubinfeld, 1978; Legget and Bockstael, 1999).

Cleaning water, for instance, is an expensive procedure for government to fund. Removal of nitrogen and phosphorous, two common methods for evaluating water quality, is efficiently achieved by greenways (Legget and Bockstael, 1999). For example, New York city saved eight billion dollars by not building treatment plants for cleaning stromwater runoff, but instead investing 1.5 billion dollars in greenways that achieved the same outcome. Greenways not only clean the water, but provide billions in savings by mitigating flood damage and reducing recovery and relief costs associated with such disasters (Benedict, 2002).

If urban growth is not permitted to occur within greenways, costs incurred with gray infrastructure are also reduced. Gray infrastructure is considered municipal or private improvements such as water, sewer, and electrical lines as well as streets (Benedict, 2002). Such infrastructure is expensive to maintain. For example, the comparison between the median costs of maintaining greenways versus residential neighborhoods per dollar of income tax received is thirty-seven cents and one dollar and fifteen cents respectively (Crompton, 2001).

Tourism generated by greenways and the recreational opportunities they provide also create economic revenue (Burel and Baudy, 1995; McGuckin and Brown, 1995). Such recreational opportunities consist of cycling, hiking, equestrian trails, picnicking, camping, fishing, water sports and nature watching (Cook, 1991; Dawson, 1995). Such revenues not only stem from activities like nature watching, but the related businesses that are created by tourism. These businesses raise land values through supply and demand and enlarge the job market (Breffle et al., 1998). Additionally, amenities created around greenways and the tourist industries associated with them attract many large

companies, such as Dell Computers (Crompton, 2001; Scholl and Schwartz, 2003; Tajima, 2003).

2.3 Social Impact

Greenways are increasingly recognized in contributing to quality of life or QOL. Studies have indicated that people feel greenways improve life (Lindsey, 2003; Shafer et al., 2000). Improvement in QOL is accomplished by aesthetics, recreational opportunities, and social and psychological interaction between people and nature (Hoover and Shannon, 1995; Jongman, 2003; Searns, 1995). Because of this, cities with greenways are viewed as healthier and more enjoyable places to live (Lindsey, 2003)

Quality of life is improved through increased social interaction of people meeting other people, walking trails and volunteering programs for instance, that otherwise would not interact (Bischoff, 1995). Not only do people interact more with one another, but interaction between people and nature also improves QOL (Lindsey, 2003; Shafer et al., 2000).

The quality of people's lives within cities is also improved through recreational usage of greenways. Greenways increase pedestrian mobility by providing urban pathways and connectivity to other areas, such as parks and neighborhoods (Lindsey, 2003). Walking or riding bikes is also encouraged as people are buffered from noise and traffic generated by streets (Marcus and Francis, 1998; Shafer et al., 2000). The increase in pedestrian activity also leads to better health through increased exercise (Benedict, 2002).

Education is also an important aspect of the social benefits provided by greenways. Greenways can be set up as learning centers to encourage education of natural processes occurring within the environment and the role people play in that (Jongman, 2003; Searns, 1995). Outdoor classrooms have already been established by schools to educate students about the environment. Many programs have adopted portions of greenways, maintaining them and fostering a sense of ownership in nature (Searns, 1995).

2.4 Methods of Acquisition

The most common methods of greenways acquisition include landowner subsidies, tradable development rights (TDR), fee-simple land purchase, command-control regulations, and conservation easements (Boyd et al., 2000; Michael, 2003; Patney, 2000). This section describes what the acquisition methods are and identifies their strength and deficiencies.

2.4.1 Conservation Subsidies and Taxes

Conservation subsidies and taxation used for conservation of land are a straightforward method of preserving existing land. Three types of subsidies and taxation methods give local government a wide array of ability to utilize each. However, there are several drawbacks to the usage of subsidies and taxes for conservation in regard to greenway fragmentation and cost.

2.4.1.1 How Conservation Subsidies and Taxes Function

Conservation subsidies are payments to property owners who voluntarily forgo specific development rights (Michael, 2003). These subsidy payments are in the amount equaling the difference between the current land use and its relinquished use. For example, if development of the property would yield $200 per acre, a subsidy of that amount would be paid to owners negating any monetary gain (Boyd et al., 2000).

The three existing types of subsidies are 1) direct payments 2) tax exemptions and 3) reduced infrastructure costs. Direct payments are a monetary payoff for potential development losses, thus a $200 loss for not developing would yield a $200 payment. Tax exemptions are indirect payments made to the landowner for not developing a property. For example, if the cost of not developing resulted in a $200 loss, a property tax deduction in that amount would be made. To offset potential development loss, landowners are compensated with reduced infrastructure costs. Thus, if the land were used for farming instead of a residential subdivision, a water connection to the land may be granted at lower charges and fees (Mountford and Keppler, 1999).

Taxes can also provide a disincentive to develop property. For example, a $200 per acre tax could be assessed for developed land to negate profits made by the developer. The difference is who bears the burden of cost, the developer or the taxpayer (Boyd and Simpson, 1999; Boyd et al., 2000). In this case, a developer may be persuaded to reserve more greenways in a project because of the tax incentive.

2.4.1.2 Benefits of Subsidies

Two benefits of using conservation subsidies to protect greenways are promotion of economic activities and use of existing governmental functions. Subsidies can promote economic activities such as eco-tourism and recreation that preserve natural resources (Bowles et al., 1998). Second, evaluation of land value and implementation of taxation is easily accomplished by established agencies. For example, the Internal Revenue Service (IRS) and the U.S. Department of Agriculture have procedures in place that make taxation relatively easy to administer (Boyd et al., 2000).

2.4.1.3 Subsidy Drawbacks

Subsidies have four specific drawbacks to their usage. First, subsidies and taxes cannot be used to target specific properties. Because they are voluntary and must be applied across a jurisdiction, greenway fragmentation and loss of targeted property may result if landowners decline to accept subsidies (Boyd et. el., 2000; Michael, 2003). Additionally, the general nature of taxation and subsidies fails to account for variations in supply and demand across geographic areas. For example, a subsidy of $200 an acre may not negate profits in areas where development pressures result in profits of $300 an acre

(Innes et. al, 1998). Second, subsidies represent a financial loss to government in the form of revenues paid to landowners to forgo development (Mountford and Keppler, 1999). Third, the reliability of government or taxpayers to subsidize or tax property over time is subject to change due to political pressure allowing potential loss of greenway property (Michael, 2003). Lastly, terms for monitoring and enforcement required for landowners to receive subsidies are costly to administer further draining government funds (Boyd et al., 2000).

2.4.2 Fee-Simple Land Purchase

The use of fee-simple land purchase is the simplest method for acquiring land for conservation. Land targeted for protection is purchased outright to prevent development of any sort. While this appears to be the ideal way to preserve land, it has three financial disadvantages.

2.4.2.1 Benefits of Fee-Simple Purchase

One of the primary methods of acquiring land has been the use of fee-simple purchases, which transfer full ownership to the buyer (Barbec and Smith, 2002). The two reasons for utilizing fee-simple purchases are 1) financial impact on governing entity and 2) land use restrictions. Fee-simple purchases carry little burden on the owning entity for monitoring property and require only a simple transfer of real estate ownership. Additionally, full ownership by either a governmental or non-governmental entity precludes incompatible land uses on purchased land (Boyd et al., 2000).

2.4.2.2 Drawbacks of Fee-Simple Purchase

While fee-simple purchases of land provide total control over the purchased land use, there are three disadvantages. First, full purchases of property are expensive and quickly deplete funds, limiting the amount of property that can be protected. Compounding the costs are supply and demand: as supply of property decreases and demand rises the cost of the remaining land increases (Innes et al., 1998; Michael, 2003). Second, landowners who anticipate condemnation and purchase of their land may inflate the value of the property. This is done by investing in infrastructure, thus increasing the purchase cost of the land, which may reduce the ecological value of conserved land (Blume et al., 1984; Farber, 1992; Innes et al., 1998). Third, complete purchases of property may exclude compatible land uses such as farming, which cannot be managed effectively by local government (Boyd and Simpson 1999; Boyd et al., 2000).

2.4.3 Tradable Development Rights

Tradable development rights or TDRs are a method of conserving land within a defined geographic region where development rights may be traded. Three benefits associated with this approach are the creation of open space, the creation of natural habitat, and the preservation of land. However, TDRs cannot address issues of value, fragmentation, and financial burden to various groups.

2.4.3.1 The Function of TDRs

Tradable development rights work in two way’s by restricting land use and by allowing trading of these restrictions. Land use restrictions are set on a portion of the

property limiting the type of development that may occur such as farming (Daniels, 1997). These land use restrictions can be traded between designated sending and receiving areas (Arendt, 1997). Sending areas are regions where land use restrictions may be allocated, while receiving areas accept development rights (Daniels, 1997). For instance, if 10 acres of property are restricted, those acres may be transferred to another property that lacks development constraints. Thus, the sending area would lose 10 acres of allowable development while the receiving area would gain 10 acres of development rights (Brabec and Smith, 2002; Innes et al., 1998; Mountford and Keppler, 1999).

2.4.3.2 Benefits of TDRs

Tradable Development Rights have been cited as an inexpensive method to protect agricultural land, historical areas, and open space in three ways (Pfeffer and Lapping, 1994; Strong, 1987). First, they create open space in a subdivision by protecting land with restrictions. These restrictions permit parkland or low impact uses like playgrounds, for example. Second, the open space created by TDRs provides habitat for wildlife (Arendt, 1997). Third, TDRs may preserve large amounts of land over large geographic regions (Brabec and Smith, 2002).

2.4.3.3 Drawbacks of TDRs

While TDRs may protect large amounts of land and create open space, they can fail in three ways. First, land preserved by this method may lack connectivity leading to fragmented greenways (Daniels, 1997). Second, since TDRs function best over large geographic regions they often cross governmental boundaries. This results in some

jurisdictions having more conserved land and others having less. Third, TDRs do not necessarily prevent the most ecologically sensitive areas from being developed because equal market and ecological value is assumed (Boyd and Simpson, 1999). For example, the market value of land maybe $200 an acre while the ecological value maybe higher.

TDRs carry additional hidden costs that impact regulating entities, landowners, and developers. First, regulating entities pay higher costs via enforcement of land use restrictions. Second, landowners may have to forgo certain development potential. For instance, land use restrictions may prevent residential or commercial development, but may allow for less profitable land uses such as nature tours. Third, developers must purchase development rights adding to their overhead costs (Boyd and Simpson, 1999). In this event developers must find land for sale that can act as a sending area for restrictions. This can be difficult and costly to accomplish in small geographic regions (Brabec and Smith, 2002; Strong, 1987). These financial impacts result in a lack of political will to use TDRs because it is viewed as an illegal use of governmental power by local governing bodies. Courts, however, have upheld their legitimacy in numerous cases (Arendt, 1997).

2.4.4 Zoning

Zoning has long been used within the United States to control land use and for the preservation of land. Because of zoning's power to regulate land use, it has become a powerful tool in protecting greenways. First, it does not impact taxpayers the way subsidies and fee-simple purchases do; second, it can target specific areas; third, it can be

quickly implemented. However, zoning tends to carry heavy costs for enforcement and regulation and can lacks permanence over time.

2.4.4.1. Intent of Zoning Restrictions

The control of land use in the United States is commonly achieved through zoning regulations (Daniels, 1997). The creation of zoning as a tool by the state of Oregon in the 1970's stemmed from political pressure to control land use (Brabec and Smith, 2002; Bowles et al., 1998). Since its conception, zoning has been upheld by U.S. courts as a lawful use of governmental power so long as the economic value of the land remains (Daniels, 1991; Lapping et al., 1989). The original intent of zoning was to address limited environmental resources expanded to address issues of sustainable urban growth and pollution. Through zoning, environmental resources can be protected, buffered and managed from the impacts of urban growth (Arendt, 1997; Bowles et al., 1998; Lapping et al., 1989).

2.4.4.2 Zoning Protection of Greenways

In College Station, the use of agricultural open space (A-O) zoning is currently used to protect greenways (City of College Station, 1999; City of College Station, 2003b). A-O zoned are areas used for agriculture and low-density development within the city limits (City of College Station, 2003b). Low-density development, defined by Daniels and Arendt, is either one or two acres per dwelling unit or as land in which one-half to two-thirds of parcel's are set aside for conservation (1997). The intent of such districts is to minimize the impact of both new development and the removal of natural

resources (Arendt, 1997). In addition to the use of A-O zoning, overlay districts may also be used. Overlay districts consist of specially designed areas that go beyond restrictions applicable to traditional zoning. In the case of A-O overlay districts the function is to preserve portions of parcelized property that are deemed as environmentally important (Barbec and Smith, 2002).

2.4.4.3 Benefits of Zoning

The use of zoning is seen as the first line of defense in safeguarding land from conflicting land uses (Gustanski and Squires, 2000). It does not shift the burden to taxpayers or developers, as do subsidies or taxes (Daniels, 1991). Zoning can target specific portions of land unlike subsidies and taxes, thus protecting the most important ecological areas (Boyd and Simpson 1999; Boyd and. Cabellero., 2000). Additionally, it can provide protection in areas where permanent protection methods are unfeasible because of political or economic reasons (Arendt, 1997). Thus, the long-term usage of zoning is more cost effective than fee-simple purchases of land (Daniels, 1997).

2.4.4.4 Drawbacks of Zoning

The perception of inexpensive or cost-free protection has led some to believe that zoning carries no implementation or utilization cost, which is incorrect (Boyd and Simpson, 1999; Daniels, 1997). Zoning costs can be prohibitively high because of enforcement costs, regular zoning changes, the need to identify areas requiring protection, and the lost economic earning potential of land (Bowles et al., 1998; Boyd et al., 2000).

The cost associated with zoning is not its only drawback. Zoning is not permanent and tends to change over time. This change is motivated largely by political and development pressures. It is often viewed as a quick fix to respond to political pressure and to delay development until better guidelines can be developed (Daniels, 1997). Zoning changes can result in the loss of greenway connectivity (Barbec and Smith, 2002; Pfeffer and Lapping, 1995). In addition, identifying areas to be protected by zoning is expensive, resulting in poor acquisition of greenways due to limited budget (Boyd and Cabellero, 2000). Because of the impermanence of zoning, it is considered an imperfect tool to protect land in the long term (Daniels, 1991; Daniels, 1997).

2.4.5. Conservation Easements

Conservation easements are the most powerful tool used today for preserving land by targeting specific areas and precluding specific uses. These precluded uses are often detailed in contracts that define the landowner's rights and the regulating entities powers. This benefits both landowners and regulators monetarily through tax deductions and less than fee purchases while still preserving greenways. However, fragmentation of greenways may occur, costs for acquisition remain high, and imperfect information concerning true land value all exist. This has led to the development of a new method termed the two-step approach, which addresses the main concerns of conservation easements.

2.4.5.1 How Conservation Easements Function

Conservation easements are partial interest easements where portions of property rights are transferred to a regulating entity (Boyd et al., 2000; Mountford and Keppler, 1999). These rights include such elements as mineral and development rights that transfer to the regulator, but do not preclude the use of the land for unregulated activities (Boyd and Simpson, 1999). Conservation easements remove the right to all or specific types of developments from the "bundle" of rights, such as residential use (Gustanski and Squires, 2000). These rights are transferred to either a governmental or non-governmental entity (Innes et al., 1998; Patney, 2000).

There are three standard practices that have led to wide acceptance of conservation easements by landowners. First, owners retain the title to the property and may sell or develop the land, although the easement follows the title in perpetuity (Daniels, 1991; Innes et al., 1998). Second, public access is often forbidden on the conserved land (Daniels, 1991; Mountford and Keppler, 1999). Donations or sales of easements are voluntary and thus viewed as fair unlike that of command control regulations, such as zoning (Boyd and Simpson, 1999; Coughlin and Keene, 1981).

2.4.5.2 The Establishment of Conservation Easements

The establishment of a conservation easement is accomplished either through purchasing of the land or its donation. If land is purchased, the value of the easement is determined by the difference in property value before the easement is enacted and the value after restrictions are imposed (Gustanski and Squires, 2000; Michael, 2003). These values are based upon fair market values as determined by an appraiser and are purchased

using public funds raised through taxation or bonds (Brabec and Smith, 2002; Innes et al., 1998; Pfeffer and Lapping, 1994). Donated land may be used as a tax deduction if IRS tax guidelines are met (Strong, 1983). The deductible amount is determined using the same method used to derive the purchase price (Patney, 2000).

2.4.5.3 Contracts

Easements also offer the ability to protect land in perpetuity depending on the content of the contract (Pfeffer and Lapping, 1994). While contracts may limit the time span an easement is valid to a few years, it is often bound to the property permanently (Daniels, 1997; Gustanski and Squires, 2000). This is due to reductions of costs associated with renegotiation of restrictions, requirements for tax deductibility by the IRS, and contract length (Boyd and Simpson, 1999; Francell, 2000; Gustanski and Squires, 2000; Strong, 1983). Because of these issues, contracts share basic uniformity as outlined in Table 1.

2.4.5.4 Advantages of Conservation Easements

Conservation easements have three advantages for use in protecting greenways. First, they function as tax write-offs for landowners, encouraging the establishment of an easement (Patney, 2000). Second, specific portions of land can be targeted for protection indefinitely (Daniels, 1997; Mountford and Keppler, 1999). Third, easements are inexpensive to implement, administer and enforce (Boyd and Simpson, 1999; Patney, 2000).

Table 1: Conservation Easement Contract Elements. The table depicts the principal elements common to conservation easement contracts (Adapted from Boyd and Simpson, 1999).

Element	Description
Descriptor	Outlines the intent of the easement, pre-existing environmental conditions, and metes and bounds of the property.
Auditing	Stipulates any environmental audits needed for the property and concerns to be addressed before the easement is enacted.
Limitations	Defines what types of land uses are not permitted under the easement.
Seller Rights	Defines the rights remaining to the property owner.
Management of Land	Outlines the responsibilities of the landowner in managing the land placed under the easement.
Access	Defines when and why the conservator or others may enter the easement for monitoring of contract terms.
Unencumbered Ownership	Owner must demonstrate that no liens are made against the property for outstanding debts.
Contract Ramifications	Defines legal and remedial actions that each party may seek in the event the contract is breached.
Element	Description
Conservators Liability Limitations	Conservator is exempt from any liabilities associated with the land caused by the property owner.
Title Transfers and Easements	Outlines how the easement is bound to the title in perpetuity unless otherwise noted.
Terms of Sale	Defines form of payment and any deadlines or obligations that are to be met under the terms of contract.

The use of easements has increased over the last several years because of their use as tax deductions (Daniels, 1991; Gustanski and Squires, 2000; Pfeffer and Lapping, 1995). Because of this, easements have served as an incentive to donate land for conservation (Michael, 2003). Tax regulations allow land donations to constitute up to 30% of adjustable gross income a year for up to six years (Daniels, 1991). The IRS, however, requires four criteria to be met to receive tax deductions for donated land. First, conserved land may not inhibit development (Diehl and Barrett, 1998). Second, the

donated land cannot be under greater than moderate development pressure. For example, no adjacent sewer or water infrastructure is permitted, but development in the general area is allowed. While the term “general area” is ambiguous, the intention of the water/sewer stipulation is to prevent infrastructure from encroaching on the conserved land. In addition, the IRS discourages the donation of land for tax deductions that are expected to experience future growth impacts. This is because areas experiencing increased development pressure may exceed the government’s ability to secure easements, leading to greenway fragmentation (Daniels, 1991). Third, land that has a conservation easement is permitted a tax deduction on estate tax for up to 40% of the value of the subjected land. Combined, the donation and estate tax deduction have led to considerable land preservation (Innes et al., 1998).

Conservation easements also have the ability to target specific portions of property (Mountford and Keppler, 1999). This allows only the land needed for conservation to be protected. The remainder of the property outside the easement may be developed as desired (Innes et al., 1998). Thus, the protected portion may be used for habitat conservation or open space while the remainder can be developed into residential neighborhoods or other uses (Daniels, 1997).

Conservation easements have also reduced cost compared to other methods. Easements are widely utilized for public infrastructure and access so governmental structure already exists to manage easements. The existing administrative structure reduces cost versus the creation of a new system, such as TDRs that are not used in College Station. Second, payment of partial interest is less costly than fee-simple purchase of land allowing for more land to be purchased (Boyd and Simpson, 1999).

Finally, many contracts specify that landowners must enforce the terms of the agreement regarding the easement, removing the financial burden on government (Michael, 2003; Patney, 2000). This is done because the landowner has an interest to adhere to the contract or face losing the tax deduction and paying a financial penalty. Landowners are more efficient at managing certain land uses than a regulating entity would be (Patney, 2000). For example, a landowner who uses the land for farming would be more efficient than local government given the same usage.

2.4.5.5 Drawbacks to Conservation Easements

Conservation easements alone cannot conserve land for three reasons. First, greenway fragmentation may occur due to their voluntary nature reducing the effectiveness of land conservation. Second, easements can be expensive to purchase (Daniels, 1991; Pfeffer and Lapping, 1995). Third, proprietors of the easements regularly do not have the background to assess the value or manage land efficiently (Boyd and Simpson, 1999).

Due to the voluntary nature of conservation easements, sporadic parcels of land may be acquired causing fragmentation. Additionally, easements granted in perpetuity tie up money in land that may no longer have ecological value. Removing the easement often requires a court order unless the contract stipulated joint abandonment. Thus, if both the owner of the easement and titleholder agree to abandon the easement, it is then nullified (Daniels, 1991).

While conservation easements may be less expensive than fee-simple purchases of land, they still comprise a large percentage of the outright purchase price (Daniels,

1991; Pfeffer and Lapping, 1994; Pfeffer and Lapping, 1995). In areas experiencing high development pressure it is often exceedingly expensive to purchase property causing a potential loss of valuable land (Arendt, 1997). The costs associated with properly assessing and applying a conservation easement may also be high (Boyd and Cabellero, 2000).

In addition to the financial costs associated with conservation easements are lost opportunity costs. Easements may restrict compatible development, such as residential parks, that would still maintain land in an ecologically beneficial state. The problem of lost opportunity costs are exacerbated as conservators often do not have the knowledge to properly assess land either to its potential future use or compatible land uses (Boyd et al., 2000).

2.4.5.6 Two-step Conservation Easements

Two-step conservation easements, as proposed by Jeffery Michael, is a method that address the shortfalls of traditional conservation easements including greenway fragmentation, implementation and voluntary donations (Michael, 2003). Two-step conservation easements utilize two separate functions to achieve conservation goals. First, it utilizes condemnation of property to obtain the land. Condemnation of land occurs when government seizes land in the interest of the public good. The owner of the land is then compensated fair market value of the land rights that were taken. Second, after the easement has been installed, the land is then sold back to the owner at the cost it was purchased (Michael, 2003).

This method thereby gives government the power to take contiguous tracts of land to ensure that fragmentation is prevented. This method not only provides a means to circumvent uncooperative landowners, it increases the government's ability to negotiate agreements with other landowners and reduce costs. By utilizing the threat of condemnation, landowners do not tend to holdout for higher prices knowing that the land can be taken outright. Also, incentives can be given to owners who cooperate by donating land in the form of a cooperation bonus. For example, a payment may consist of a portion from administrative costs saved by not condemning the land. Finally, both condemnation and easements are already used by governments and thus incur little additional implementation costs (Michael, 2003).

CHAPTER III

RESEARCH METHODS

3.1 Objectives

The overall goal of this research is to create a comprehensive set of methods for greenway acquisition to facilitate implementation of greenway preservation in urban planning. Specific objectives include:

1. Compare existing methods to establish a baseline for improvement;
2. Evaluate local practices regarding greenway acquisition to make methodological improvement; and
3. Apply the improved methodology to develop a better-fit greenway acquisition framework based on growth trends and on GIS modeling.

3.2 Study Site

This research used the City of College Station, Texas, as the study site. The city has a total of 47.3 mi^2 in area and is rapidly growing South/Southeast. The population has grown from an estimated 69,000 in 2000 to 78,000 in 2003. The level of development in the city during the past four years has drastically increased. During this period, the number of new development projects has averaged approximately twenty-two per year, an increase of almost two hundred and fifty percent since 1992 (City of College Station, 2003a). This phenomenal growth creates pressure on the city's reserve of seven proposed greenway linkages. Thus, the knowledge gained from the case of College Station can be utilized by other cities that face similar situations.

3.3 Research Methods

This study first examined and compared existing greenway acquisition methods to establish a matrix of norms. Based on the norms, an of evaluation was conducted to gain insight into factors contributing to the desired locales for placing greenways. Information generated from the evaluation was then incorporated into a GIS-based ranking model to assess the adequacies of the existing Greenways Master Plan of the City of College Station.

3.3.1 Comparison and Evaluation of Existing Greenways Acquisition Methods

Currently the City of College Station is not systematically acquiring land for greenways. Instead, land is being purchased in response to development pressure. The ad hoc approach to land acquisition has led to fragmented greenway preservation. Therefore, comparison of existing greenways acquisition methods is a critical endeavor to establishing a baseline of the pros and cons and the applicability of the various methods.

3.3.2 Evaluation of Practices Regarding Greenway Acquisition

The outcomes from the above comparison were used as a reference to evaluate greenways acquisition practices at College Station. A growth model of potential future development impacts was generated. The model consisted of evaluation of development trends to determine the yearly total urban growth. To accomplish the objective, necessary data sources were compiled. City limits after annexation information were gathered for use within the predictive model. Finally, maps for the Greenways Master Plan and past property acquisitions were collected.

3.3.3 GIS-based Ranking

Ranking of College Station's Greenways will utilize modeling of future development generated within a Geographic Information System. The model takes into account the spatial growth of College Station through the use of past annexations. Annexation is a good indicator of growth as it tends to follow sewers and highways, which are associated with development (Kelly, 1993). To determine past growth trends, a weighted average distance and direction grown per five-year interval over the last twenty years was calculated. The average distance and direction based upon weighted annexed areas from the last annexation that occurred in 2002 was used to determine potential for future growth impacts on the current greenways plan.

The data for the model consisted of two primary sources: the Greenways Master Plan information and College Station city limits after annexation. The greenways data, comprised of the one hundred and five hundred year floodplain, was created by Federal Emergency Management Agencies (FEMA). This data was then made to fit the 1996 jurisdictional boundaries of the City of College Station city limits byway of clipping the floodplain data to the city limits. The College Station city limits used for this study date from 1982 and extend to the current city limits established in 2002. The time range was then grouped into five-year intervals. The boundaries of each annexed year were determined by surveyed metes and bounds originally stored in Computer Aided Design software. This data was then converted to a GIS compatible shapefile for use within ArcGIS. The weighted center of each five year group by area was then determined and represented as points.

The points were then used to determine if a linear trend in distance or direction occurred. This was accomplished by measuring the distance from one point to the next beginning at 1982 and going sequentially to 2002. The four distances measured were then averaged to determine the growth rate over an average growth during a five-year period. Using the data as a predictor of growth, a future trend line was approximated to the potential for the continued growth of College Station's city limits.

The potential future growth line was calculated with origin at the 2002 annexation weighted center. From the origin the average distance and direction as determined from evaluation of past trends was used to model potential growth in relation to the proposed greenway areas. This was accomplished by using the past twenty year data and estimating a best fit trend line. Using the estimated trend line and the average distance grown for the past twenty years for a five year interval, the potential for future growth was derived. This potential for future growth was characterized by a line representing distance grown during the next twenty years in relation to the proposed greenways, allowing predicted growth to be seen in relation to greenway areas.

Portions of the existing greenways plan were excluded from ranking based upon fragmentation and development within designated greenway areas. Fragmentation of greenways were determined by whether or not the greenway network remained connected to the overall system. Areas that were no longer connected to the rest of the network were excluded based upon the reasons outlined in 2.1.1. Fragmentation in all areas, defined as disconnected, were caused by cut-through of roadways. Developed areas were determined from aerial photography flown in 2002 at one-foot resolution. Areas that were identified as containing housing or those that had been lined with concrete and

straightened were excluded. These exclusions were made so that areas that were undeveloped and remained in a more natural status could be acquired because of their higher ecological, economic and cultural value.

The modeled potential growth of the city along with existing development pressures in the vicinity of greenways was then used to rank the order of acquisition for each continuous greenway area. Greenways were removed from the ranking scheme if they were fragmented to the point that there was no longer connectivity to the larger system. These were excluded because of the inability of the areas to support health plant and animal populations (Jongman, 2003). Second, areas that are already developed were excluded from ranking. Many of these have structures in them or areas that are lined fully or partially lined by concrete and have been straightened. These were all the areas west of Earl Rudder Freeway and State Highway Six and were removed from consideration. These areas suffered from both existing development within the designated greenway area and fragmentation from the existing greenways structure (Figure 2).

3.3.4 Synopsis of Information for Greenways Decision Support

The evaluation of the acquisition of the City of College Station's greenways was based upon both academic research and comparison of acquisition methods. These were then be evaluated on criteria important to the City of College Station. These factors were immediate protection of greenways, long-term protection, low cost and political pressure.

Recommendations were made based on both the evaluation of acquisition methods and the model results. These included which land to acquire in what order based on development potential and how best to obtain them. This is important so that land is

not attained in an ad hoc way to preserve connectivity. The process for accomplishing this is depicted in Figure 2.

Maps depicting the historical growth, predicted growth trend, and current greenway plan were then created. Based on the data an additional map depicting a re-ranked acquisition plan was then generated. The ranking first targeted greenways that were under the most pressure from development and went on to rank areas under the least pressure. In addition, areas that no longer presented value ecologically or contributed to connectivity were excluded from the ranking (Figure 3).

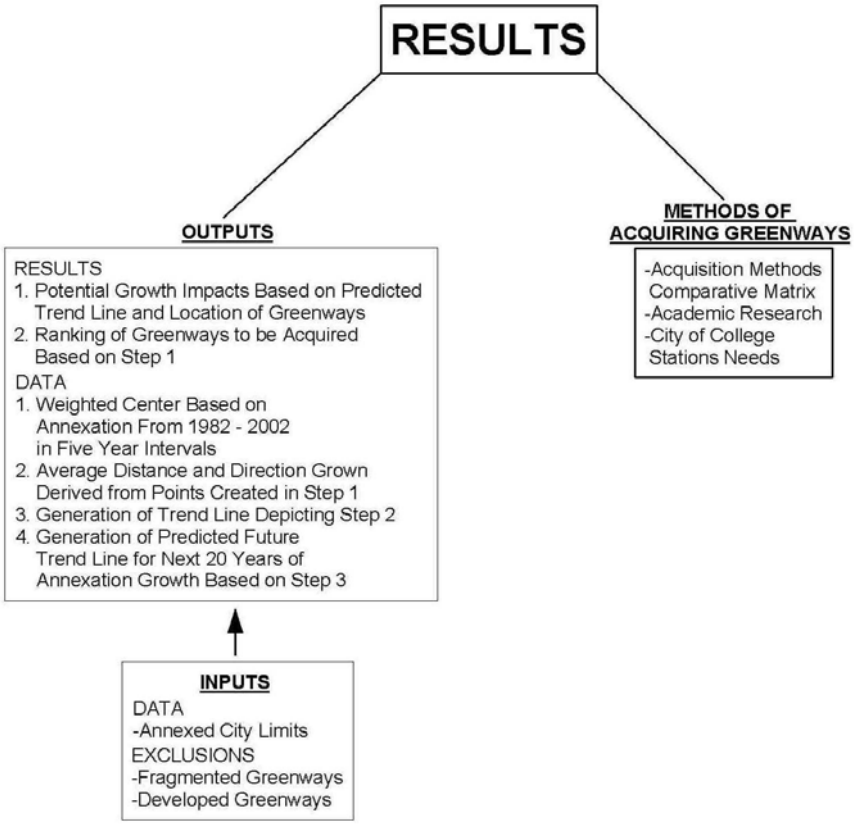

Figure 2: Decision Making Process Flow Chart. The chart depicts the methodology regarding the growth model, the acquisition methods and the input into the resulting conclusion.

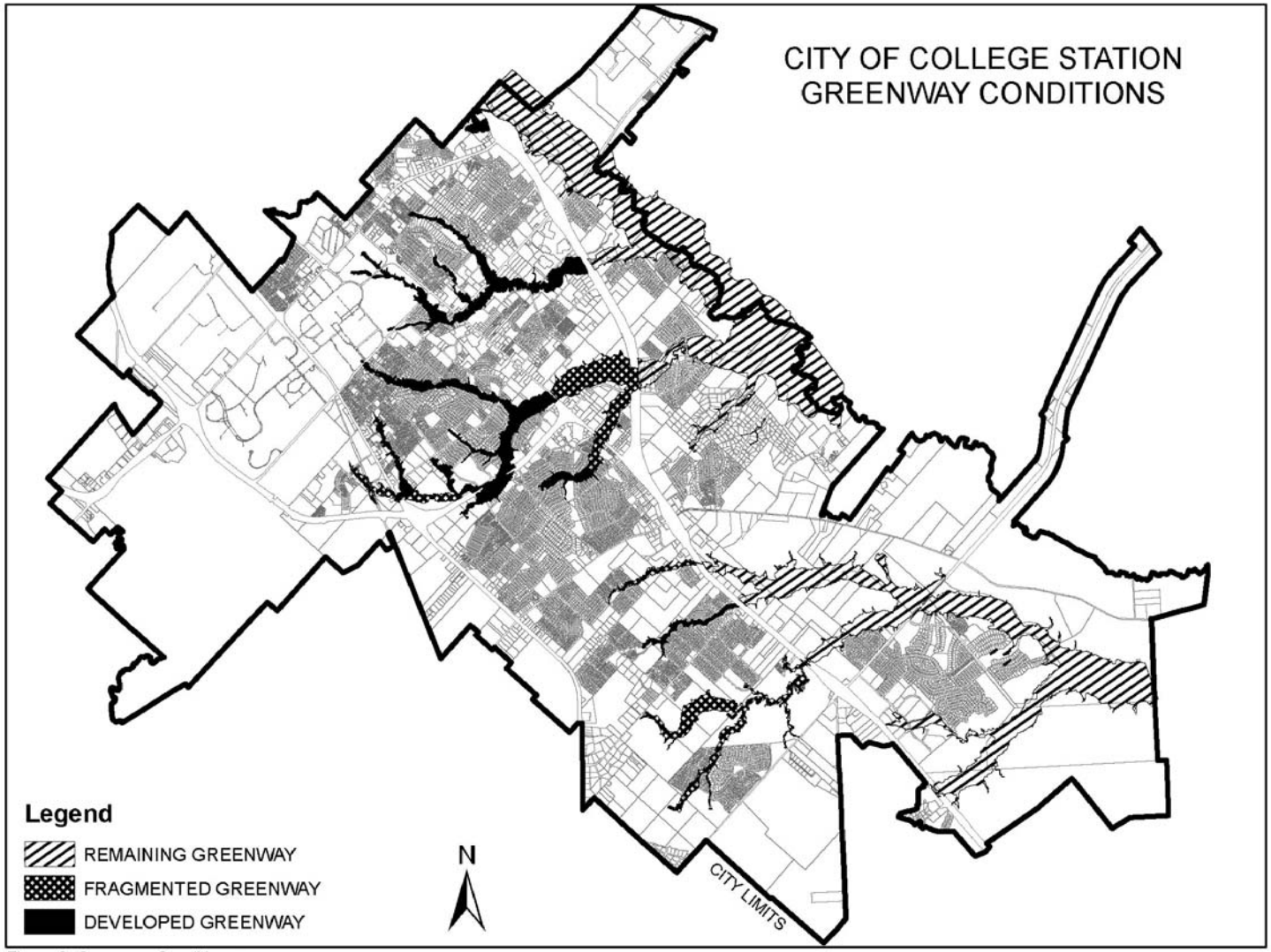

Figure 3: Greenway Conditions

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Results

This chapter discusses the results of both the ranking of greenways and the recommended methods of acquisition. The re-ranking, based on the growth model, proposes an improved order for obtaining greenways as proposed by the Greenways Master Plan. The methods for acquiring land were based on research and local conditions.

4.1.1 Model Results

The results of the model indicate a south/southeast trend in the City of College Station's annexed growth. The trend averaged three thousand feet of growth over a twenty-year time span (Figures 4 and 5). The resulting trend indicates that much of College Station's future growth will encroach upon the remaining unfragmented and undeveloped sections of greenway outlined within the city's plan.

Prior to ranking the order of acquisition based upon the potential growth model and existing development pressure, all the areas west of Earl Rudder Freeway and State Highway Six were removed from consideration. These areas suffer from both existing development within the designated greenway area and/or fragmentation of existing greenways structure. Once developed and fragmented areas were removed from consideration, five areas or portions of areas remained to be ranked. These five areas consist of Lick Creek, Alum Creek, Carter Creek, Wolfpen Creek, and Bee Creek. These

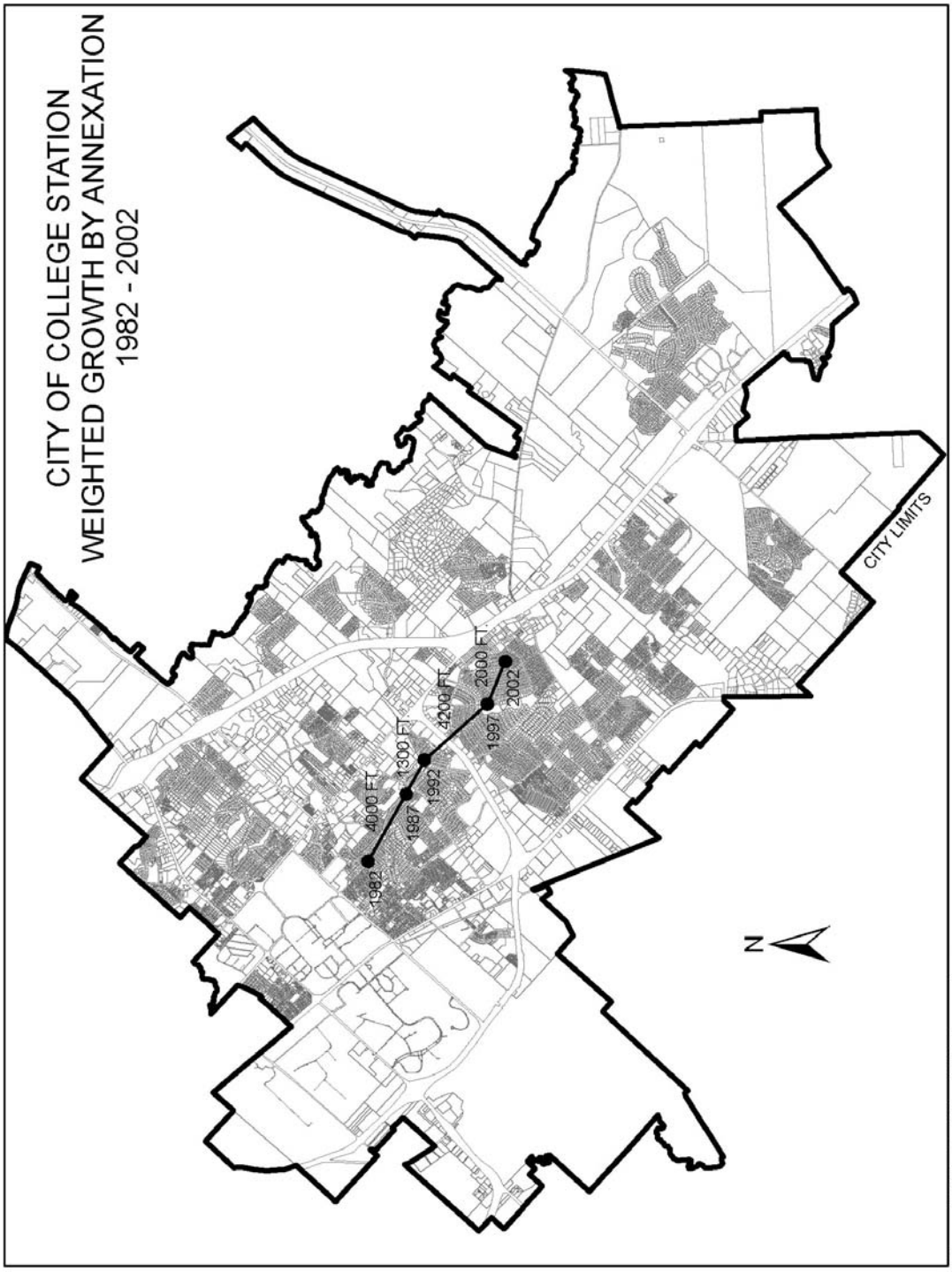

Figure 4: Weighted Growth By Annexation

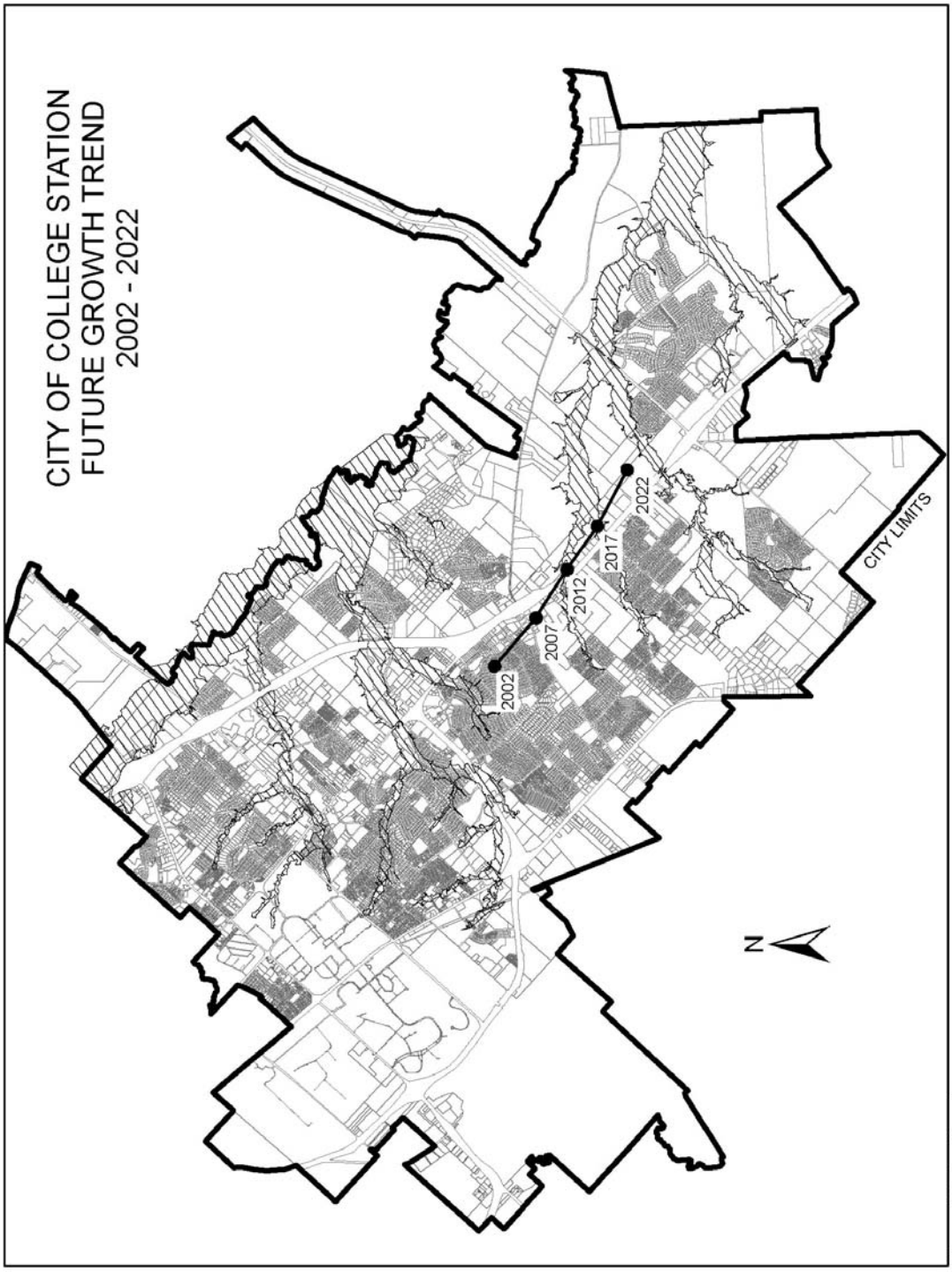

Figure 5: Future Growth

creeks were designated as a functional unit for ranking each greenway section within the city's greenway plan. Areas of importance for greenway acquisition were ranked from one to four, with four being the most important and four being the least important (Figure 6).

The area deemed most important based upon the criteria was the area around Lick Creek. Due to the results of the growth model's trend toward the south/southeast, Lick Creek was the first area impacted by predicted growth. Because of this, it is imperative that it be acquired first to prevent large-scale development impacts. The second area of importance is Alum Creek for the same reasons as Lick Creek. Because it is further south than Lick Creek, it will likely be impacted by development after Lick Creek.

The third ranked area for greenway acquisition was the Carter Creek area. This area was not within the model's projected growth impact area and does not suffer from much existing development impact. Most of the existing impact is to the west side of the creek with none expected on the east side. This is because there are no existing developments or infrastructure, such as roads, that would attract development.

Finally, Wolfpen and Bee Creek are equally ranked fourth for the purpose of acquisition based upon potential growth impact. Both of these areas are already encompassed by growth, but remain undeveloped and connected to Carter Creek. Because they remain connected, they add to the overall area preserved within the greenway plan. However, these areas should be acquired last because the areas are already built out to include the creeks as part of the neighborhood fabric, and are therefore not as likely to be subjected to further development pressure in the future.

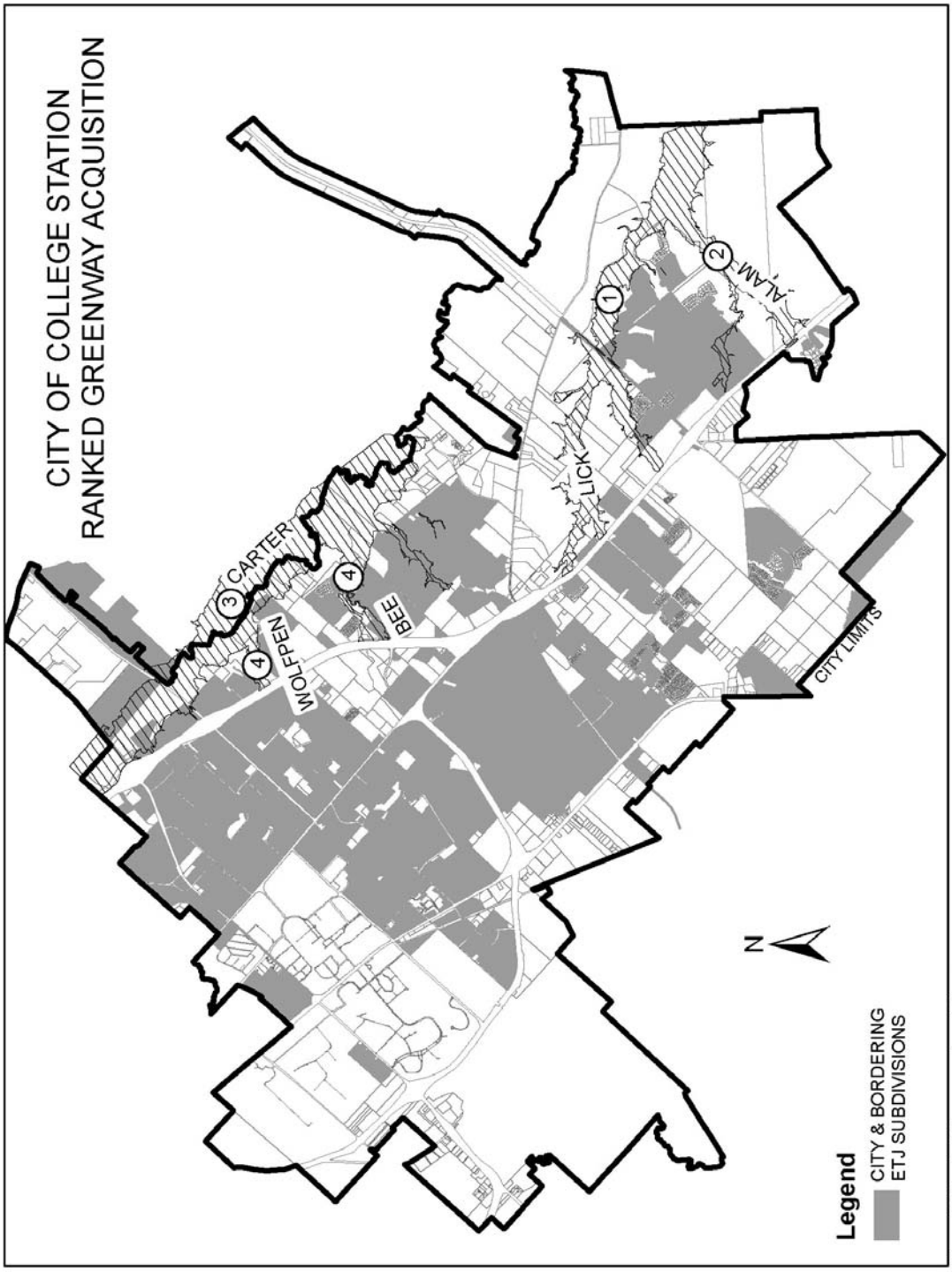

Figure 6: Ranked Greenway Acquisition

4.2 Method for Greenway Acquisition

In the development of a method for acquiring land, thirteen criteria have been used in comparing various methods for obtaining land: compensation to owner, tax incentives, cost to governing entities, political pressure, allowable alternative land uses, applicable scale of method, complexity of implementation, voluntary cooperation of owner, required enforcement, how quickly the method can be implemented, ability to target specific property, and permanence. Table 2 depicts the layout of the comparison scheme based on these criteria. In addition, these methods were compared to the City of College Station's need for immediate protection of greenways, long term protection, low cost and little political pressure.

Table 1: Land Acquisition Method Scheme Comparisons. The table depicts the comparison of various factors important to acquisition of greenways. This was then used in the evaluation of best practice for the City of College Station based upon local conditions.

	SUBSIDIES/TAXES	FEE SIMPLE	TDR	ZONING	CE	CE: 2-STEP
OWNER COMPENSATION	X	X			X	X
TAX INCENTIVES	X				X	
HIGH COST TO GOVERNMENT	X	X	X		X	
POLITICAL PRESSURE	X		X	X		X
PERMITS LAND USE	X		X	X	X	X
SMALL SCALE	X	X		X	X	X
LARGE SCALE			X			
COMPLEX IMPLEMENTATION	X		X			
VOLUNTARY	X*	X**		X		X
REQUIRES ENFORCEMENT	X		X	X	X	X
SPEEDY IMPLEMENTATION				X		
TARGETS PROPERTY		X		X	X	X
PERMANENT		X	X		X	X

X = Yes; * = Subsidies only; ** = Without condemnation

Using the comparison of each method outlined in table 2 to the criteria of College Station and academic research, the following techniques were eliminated. Fee-simple and subsides were eliminated due to high cost associated with full purchase of property and cost to tax payers to prevent development in areas that were not usable to the public. Subsidies and tradable development rights were not considered either because they are unable to target specific properties. TDRs, in addition, require large geographic areas that are typically done statewide.

After eliminating these, zoning and conservation easements were chosen to acquire land toward the city's greenway plan. Zoning is an existing means used within the city to protect land, thus it is easily implemented. Additionally, taxpayers do not bear any costs. However, since zoning can change a more permanent solution is needed. Conservation easements fit this solution by creating permanent protection of the land. Furthermore, it rewards conservation through tax breaks from the federal government. In cases where landowners are unwilling to adopt conservation easements, Michael's two-step conservation easements can be used. This method proposes the taking of land temporarily to establish an easement and then returning it to the owner.

While these two methods have high costs and are partially subjected to political pressure, they are less than others. The cost of enforcement of both zoning and conservation easements are negligible in College Station. The reason for this is that both easements and zoning regulations are already in use and policed. Thus, little additional cost would be added to an already existing function.

4.3 Potential Problems

A potential problem with the model's usage is if annexation does not occur in a linear direction. For instance, growth occurring to the east or west could skew the trend in either direction. This, however, is not a substantial problem in College Station regarding growth impacts on greenways for two reasons. First, areas to the west have no designated greenways. Second, the city is bound to grow predominantly southward as it is bordered by the City of Bryan to the north. While potential annexation to the east is possible, it is unlikely to affect the model as little land available due to the City of Bryan's ETJ boundary there. Additionally, development is not likely to occur as no substantial amount of infrastructure exists, which annexation typically follows (Kelly, 1993).

CHAPTER V

CONCLUSION AND FUTURE WORK

5.1. Conclusion

Although the City of College Station has lost all of the areas designated for greenways in the core portion of the city lying between Wellborn Road to the west, Earl Rudder Freeway to the east and Rock Prairie Road to the south to fragmentation and development, it can still preserve a large portion of the overall greenways plan by acquiring land ahead of development pressure. In addition, areas to the south of Rock Prairie Road that are no longer connected to the rest of the greenway system could be recaptured. This could be accomplished by the methods outlined by Rob Jongman to restore connectivity of greenways (2003).

To conserve the remaining greenways, the approach recommended from this study would be two tiered. To acquire land, a combination of zoning and conservation easements advocated by Daniels is recommended, but substituting Michael's two-step approach in place of traditional easements (1991; 1997; 2003). Zoning lends itself well to preserving greenways because it is virtually costless to the public, easily implemented, and already utilized by the City of College Station (City of College Station, 1997; Daniels, 1991). However, because zoning is impermanent, it must be combined with conservation easements that can secure land in perpetuity. To reduce the cost of acquiring conservation easements and to prevent greenway fragmentation, the two-step method should be utilized to increase the efficacy of greenway conservation (Michael, 2003).

With this recommendation, the city would also need to place priority on obtaining greenways in a more systematic manner to account for potential development pressure. Using the model results, it would be better able to pursue land acquisitions ahead of development instead of responding to it. Adhering to such a plan would cease the fragmented nature of their acquisitions thus far and ensure a more connected and healthy greenway system.

In addition the city must broaden its jurisdictional powers for governing greenway usage beyond current city limits. This expansion of authority should encompass the extra territorial jurisdiction, which is predominantly undeveloped. Given the lack of disturbance, the land in this area lends itself well to preserving large areas of land for creating a connected regional greenway system. Further more, College Station should use its experience and regional economic influence to help expand greenway preservation into surrounding communities and neighboring counties.

College Station must also expand the definition of greenways beyond that of the FEMA floodplain. While preservation of the floodplain preserves biological diversity of species inhabiting those areas, it fails to preserve species that do not use such areas as habitat. Thus, College Station must look at such places as upland post oak savannas and similar areas. Conservation of areas outside of floodplains helps to further mitigate water pollution and maintain species diversification. Without preserving such areas College Station falls short of maintaining a diversified and healthy greenway system.

To accomplish the expansion of greenway acquisition and to further refine ranking of greenways for acquisition, the City of College Station must perform ecological assessments. While ecological assessments have been performed in the areas to the

Southwest of Lick Creek Park, there has not been a comprehensive study of areas outlined as part of the College Station greenway plan. Such assessments are key to obtaining the most important areas first that serve as habitat to endangered species or provide key roles in the overall system's ecological health. Without performing such evaluations the city bypasses key factors that should influence a greenways program.

To bolster the need for ecological assessment of greenways the city must also develop specific guidelines regulating development surrounding greenways. These guidelines should be developed as part of the subdivision regulations which define development standards. The standards developed for this should be developed in conjunction with the ecological assessment of each greenway area. This would not only be used to broadly define ecologically sound development practices, but allow for specific guidelines to be written for ecologically significant areas that may require more stringent criteria regarding development.

5.2 Future Work

Further research is still needed to explore how to implement a greenways program on a more regional and statewide basis to ensure the preservation of the landscape as a whole. This is particularly difficult since there are few large scale areas set aside within the United States to study and implement such a program. The areas that do exist, such as the Appalachian Trail, are very rural and do not share the development characteristics present in urbanized areas. Because of this, the research conducted by Jongman in the establishment of national greenways should be studied as to how it may be best implemented in the United States (2003).

Also, further research is needed into the economic value of greenways in rural areas. Most studies, thus far, have focused on economic value within urbanized areas and have used that to demonstrate why they are economically important to cities. These studies have not put a dollar value to property that borders greenways or assessed what rural households are willing to pay for greenway preservation.

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