Huron River Watershed Council

POTENTIAL IMPACTS OF TRANSFER OF DEVELOPMENT RIGHTS FOR MICHIGAN COMMUNITIES

The Huron River Watershed Scenarios

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About the Huron River Watershed Council

The Huron River Watershed Council (HRWC) is the first and oldest river protection group in Michigan. Founded in 1965 as a public, non-profit organization, HRWC is a coalition of Huron Valley residents, businesses and local governments established under Michigan's Local River Management Act (253 P.A. 1964). Since its formation, HRWC has grown to be a respected voice for protection of the Huron River and its tributary streams, lakes, wetlands and groundwater.

HRWC has a history and reputation of working creatively and cooperatively to tackle a wide variety of issues facing the basin. HRWC has worked closely with local governments throughout the Huron River Basin to enact local wetland protection ordinances, stormwater management plans, and groundwater protection ordinances. HRWC was instrumental in the passage of several of Michigan's wetland and water quality protection statutes, and in passage of State Natural River designation for the Huron. Today, 40 communities, representing over 500,000 residents, support technical assistance, hands-on education and advocacy programs through voluntary HRWC membership.

The mission of HRWC is to inspire attitudes, behaviors, and economies that protect, rehabilitate, and sustain the Huron River system.

About the Huron River Watershed

The Huron River Watershed is one of Michigan's natural treasures. The Huron River Watershed is a unique and valuable resource in southeast Michigan that contains two-thirds of all southeast Michigan's public recreational lands, supplies drinking water to approximately 150,000 people, supports one of Michigan's finest smallmouth bass fisheries, and is the only designated Scenic River in southeast Michigan . In recognition of its value, the State has designated 27 miles of the Huron River and three of its tributaries as Michigan Department of Natural Resources Country Scenic River under the State's Natural Rivers Act (Act 231, PA 1970). The Huron is home to one-half million people, numerous threatened and endangered species and habitats, abundant bogs, wet meadows, and remnant prairies of statewide significance.

The Huron River basin is located in southeastern Michigan and encompasses approximately 900 square miles (576,000 acres) of seven counties. The main stem of the Huron River is approximately 136 miles long, with its origin located at Big Lake and the Huron Swamp in Springfield Township, Oakland County. The main stem of the river meanders from the headwaters through a complex series of wetlands and lakes in a southwesterly direction to the area of Portage Lake. Here, the river begins to flow south until reaching the Village of Dexter in Washtenaw County, where it turns southeasterly and proceeds to its final destination of Lake Erie.

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TDR is recognized nationwide as a vital tool in promoting smart growth, perhaps the only tool that specifically links increased densities in appropriate areas with actual, permanent protection of open space and farmland in rural areas. However, communities in Michigan have been reluctant to take the step of actually enacting a program, due to uncertainties about how they would implement the program, economic and political feasibility, and community acceptance. At the same time, interest in TDR within the Huron River Watershed has increased recently.

Using simulation modeling for three actual developments in southeastern Michigan, this report examines the impacts of the developments as planned, and then examines the impacts of the developments had they been planned as part of a TDR program. A hypothetical TDR program serves as the background for the modeling. The goal of the investigation was to examine the relative impacts of TDR and its relative application among different communities. Based on the results of the simulation modeling and considering the caveats inherent in the study, this study demonstrates that, in most cases, TDR reduces the impacts of residential development while bringing to bear private funds for land preservation to meet communities' land use goals.

Overall, the project team finds:

- Environmental impacts were reduced significantly and consistently when a TDR program was employed. The reductions in environmental impacts ranged from 9% to 93% across the three developments. In addition, many acres of farmlands, woodlands and wetlands were preserved with a TDR program in place.

- This study finds a clear cost advantage for the developer engaged in a transfer of development rights. Across all of the developments, the costs associated with developing the sites decreased substantially with the TDR alternative.

- In general, the TDR alternative was advantageous for most of the indicators measured for each of the three developments. The four areas measured – fiscal, environmental, societal and transportation – showed a reduced impact when TDR was employed in most situations.

- The results are affected by the locations of the sending and receiving areas because the impacts are spatially dependent. In general, TDR generates the greatest benefits for the Ann Arbor scenario due to the close proximity to the amenities of urban living and less dependency on car travel. Impacts with TDR are not uniformly positive in suburban townships when the receiving sites are located away from existing infrastructure or when service areas are spread out.

Several opportunities exist to expand the scope of this study. Determining the cost of the development right transferred from the sending area to the receiving area would make the developer fiscal analysis more robust. Future research should include a multitude of sending parcels within an identified sending zone and a multitude of receiving parcels within an identified receiving zone in order to simulate more closely the market of willing buyers and sellers engaged in a TDR program. Finally, the results of the project's professional evaluation could serve as a rich vein for mining key audiences' perceptions of TDR in Michigan that would help steer future efforts to increase the use of TDR across the state and to demonstrate the broad interest for state enabling legislation.

The Huron River Watershed Council (HRWC) views TDR as an underutilized land preservation tool to protect natural areas and agricultural land in the Huron River Watershed and throughout Michigan. HRWC, among other activities, will continue to share the results of this study with key audiences throughout the Huron River Watershed and Michigan to increase familiarity with this land preservation tool.

1. INTRODUCTION

A. Demonstrated Need for TDR in Michigan

Unplanned, uncoordinated, low density residential development ("sprawl") in the fringe of urbanized areas in Michigan has long been recognized as one of the biggest threats to the State's economic, cultural, and environmental well being. This spread-out development quickly fragments natural areas and, over time, creates a demand for expensive infrastructure. The density is too low to economically provide urban services, but high enough that expensive road and other infrastructure improvements are necessary and significant degradation of water quality occurs.

National research has documented that even moderately intense development (development that results in over 8-10% imperviousness on the site) spread throughout an area will cumulatively result in negative impacts on sensitive streams. Stormwater from impervious surfaces raises stream volume, velocity and temperatures, and carries sediment, as well as a host of other pollutants into small streams and drains that have limited ability to absorb these impacts. Over time downstream flooding also increases.

At the watershed level, the desired development pattern is easy to describe: new buildings and infrastructure grouped or clustered in a few small areas, leaving large and especially sensitive areas undeveloped. This pattern of development is known as "smart growth."

Transfer of development rights (TDR) is recognized nationwide and in Michigan as a vital tool in promoting smart growth, perhaps the only tool that specifically links increased densities in appropriate areas with actual, permanent protection of open space and farmland in rural areas. However, communities in Michigan have been reluctant to take the step of actually enacting a program, due to uncertainties about how they would implement the program, economic and political feasibility, and community acceptance.

At the same time, interest in TDR within the Huron River Watershed has increased recently, with TDRs proposed by developers in Superior Township and the City of Ann Arbor, a TDR workshop hosted by the Washtenaw County Planning Department attended by more than 200 people, and many Michigan communities drafting ordinances. In addition, the City of Ann Arbor and Ann Arbor, Pittsfield, Scio and Webster townships all participate in an inter-jurisdictional PDR program to create a "Greenbelt" of farmland and natural areas surrounding the City. A recent City of Ann Arbor report, "Recommended Policy Framework for Downtown Ann Arbor" written by Calthorpe Associates recommends TDR to promote compact development.

TDR is increasingly seen as a useful method of preserving land that takes advantage of real estate market forces rather than relying on public coffers to fund land acquisition. The Michigan

What is TDR?

Transfer of development rights is the sale of a parcel's development rights to the owner of another parcel, which allows more development on the second parcel while reducing or preventing development on the originating parcel. Development rights are severed from a lot designated for protection (sending site), and the severed rights are transferred to a lot in a site where additional development is permitted (receiving site). [ii]

Figure 1-1 provides an example of a community transferring development away from wetlands to be preserved to an area where infrastructure and more density exist.

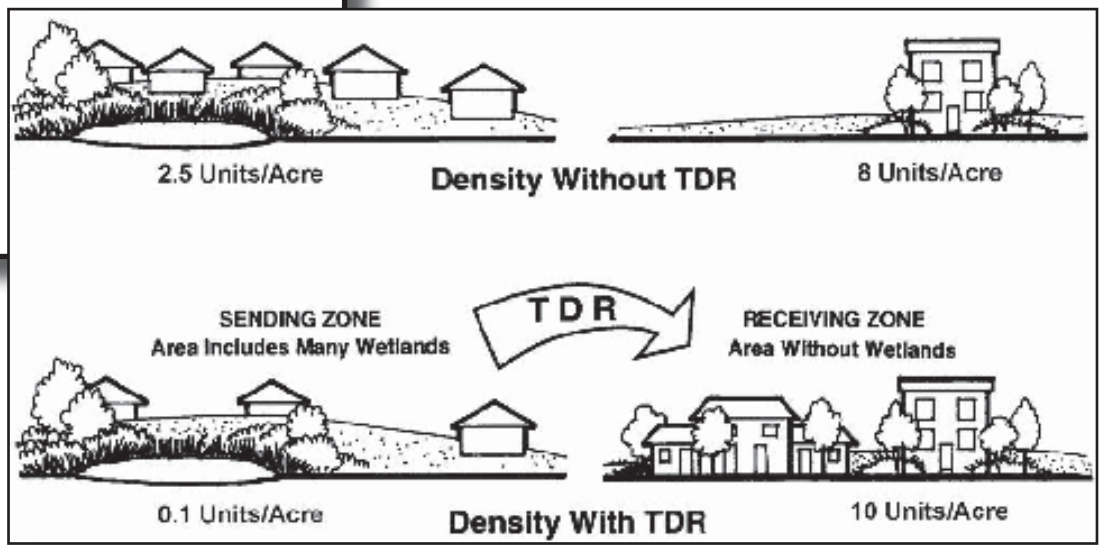


Figure 1-1. Development rights transfer to protect wetlands.

– graphic: Michigan Department of Environmental Quality, 1995, produced by the Planning and Zoning Center

Land Use Leadership Council in its 2003 report recommends a Balanced Growth Strategy (Recommendation #25) that recognizes the desirability of "allowing higher density than is typical where infrastructure and community services are adequate and much lower density than is typical where there are farmland, open space, environmentally sensitive lands, and other resources of high priority for long-term protection and economic viability". The report recognizes TDR as a tool for helping to meet this Balanced Growth Strategy and the need to authorize new tools for local governments to employ this market-driven land preservation and density enhancement technique.

While a handful of communities in Michigan has explored creating TDR programs few TDR programs operate in the state presently. Planning experts have posited several reasons for the lack of such programs, including unfamiliarity with the concept and whether sufficient legal precedent is present in Michigan to enact a TDR program. In fact, the zoning acts were amended to allow a form of TDR in conjunction with Planned Unit Developments (PUDs), and as far back as 1990, planning experts established that there is sufficient legal precedent to establish a TDR program. Certainly, statutory authority that allows the establishment of TDR programs is most desirable to Michigan communities but apparently not necessary. A demonstration of how a TDR program could work locally would be beneficial to Michigan audiences in order to address some of the questions about its effectiveness.

B. Purpose and Scope of Study

The purpose of the study is to analyze the impacts of three residential developments in three Michigan communities, and then analyze the hypothetical impacts of these developments had they been developed using TDR. It role plays how a TDR could work in these communities through simulation modeling. The results show the relative impacts of TDR and TDR's potential application among different communities.

Three existing site plans were selected in the following communities in the Huron River Watershed of southeastern Michigan, and then sending sites were selected from which density was transferred:

Receiving Sites	**Sending Sites**
Highland Township	Highland Township
City of Ann Arbor	Dexter, Webster, Scio townships
Scio Township	Dexter, Webster, Lima townships

The agricultural and natural features at the sending sites would be preserved under the hypothetical TDRs. Site layouts were created for the sending sites showing the development alternatives with TDR and without TDR, and then the impacts were measured for each alternative. Site layouts were created for the receiving sites to illustrate the development potential for alternative densities, and then the impacts were measured for each alternative. Figure 1-1 illustrates the conceptual transfer of development rights envisioned for the Highland Township Scenario. Table 1-2 shows site areas, development densities, and the number of residential units each scenario would yield.

Typically, TDR programs have regions designated for sending or receiving development rights, with regions being several hundred square miles, in some cases. This study focuses on specific sites within hypothetical larger sending and receiving areas for the purpose of applying the suite of indicators to the development alternatives. The site-based approach allows a more targeted analysis of the potential impacts.

The impacts analyzed fall into four overlapping categories: fiscal, environmental, societal and transportation. Indicators for each category were selected and measured for each of the three development scenarios to estimate their potential impact with and without a TDR. Long-term costs were measured where possible, as well. Section 3 provides details on the suite of indicators analyzed to measure impacts of the developments. Section 4 provides the results of the simulation modeling, and the discussion of the results is presented in Section 5.

The study does not focus on creating an entire TDR program for these communities. TDR planning and legal experts can be found around the country who specialize in establishing workable TDR programs for communities. Rather, the study looks at specific examples of how a TDR would impact particular sites within a given community. The TDR program components assumed in this study represent one of numerous ways of assembling a TDR program. Each TDR program should be tailored specifically to the circumstances of the community involved.

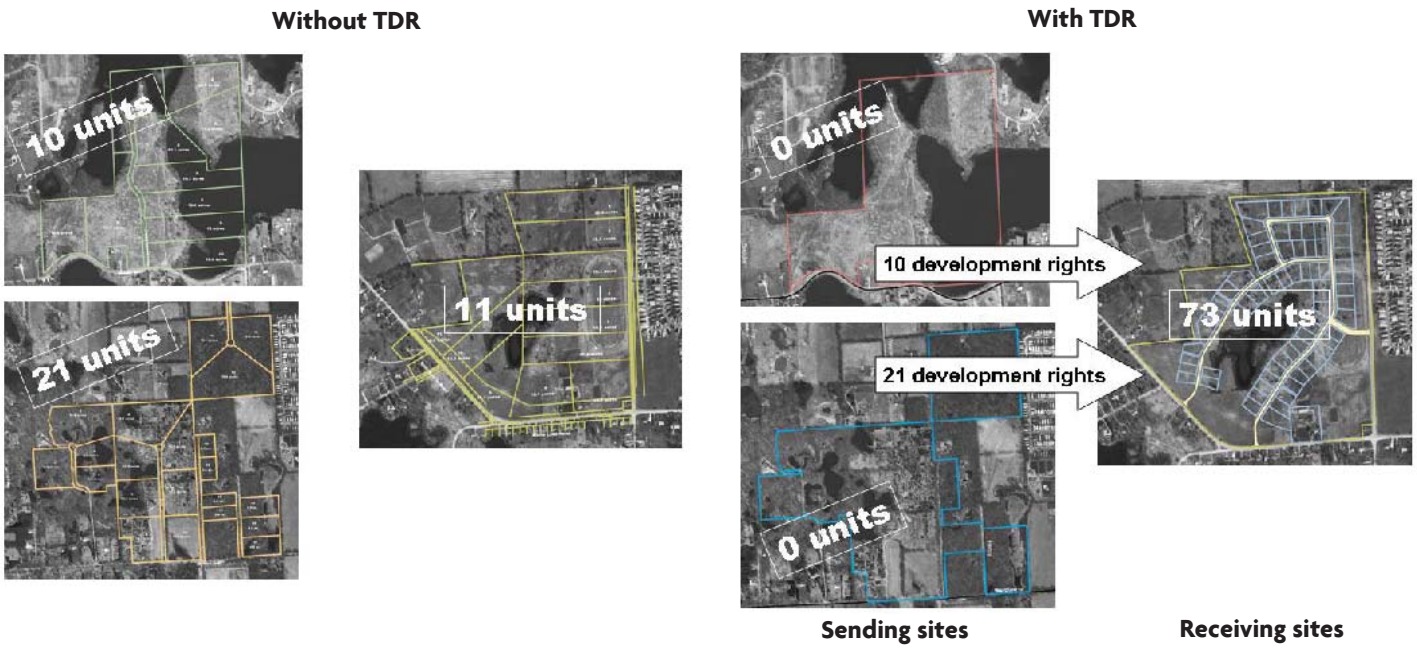


Figure 1-1. Parcels in Highland Township, Michigan identified as hypothetical sending and receiving sites. Without TDR (left), three sites are developed on 433 acres producing 42 units, while with TDR (right), one site is developed on 125 acres yielding 73 units as a result of development right transfers. A 2:1 allocation rate is employed resulting in one development right created in a sending site is two rights that can be transferred to a receiving site.

Machemer, Kaplowitz and Edens provide a succinct description of the basic structure of a TDR program. [iii]

The basic elements of a TDR program are an identified site to be developed at greater than "normal" densities (receiving site); an identified site to be preserved or restricted from development (sending site); the definition, specification and delineation of parcel's development rights; and a process by which rights may be transferred from one landowner to someone else. In the sending site, landowners are limited in their on-site development opportunities. However, these landowners are assigned transferable (i.e., sellable) development rights. These landowners may not use their properties' development rights within the sending site. However, owners of such development rights may sell them to landowners, developers or others for use in the designated receiving site.

When the development rights are transferred, the land of the sending site that gave rise to the rights becomes restricted — a permanent conservation easement is placed on it. Such as easement is duly recorded as part of the property's title, which notifies all present and future landowners of the development restriction on the land. In the receiving site, the acquired development rights usually permit development of a particular type and density that otherwise would not be permitted. The transferred development potential, therefore, usually takes the form of additional dwelling units, parking spaces, increased floor site ratio or other concessions.

Table 1-1. All density alternatives: area, density, and number of units for three scenarios

	Area (acres)	Density without TDR	Density with TDR	# units without TDR	# units with TDR	# units w/ inter. TDR
Highland Township Scenario						
Receiving site	125	1 lot per 10 acres	1 lot per 1.5 acres	11	72	N/A
Sending sites						
Middle Road	121	1 lot per 10 acres	0	10	0	
Wardlow Road	187	varies: 1 lot per 1.5, 3, 5 and 10 acres	0	21	0	
City of Ann Arbor Scenario						
Receiving site	0.56	N/A	N/A	114	164	N/A
Sending sites						
Scio Township OR	180	1 lot per 5 acres	0	35	0	
Webster Township OR	78	1 lot per 2 acres	0	30	0	
Dexter Township	177	1 lot per 5 acres	0	25	0	
Scio Township Scenario						
Receiving site	320	1 lot per 1.5 acres	1 lot per 0.5 acres	207	420	320
Sending sites						
Lima Township	358	1 lot per 5 acres	0	52	0	24
Dexter Township	177	1 lot per 5 acres	0	25	0	12
Webster Township	78	1 lot per 2 acres	0	30	0	15

In the table above, the number of units developed without TDR does not always result in the full number of units allowed under the current zoning because site characteristics (steep slopes, wetlands, waterbodies, etc.) may reduce the actual number of units available for building at the sites. In addition, some of the land may be needed for utilities further reducing the amount of land available for units.

This table presents the number of units produced at each sending site. In the case of Scenario 2, preservation on some sending sites provides more TDRs than can be used at the receiving site. The "extra" rights are the result of selecting sending sites that are larger than necessary to provide the rights to the receiving sites

2. METHODOLOGY

A. Method for Selecting Communities and Receiving Sites

The basic elements of a TDR program are: sending sites; receiving sites; definition and specification of parcels' severable development rights; and the process by which development rights may be transferred. While this study does not focus on creating an actual TDR program requiring decisions for these four elements, a few basic decisions do need to be made in order to run the density transfer simulations. To that end, legitimate sending sites and receiving sites were selected.

A legitimate receiving site is both physically and politically feasible. Space, utilities and other physical considerations need to be available for increased density. The receiving sites need to be located where the communities already have determined more development is desirable. Municipal planning consultants and planning staff assisted with identifying plausible receiving sites.

We selected the three receiving sites from one dozen potential areas located throughout the Huron River Watershed. Pros and cons associated with each of the potential receiving sites were assessed, and the communities were contacted to gauge their levels of interest. Final selection was based on geographic location in the watershed, political receptivity to the potential role of TDR, cooperation of government staff and officials, level of existing development in the community, and willingness of the developer to share information about their costs. In the end, receiving sites were selected that met these criteria and were consistent with the vision of each local unit of government.

The study deliberately looks at three different receiving sites that cover the spectrum of Michigan communities, ranging from rural township to village to downtown city. All three sites are located in southeastern Michigan and in the Huron River Watershed (Figure 2-1). These areas are the following:

1. The receiving site for Scenario 1 is located in Highland Town ship, Oakland County, and receives density from two send ing sites within Highland Township to provide an intra-juris dictional transfer example.

2. The receiving site for Scenario 2 is based in downtown Ann Arbor in Washtenaw County, and receives density from one of three alternatives located in out-county townships to provide an inter-jurisdictional transfer example.

3. The receiving site for Scenario 3 is based in Scio Township adjacent to the Village of Dexter in Washtenaw County, and receives density from three sending sites in out-county townships to provide another inter-jurisdictional transfer example.

Scenario 1: Highland Township receiving site

The details for this scenario are based on actual conditions in a suburban township located in southeastern Michigan's Oakland County. As of 2000, 48% of the township's 36 square miles had been converted to developed uses, 16% was farmed and the remaining land (36%) remained undeveloped as forest, wetland and grass/pasture. A diffuse development pattern characterizes the township and has resulted in land conversion throughout except in the southeast corner where the State of Michigan owns nearly 6,000 acres.

The growth pattern of the township typifies the pattern found in many Michigan communities lacking a strong town/urban center, and extensive natural features have been fragmented. Highland Township represents a community halfway to being fully built out according to its zoning plan. The township estimated population is 20,000 (May, 2007, SEMCOG), with a forecasted increase to 21,681 by 2030.

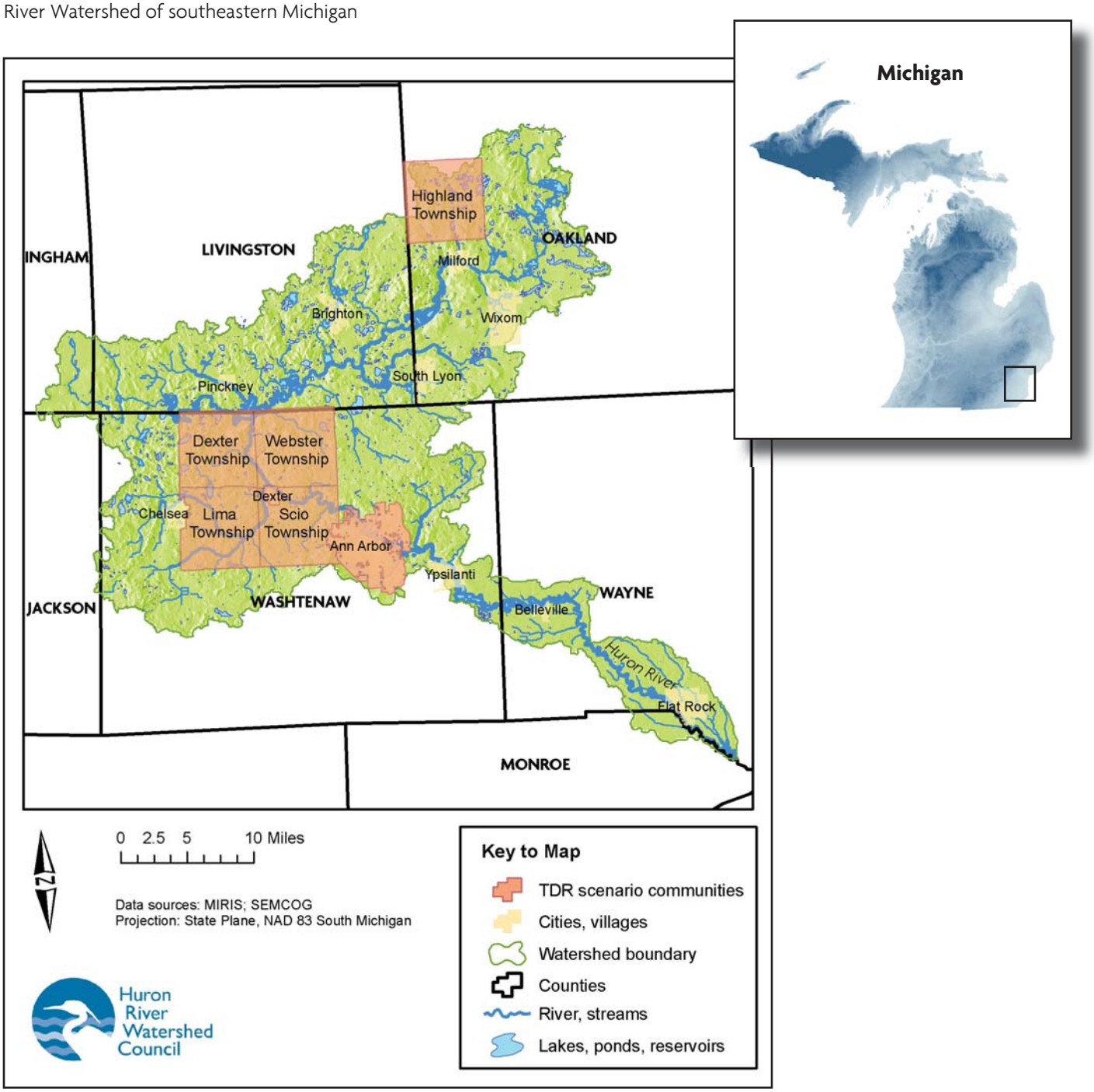
The receiving site is a 125-acre parcel bordered by single family residences to the south and west and by a mobile home park to the east, and is serviced by county-owned gravel roads. The parcel is flat with a state-protected wetland with steep slopes situated in the middle. It was the first development selected among the case studies when early on in the project it appeared that developer participation was essential for analyzing impacts of the development. Open lines of communication with the developer, combined with cooperative township staff, led to selection of this development to receive more density. Arguments for its role as a receiving site include that this site is surrounded by residential development including a mobile home park, and road improvements are planned for the gravel roads serving the site.

Scenario 2: City of Ann Arbor receiving site

The details for this scenario are based on actual conditions in four communities located in southeastern Michigan's Washtenaw County. The receiving site is located in the City of Ann Arbor; while the sending sites are located in rural townships situated at various distances away -- the townships of Webster, Scio and Dexter. The townships represent a range of development intensity from primarily agricultural to suburban.

The City of Ann Arbor is home to 114,000 residents with a slight population increase to 116,000 forecasted by 2030 (SEMCOG). Three-quarters of the city is developed. Most of the city's developable land has been built, so urban in-fill and increasing building height are the primary means to accommodate growth. Highways border all sides of the city with at least seven highway interchanges (on-ramps and off-ramps).

Figure 2-1. Location of TDR scenario communities in the Huron River Watershed of southeastern Michigan



The receiving site was selected with the input of city planning staff so that it would be feasible both physically and politically. In addition, the site is in the downtown area, the focus of a three-year strategic visioning session in 2006 that included increased density for that site. The city's downtown typifies the successful receiving site of many TDR programs with its growth pressure, vibrant urban offerings, and a local government that exercises the range of land use planning tools. In fact, the city is investigating the feasibility of employing TDR in the city to shift development pressure from floodplains and historic districts.

A downtown city lot measuring one-half acre serves as the site to receive density in this case study. The lot served as a parking structure for decades but the city recently issued a Request for Proposals to develop the lot as high-density residential with parking. The receiving site, in the central business district of the city, is surrounded by mixed use development interspersed with historic buildings dating to the 1800s, all arranged on a grid street design. Planning staff for the city support the notion of adding density to this location since doing so is consistent with zoning and strategy for downtown mentioned earlier.

Scenario 3: Scio Township receiving site

Scio Township is located immediately to the west of the city. The township represents a community with multiple influences on its land use pattern with the expanding city of Ann Arbor in the east, a village in the northwest corner, an interstate highway bisecting from west to east, and active farmland in the south and west. Current population surpasses 16,300 and is forecasted to grow to 23,164 by 2030 (SEMCOG).

Nearly one-third (29%) of total township land is farmed actively, one-third (34%) remains woodland, wetlands/water, grass or pasture, and the final one-third (37%) is used for single-family residences, commercial or industrial purposes. In general, farmlands dominate the western and southwestern portions of the township while developed land characterizes the eastern portion and northwest corner where the Village of Dexter is situated. In fact, eastern portions of the township utilize city services. An interstate highway cuts west/east across the township with at least three interchanges.

The receiving site occupies 320 acres in the northeast portion of the township adjacent to the Village of Dexter, a two-square-mile village of approximately 3,500 residents (SEMCOG), and along a major transportation corridor that connects the interstate to the village. The site, previously farmed, is now covered in grass/shrub and woodlands to the east of the road, and woodlands, and floodplain and riparian wetlands connected to Mill Creek to the west of the road. The site is surrounded by the village research and business park and a subdivision to the north, single-family large lot residences to the east, and commercial and business interests to the south.

This site has been the topic of intense discussion between the township and village since the village first sought to annex the large tract of land along Baker Road several years ago. The owners of the site wish to develop the property at a density that would require utilities from the village, which would, in turn, require annexation by the village. The discussions have resulted in the formation of the Baker Road Joint Planning Initiative to coordinate planning and manage growth along the corridor. Also, at the request of the county commissioners, the village and the township formed a group to discuss a Public Act 425 agreement between the two governmental units. An "Act 425" agreement is a conditional and contractual annexation between the parties that works out details about tax revenue sharing, services provided, and other conditions, including land use.

B. Method for Selecting Sending Sites

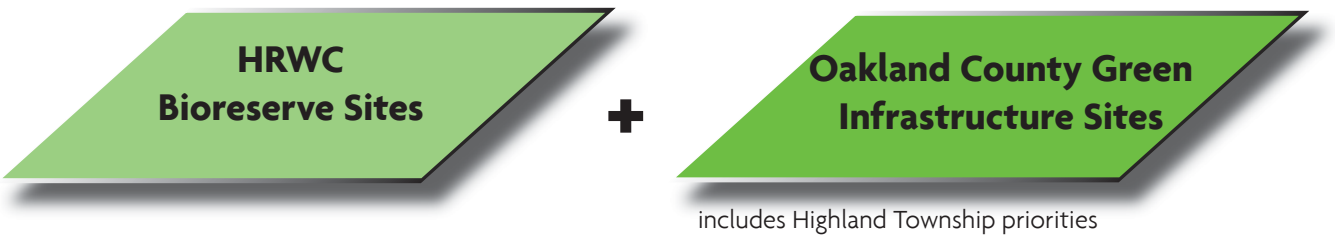
Preserving farmland and natural features in the watershed is the goal of the hypothetical TDR programs established in this study. The following questions were applied to the selection process for identifying high quality farmland and high quality natural features:

- Where are the community's priority lands for agriculture and natural features?
- Where are the county's priority lands for agriculture and natural features?
- Where are HRWC's priority lands for agriculture and natural features?

Scenario 1: Highland Township sending site selection methods

For the Highland Township Scenario, researchers worked with Oakland County Planning and Economic Development Staff and the Planning Director for Highland Township to gather current information on local and county priorities for land preservation (based on zoning, master planning, and green infrastructure planning). Then, the results of the Huron River Watershed Bioreserve map were consulted and incorporated into the layered decision-making model. The Bioreserve map outlines and ranks existing natural areas in the watershed. A computer model ranks each natural area, derived by plotting the boundaries of forests, wetlands and grasslands using computer mapping software and aerial photos, based on 15 measures of ecological value. The measures include: size; presence or absence of wetlands, streams or lakes; diversity of landscape; potential for groundwater recharge; potential for site connectivity to other natural sites; and likely coverage in native vegetation. Figure 2-2 illustrates the primary sources of information used to select priority lands for preservation.

Figure 2-2. Data for identifying priority natural sites in the Highland Township Scenario



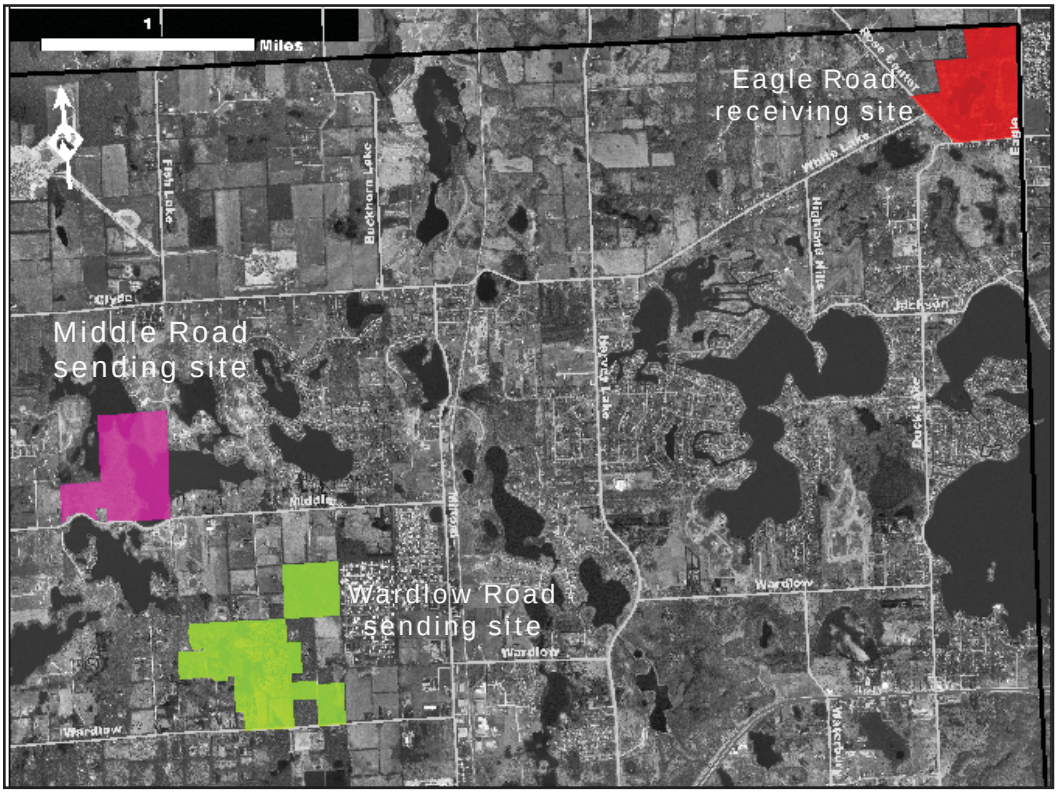
Data from HRWC and Oakland County PEDS

Scenario 1: Highland Township sending sites

Sending Site 1: Middle Road
Two sites of the township have been selected for protection based on the criteria described above. The fragmentation of natural areas in the township necessitated selecting multiple parcels as the sites to send density. The sending site on Middle Road encompasses 121 acres including 42 acres of lake and wetlands and 14 acres of woodlands and is located nearly four miles southwest of the receiving site. Preserving this site protects those natural features including considerable shoreline frontage in a township where most of the shorelines are developed. Moreover, this land is contiguous to a township park.

Sending Site 2: Wardlow Road
The sending site on Wardlow Road covers 187 acres including 99 acres of woodlands and 23 acres of wetlands. The site is located three and one-half miles southwest of the receiving site and one-half mile southeast of the other sending site. A locally-owned tree farm operates on nearly 80 acres and its preservation is a township planning objective. Several small lakes dot the landscape surrounded by mature forest vegetation. Finally, Wardlow Road, which borders the sending site on the south, is a county-designated Natural Beauty Road, and the township seeks to maintain that designation. The goal of the Natural Beauty Road Program is to preserve in a natural, essentially undisturbed condition, certain county local roads having outstanding or unusual natural beauty by virtue of native vegetation or natural features. Figure 2-3 provides an aerial view of the three study sites in Highland Township.

Figure 2-3. Locations of study sites in Scenario 1: Highland Township



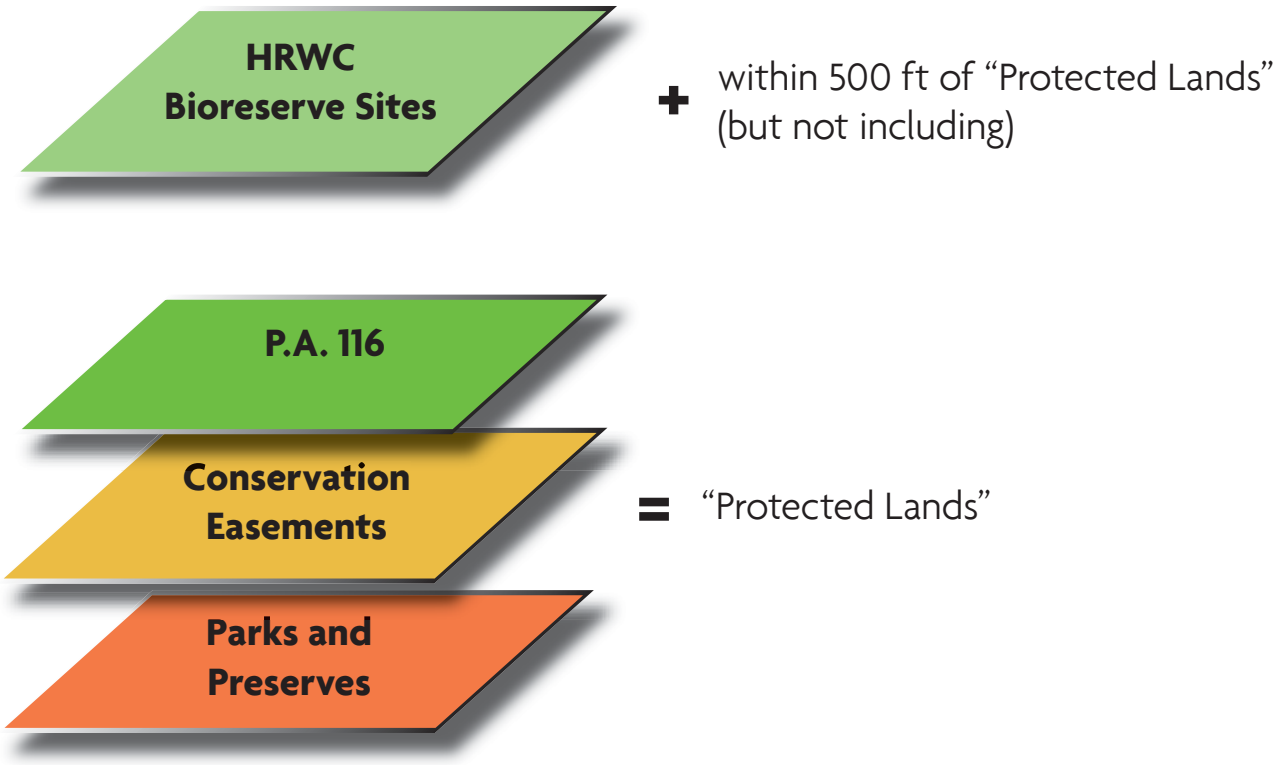
Data from HRWC and aerial photography from SEMCOG

Scenarios 2: City of Ann Arbor and 3: Scio Township sending site selection methods

For the City of Ann Arbor Scenario and the Scio Township Scenario, researchers gathered information for priority natural sites from the Huron River Watershed Bioreserve map, giving higher value to lands adjacent to sites already protected. Protected lands were defined by overlaying GIS data layers for parks and preserves, conservation lands and land enrolled in P.A. 116. P.A. 116 is a temporary land protection tool, as enrollments last from ten to 90-year terms, with 10-year terms being the most common. Landowners can withdraw from the enrollment before the term expires and sell to developers if they pay back the state income tax credits that are associated with the enrollment to the state. It is included as part of protected lands as it illustrates landowners' interests in protecting their land, even if it is not permanent protection. Conservation easements include acquisitions by such local land preservation efforts as the Ann Arbor Greenbelt Program, Washtenaw Land Trust, Southeast Michigan Land Conservancy, and local township PDR and land preservation programs. Figures 2-4 and 2-5 illustrate the primary sources of information used to select priority lands for preservation in the Washtenaw County scenarios.

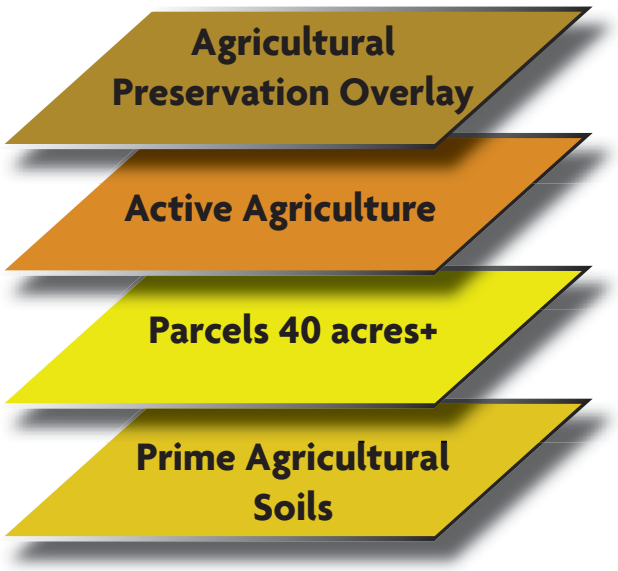
Data layers provided by the Washtenaw County GIS and Department of Planning and Environment enabled researchers to identify priority farmlands. The layers comprised the Agricultural Preservation Overlay district as defined by Washtenaw County and the townships, prime agricultural soils, parcels larger than 40 acres, and lands in active agricultural use. Sites in the county that contain data from all of those layers were considered potential sending sites.

Figure 2-4. Data for identifying priority natural sites in Washtenaw County for Scenario 2: City of Ann Arbor and Scenario 3: Scio Township



Data from HRWC and Washtenaw County GIS

Figure 2-5. Data for identifying priority agricultural sites in Washtenaw County for Scenario 2: City of Ann Arbor and Scenario 3: Scio Township



Data from Washtenaw County GIS

Scenario 2: City of Ann Arbor Scenario sending sites

How does the distance of the sending site from the receiving site affect the viability (i.e., affordability) of TDR? To attempt to answer this question, this scenario analyzes the relationships between the receiving site and three different sending areas, each a greater distance from downtown Ann Arbor. Each sending site is located in a different township.

Sending Alternative 1: Webster Township

The sending site in Webster Township covers 76 contiguous acres, most of which is high quality farmland as identified by the criteria described above and by the Ann Arbor Greenbelt District Strategic Plan (approved December, 2005 by the Greenbelt Advisory Commission). Woodlands and wetlands occupy nearly seven acres in the northeast corner of the parcel at the headwaters of a stream draining to Boyden Creek, a tributary of the Huron River. The site is part of a prime farmland complex indicating that surrounding properties are farmed actively.

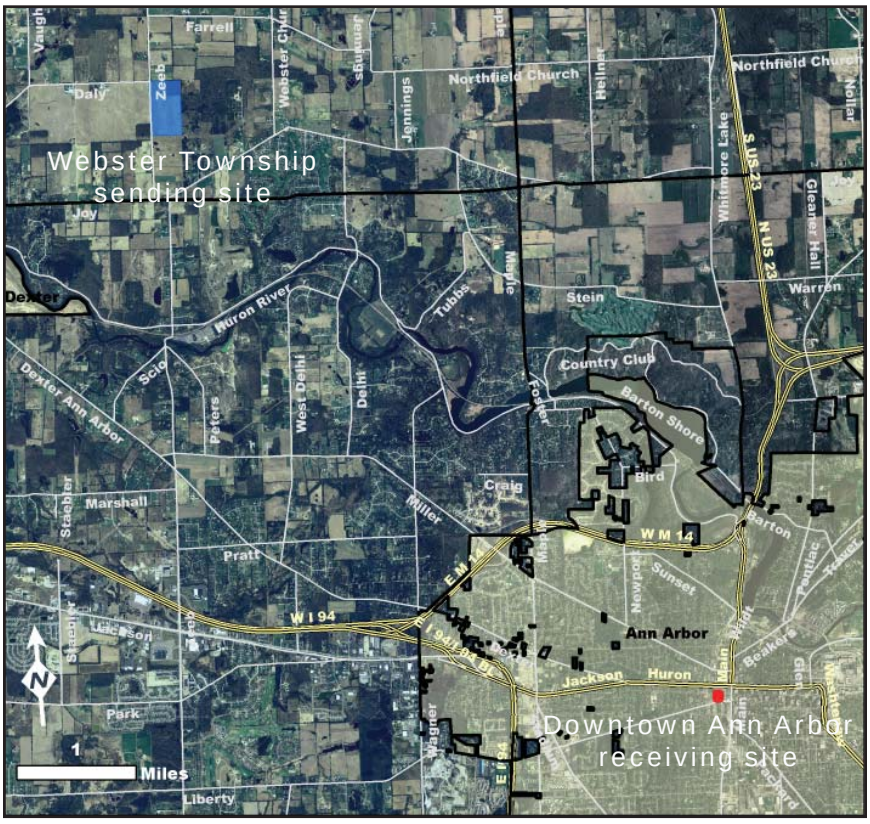
Webster Township lies northwest of the city just beyond the city boundaries. This township, of the three alternatives, is second closest to the receiving site and falls within the Greenbelt District, the designated area for which a city millage provides funds to preserve and protect farmland, open space, natural habitats, and the city's source waters. Webster Township has an estimated population of 6,329, with a forecasted increase to 13,322 by 2030 (SEMCOG). Nearly half (46%) of the total acres in the township are farmed actively while 37% of land is natural or grass and pasture and 16% is developed as large lot single-family residences. No major highways or roads intersect the township. Figure 2-6 shows the location of this study site in relation to the City of Ann Arbor receiving site.

Sending Alternative 2: Dexter Township

The sending site in Dexter Township covers 177 contiguous acres on the north end of the Four Mile Lake State Game Site, where 78 acres of wooded wetlands and riparian wetlands exist alongside nearly 100 acres of farmland. Local roads border the site to the west and east. A creek traverses the western portion of the site for nearly 2,000 feet before emptying into Four Mile Lake.

Dexter Township is located farthest from the receiving site. Dexter Township is adjacent to the west border of Webster Township and presents a similar profile in terms of current population and land use. This township, with an estimated population of nearly 6,000, has four-fifths of total acres (81%) actively farmed or covered in grass and pasture or lakes, rivers, wetlands or woodlands. The remaining acres (16%) are used primarily for large lot single family residences. No major roads traverse it; both factors may help to explain why population forecasts add less than one hundred people by 2030 (SEMCOG). Figure 2-7 shows the location of this study site in relation to the City of Ann Arbor receiving site.

Figure 2-6. Location of Webster Township sending site in Scenario 2: City of Ann Arbor

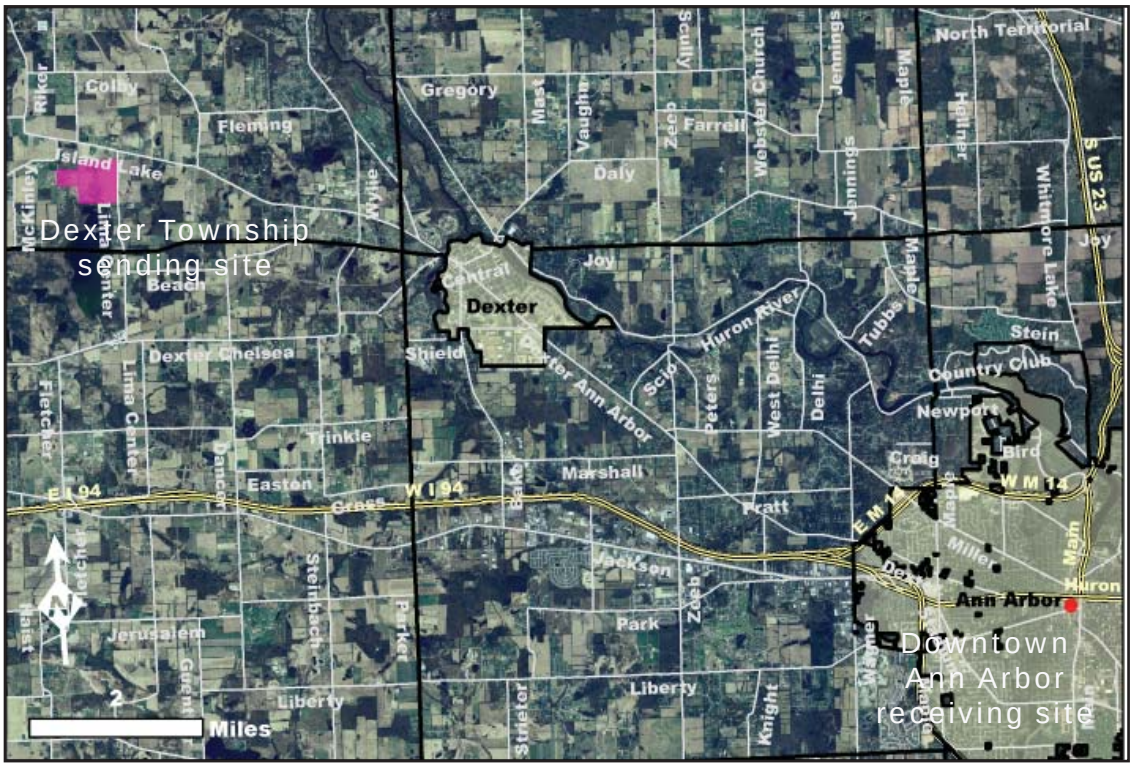


Data from HRWC and 2005 aerial photography from SEMCOG

Sending Alternative 3: Scio Township

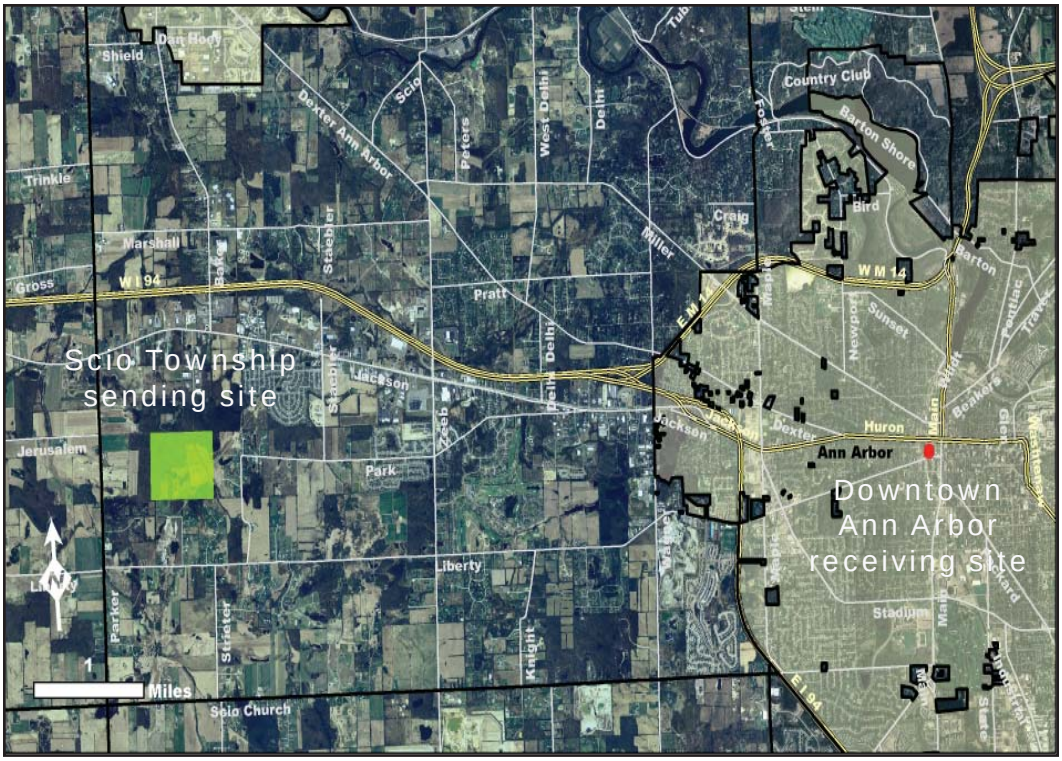
The sending site in the southwest quadrant of Scio Township covers 180 contiguous acres of which 87 acres are wetlands and nine acres are woodlands. The remaining acreage is farmed actively in multiple fragmented fields. A stretch of Honey Creek, a tributary to the Huron River, traverses the site for 3,000 feet. The land is bordered on the west by the Parker Farm that has a conservation easement on it ensuring that the land will be undeveloped in perpetuity. Scio Township is located immediately to the west of the City of Ann Arbor making it the closest of the three sending sites to the receiving site in downtown Ann Arbor. Figure 2-8 shows the location of this study site in relation to the City of Ann Arbor receiving site.

Figure 2-7. Location of Dexter Township sending site in Scenario 2: City of Ann Arbor



Data from HRWC and 2005 aerial photography from SEMCOG

Figure 2-8. Location of Scio Township sending site in Scenario 2: City of Ann Arbor



Data from HRWC and 2005 aerial photography from SEMCOG

Scenario 3: Scio Township sending sites

The question posed for the City of Ann Arbor Scenario is posed for this scenario as well but the receiving site moves from a downtown location to township land bordering a village in Washtenaw County. Again, the scenario analyzes the relationships between the receiving site and three different sending areas, each a greater distance from the receiving site in Scio Township. Each sending site is located in a different township with this scenario using two of the same sending sites as the previous scenario. *An important distinction in this scenario is that all of the sending sites are needed in order to achieve the desired density at the receiving site development.*

Sending Site 1: Lima Township

The sending site in Lima Township encompasses 358 acres of prime farmland with 40 acres of woodlands and wetlands. The land is bisected from west to east by a county road and is bordered on the west and east by county roads. This sending site sits closest to the receiving site in Scio Township of the three sending sites. The location of this sending site in relation to the Scio Township receiving site is shown in Figure 2-9.

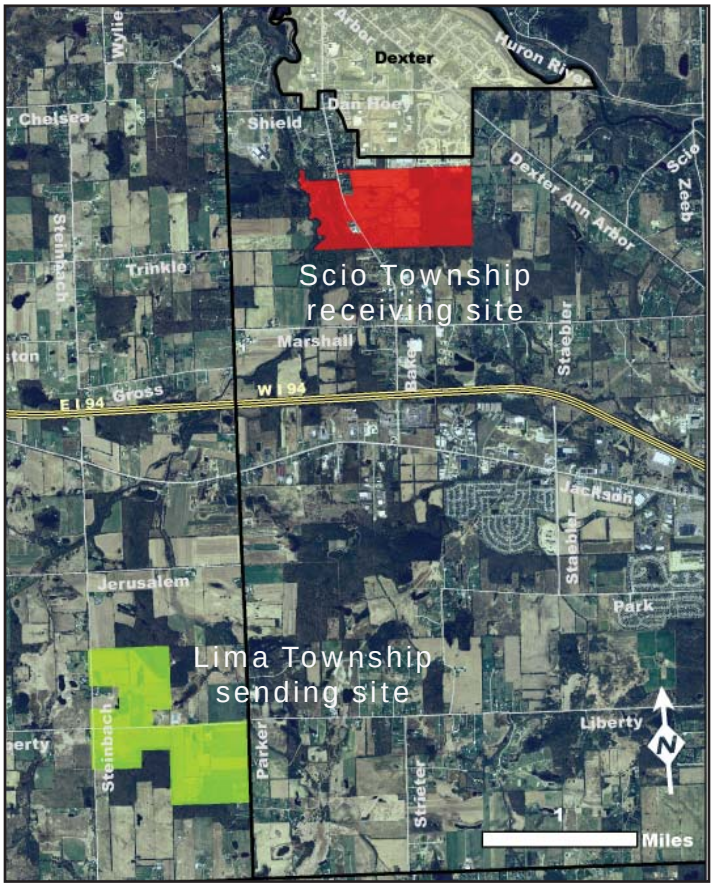
Sending Site 2: Dexter Township

This scenario uses the same sending site in Dexter Township as in the City of Ann Arbor Scenario. The site is located farthest from the receiving site in Scio Township. The location of this sending site in relation to the Scio Township receiving site is shown in Figure 2-10.

Sending Site 3: Webster Township

This scenario uses the same sending site in Webster Township as in the City of Ann Arbor Scenario. This sending site is neither the closest nor the most distant of the three sending sites to the receiving site for this scenario. The location of this sending site in relation to the Scio Township receiving site is shown in Figure 2-11.

Figure 2-9. Location of Lima Township sending site in Scenario 3: Scio Township

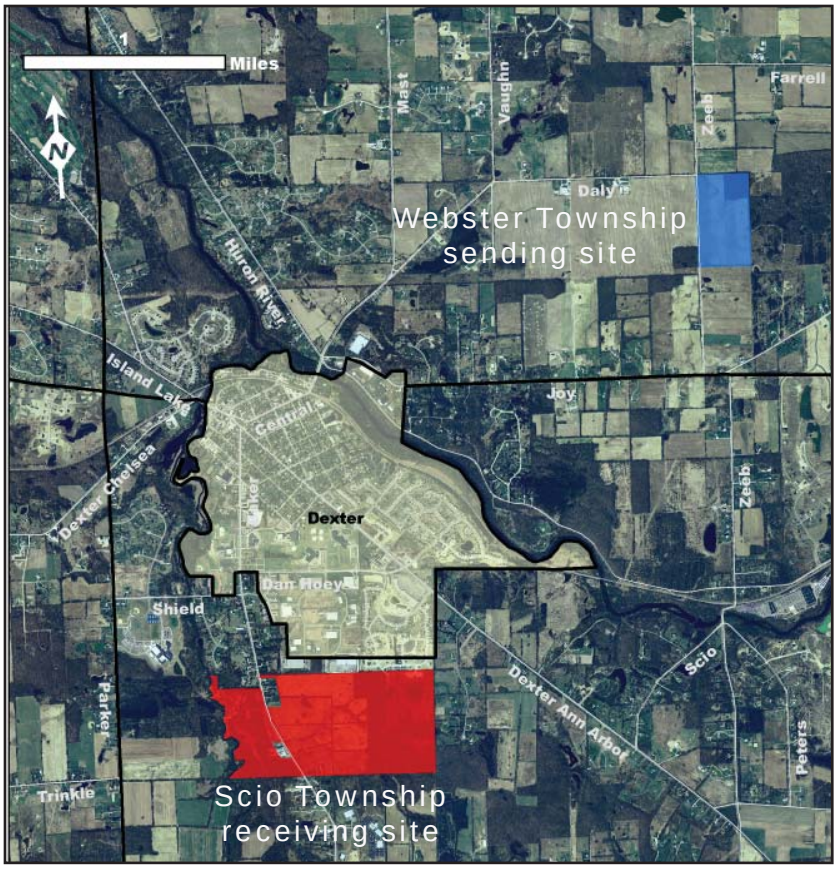


Data from HRWC and 2005 aerial photography from SEMCOG

Figure 2-10. Location of Dexter Township sending site in Scenario 3: Scio Township

— Data from HRWC and 2005 aerial photography from SEMCOG

Figure 2-11. Location of Webster Township sending site in Scenario 3: Scio Township



Data from HRWC and 2005 aerial photography from SEMCOG

C. Method for Calculating Opportunities among Sending and Receiving Sites

Once receiving sites were selected, a method for allocating development rights among the receiving and sending sites was developed for this study. We decided how many units to add to the receiving sites to make a reasonable TDR example that would be acceptable both physically and politically. With the number of receiving opportunities determined, two times the opportunities in sending areas were needed based on a 2:1 allocation rate. The allocation rate was applied across all scenarios resulting in two dwelling units in the receiving site for one dwelling unit from a sending site. The rate gives sending area landowners more opportunities and more flexibility in marketing their rights.

The sending areas then were sized to contain sufficient units to transfer. Potential sending sites were examined more closely through a process that considered local zoning, master plans, parcel maps and preferred planning tools used by the local government. This process determined the specific locations and sizes of the sending sites. For example, in Highland Township, we needed 62 receiving units using a 2:1 allocation rate and a sending site of 310 acres, but a parcel with that profile could not be found. As a result, we had to select two different areas in the township containing many parcels to make the necessary transfer.

Site visits to each of the sending sites provided verification that the desktop-based research was accurate. The sites exhibited the high quality features that warranted preservation. One exception was the addition of a small gravel extraction operation at the Lima Township sending site that did not exist at the time of data gathering.

D. Scenarios without TDR

First we measured the impacts that could result from developing the study sites in the three scenarios as if no TDR program existed. No use of TDR, given current planning and zoning conditions, is what probably will happen on these sites. Existing site plans were used to measure impacts when they were available. When site plans did not exist (i.e., in all of the sending areas as they are undeveloped and do not have pending proposals for development), we created hypothetical site plans and then measured the impacts for each alternative.

Scenario 1: Highland Township

Highland Township receiving site

The receiving site sits in the extreme northeast corner of the township on a 125-acre parcel that previously was farmed and zoned for 10-acre minimum parcels. The township master plan calls for 5- to 10-acre residential lots. A developer purchased the parcel and successfully sought re-zoning to 1.5-acre lots for a 72-unit subdivision. Prior to the re-zoning, 11 lots could have been developed on this parcel according to planning and site conditions. For the purposes of this study, we designated the zoned density of 1.5-acre lots as the TDR density and the original zoning of 10-acre lots as the density without TDR. A typical site layout for the 125-acre site based on the original zoning is presented in Figure 2-12.

Figure 2-12. Without TDR: Highland Township receiving site with hypothetical site layout

Data sources: 2000 digital aerial photography from Oakland County, MI; site layout from Carlisle/Wortman Associates, Inc.

Sending Site 1: Middle Road

The sending site on Middle Road is zoned for 10-acre minimum lots to be used as single-family residences. Given the total acreage for this sending site is 121 and it has building limitations due to one-third of the acres being lake, a total of 10 units could be developed on this parcel based on existing zoning and site conditions.

Figure 2-13. Without TDR: Sending Site on Middle Road with hypothetical site layout

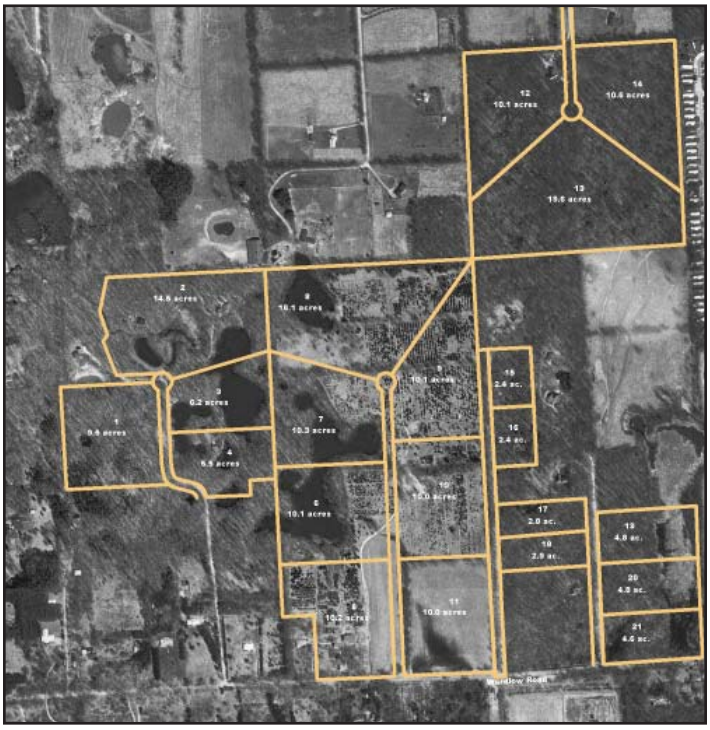
Data sources: 2000 digital aerial photography from Oakland County, MI; site layout from Carlisle/Wortman Associates, Inc.

Sending Site 2: Wardlow Road

The zoning for the parcels in the sending site on Wardlow Road ranges from 0.5-acre to 10-acre lots. A total of 21 lots ranging from 2.4 acres to nearly 20 acres could be developed on this site based on acreage (187), and existing zoning and site conditions.

Figure 2-13 and Figure 2-14 illustrate typical site layouts for these sites under current zoning requirements. The sending site on Middle Road produces 10 lots ranging from 10 acres to 16.7 acres, and the sending site on Wardlow Road produces 21 lots ranging from 2.4 acres to nearly 20 acres.

Figure 2-14. Without TDR: Sending Site on Wardlow Road with hypothetical site layout



Data sources: 2000 digital aerial photography from Oakland County, MI; site layout from Carlisle/Wortman Associates, Inc.

Scenario 2: City of Ann Arbor

Downtown Ann Arbor receiving site

The receiving site is in downtown Ann Arbor where the city approved a bid for a 5-floor residential building with 114 units and serves as the density without TDR for this case. No site layout is presented for the receiving site since it is assumed that the building will occupy the entire 0.5-acre footprint of the lot. The aerial image in Figure 2-15 shows the vicinity of the receiving site. The density with TDR allows 50 additional units, which adds two floors to the building. These additional units can be achieved by sending rights from one of the three sending sites.

Figure 2-15. Downtown Ann Arbor receiving site

Data sources: 2007 digital aerial photography from DigitalGlobe, Google

Sending Site 1: Webster Township

The site is zoned for 2-acre minimum lots to be used as agricultural residential. From the 76 acres, a total of 30 units ranging from 2 acres to 3.4 acres could be developed on this parcel based on existing zoning and site conditions.

Sending Site 2: Dexter Township

The zoning for these parcels calls for 5-acre minimum lots. A total of 25 lots ranging from 5 acres to 9 acres could be developed on this site based on the total acreage (177) and the existing zoning and site conditions.

Sending Site 3: Scio Township

The site is zoned for 5-acre minimum lots. A total of 35 one-acre minimum units could be developed on this parcel based on the total acreage (180) existing zoning and site conditions and when following the township's expectation for clustered site layout.

Figures 2-16 through 2-19 illustrate typical site layouts for these sites that meet township zoning requirements. Two site layouts are presented for the Scio Township sending site to demonstrate the difference between a standard lot split option and a cluster development option, the latter being the stated preference of Scio Township and more likely to be developed, but the former representing a more typical pattern under many other Michigan communities' current ordinances.

Figure 2-16. Without TDR: Webster Township sending site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Figure 2-17. Without TDR: Dexter Township sending site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Figure 2-18. Without TDR: Scio Township sending site with hypothetical site layout: the cluster development option

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

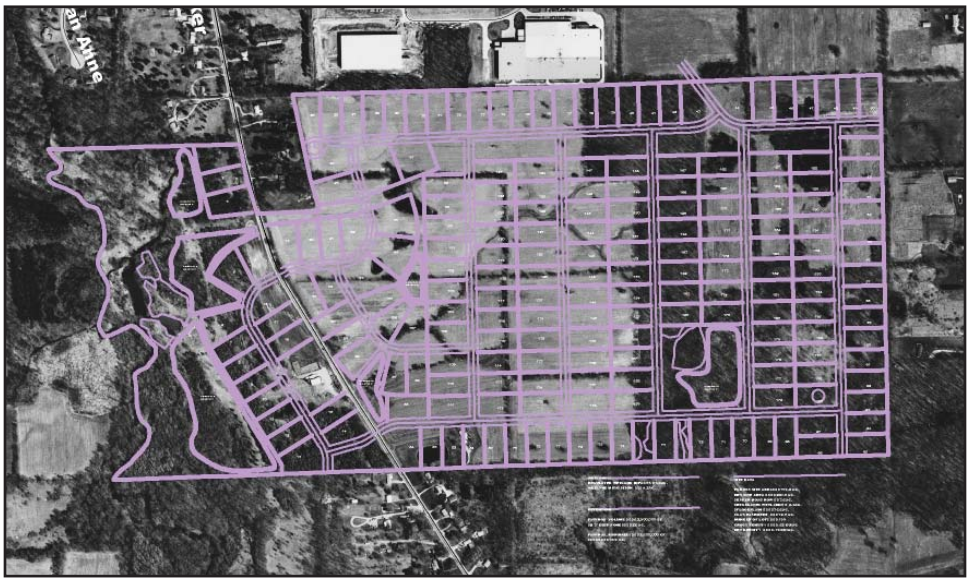
Figure 2-19. Without TDR: Scio Township sending site with hypothetical site layout: the standard lot split option

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Scio Township receiving site

The receiving site occupies 320 acres of active farmland, woodlots, and wetlands in the northeast portion of the township adjacent to the Village of Dexter. For the purposes of this study, we designated the currently-zoned density of 1.5-acre lots as the non-TDR density, which could result in building 207 lots. A typical site layout for the site based on the original zoning is presented in Figure 2-20.

Figure 2-20. Without TDR: Scio Township receiving site with hypothetical site layout



Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Atwell-Hicks, Inc. courtesy of Peters Building Co.

Because of the large size of the receiving site and the discussions currently occurring among the Village of Dexter, Scio Township, and the developer about various development alternatives, we decided to perform two TDR site plans; a "full" TDR site plan, where 213 units are transferred into the site for a density of 2 lots per acre, and an "intermediate" TDR site plan, where a smaller number (113) of units are transferred into the site for a density of 1 lot per acre. While the transfer of development rights from a single sending site will provide enough units to realize the intermediate TDR density, development rights must be transferred from multiple sending areas in order to realize the full TDR density of 420 units.

Sending Site 1: Webster Township

The density for this sending site without TDR remains the same as described above in the City of Ann Arbor Scenario. An additional alternative is presented with intermediate, or partial, TDR.

Sending Site 2: Dexter Township

The density for this sending site without TDR remains the same as described above in the City of Ann Arbor Scenario. An additional alternative is presented with intermediate, or partial, TDR.

Sending Site 3: Lima Township

The zoning for the parcels calls for 5-acre minimum lots. A total of 52 lots ranging from 5 acres to 20.2 acres could be developed from this site based on the acreage (358) and existing zoning and site conditions (Figure 2-21). An intermediate TDR alternative is presented as well.

Figure 2-21. Without TDR: Lima Township sending site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Details about the study sites for all three scenarios, such as area and number of units allowed under current zoning, are presented together in Table 2-1.

Table 2-1. Without TDR density alternatives: area, density, and number of units for three scenarios

	Area (acres)	Density without TDR*	# units without TDR
Highland Township Scenario			
Receiving site	125	1 lot per 10 acres	11
Sending sites			
Middle Road	121	1 lot per 10 acres	10
Wardlow Road	187	Varies; 1 lot per 1.5, 3, 5 and 10 acres	21
City of Ann Arbor Scenario			
Receiving site	0.56	N/A	114
Sending sites			
Scio Township CR	180	1 lot per 5 acres	35
Webster Township CR	76	1 lot per 2 acres	30
Dexter Township	177	1 lot per 5 acres	25
Scio Township Scenario			
Receiving site	320	1 lot per 1.5 acres	207
Sending sites			
Lima Township	358	1 lot per 5 acres	52
Dexter Township	177	1 lot per 5 acres	25
Webster Township	76	1 lot per 2 acres	30

** the number of units developed without TDR does not always result in the full number of units allowed under the current zoning because site characteristics (steep slopes, wetlands, waterbodies, etc.) and utilities may reduce the actual number of units available for building at the sites.*

E. Scenarios with TDR

In a TDR program, receiving sites are established with two zoning densities – the base density and a bonus density. Base density is the allowable number of units per site that can be built without purchasing development rights, i.e. allowable under current zoning. The bonus density is the allowable number of units per area that can be built with the purchase of development rights. Several incentives may be offered to receiving site property owners to encourage them to purchase and use TDRs. Typically, the primary incentive for purchase of development rights is increased building density.

In an actual transfer of development rights program, permitted base and bonus densities must be politically and legally acceptable. To select feasible receiving sites and densities for the three scenarios, researchers had to understand the current zoning and zoning history of the sites.

A consistent 2:1 allocation rate was applied across all scenarios resulting in two dwelling units in the receiving site for one dwelling unit from a sending site. The rate gives sending area landowners more opportunities and more flexibility in marketing their rights.

Scenario 1: Highland Township

Figure 2-22 presents a simplified diagram to illustrate how density moves from the sending to receiving area in the Highland Township Scenario; with each unit representing one development right, the 10 units sent from Middle Road sending site become 20 units in the receiving site and the 21 units sent from Wardlow Road sending site become 42 units in the receiving site. The transfer from the two sending sites results in 62 additional units added to the receiving site development, providing enough units to achieve 72 units. The relocation of the 62 development rights results in no additional development in the sending sites. Therefore, the natural features and farmland of these sites are preserved.

Figure 2-22. Diagram of how units are transferred in Scenario 1: Highland Township

Figure 2-23 shows the site layout of the receiving site once the TDR density is achieved under the TDR program.

Figure 2-23. With TDR: Highland Township receiving site with site layout

Data sources: 2000 digital aerial photography from Oakland County, MI; site layout courtesy of Eagle 119 Ventures, digitized by HRWC

Figures 2-24 and 2-25 show the extent of the protected sites for Middle Road sending site and Wardlow Road sending site, respectively.

Figure 2-24. With TDR: Middle Road sending site when preserved through TDR

Data sources: 2000 digital aerial photography and parcels from Oakland County, MI.

Figure 2-25. With TDR: Wardlow Road sending site when preserved through TDR

Data sources: 2000 digital aerial photography and parcels from Oakland County, MI.

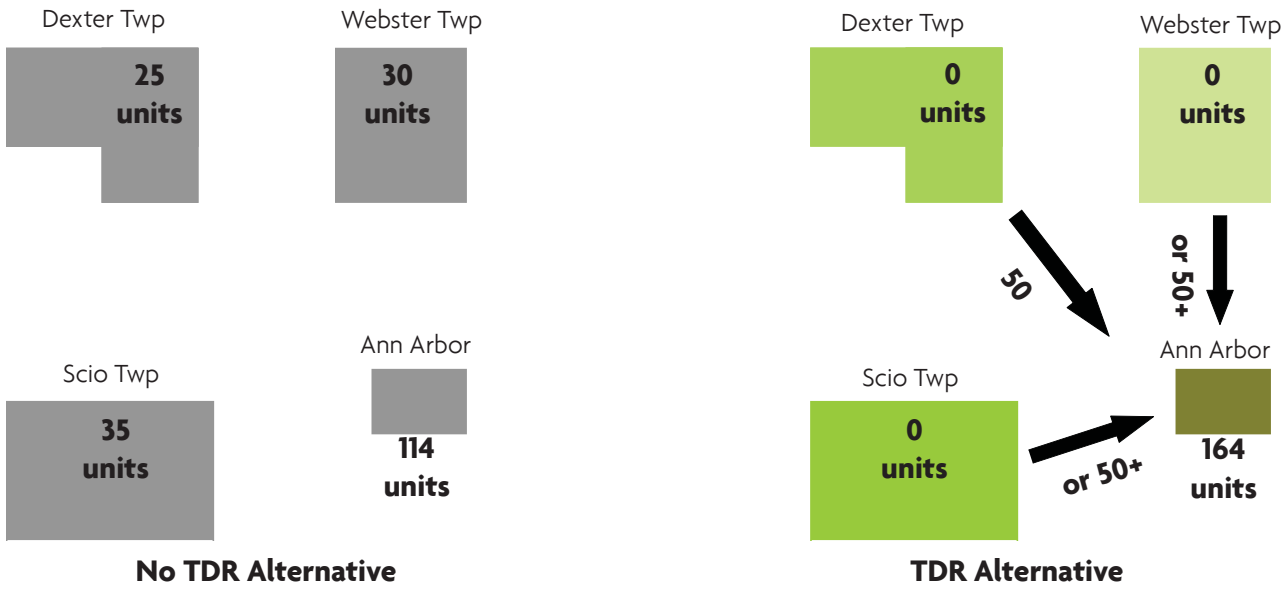
Table 2-2. With TDR density alternative: area, density, and number of units for Scenario 1: Highland Township

	Area (acres)	Density with TDR	# units with TDR
Highland Township Scenario			
Receiving site	125	1 lot per 1.5 acres	73
Sending sites			
Middle Road	121	0	0
Wardlow Road	187	0	0

Scenario 2: City of Ann Arbor

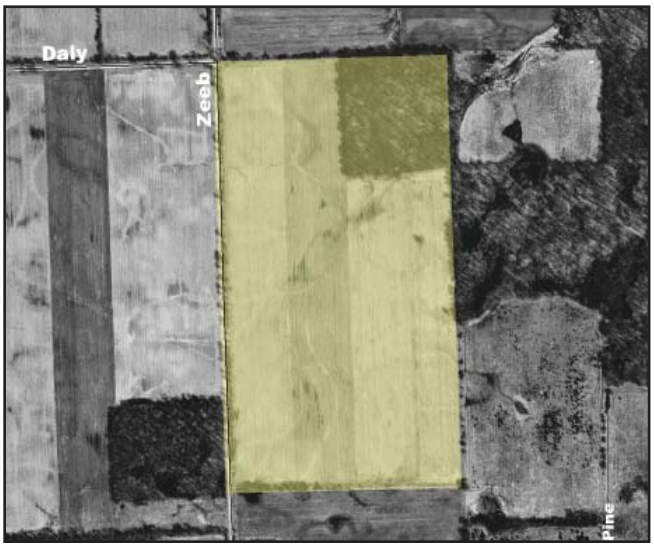
For this scenario, any one of three alternative sending sites can provide enough density units on its own to add 50 units to the receiving site in downtown Ann Arbor. Employing TDR in this scenario results in a total of 164 residential units in the building and prevents any additional development at the sending sites in the townships. When the density units from the Webster Township sending site are sent, prime agricultural land is preserved. When the density units from the Dexter Township sending site are sent, farmland, floodplains, stream and wooded wetlands are preserved. When the density units from the Scio Township are sent, farmland and woodlands are preserved. Figure 2-26 illustrates how the ratio works for the City of Ann Arbor scenario.

Figure 2-26. Diagram of how units are transferred in Scenario 2: City of Ann Arbor



Figures 2-27 through 2-29 show the extent of the sending sites that can be preserved through a TDR program in the townships of Webster, Dexter and Scio, respectively. Table 2-3 presents the density information for the study sites with a TDR program in place.

Figure 2-27. With TDR: Webster Township sending site when preserved through TDR

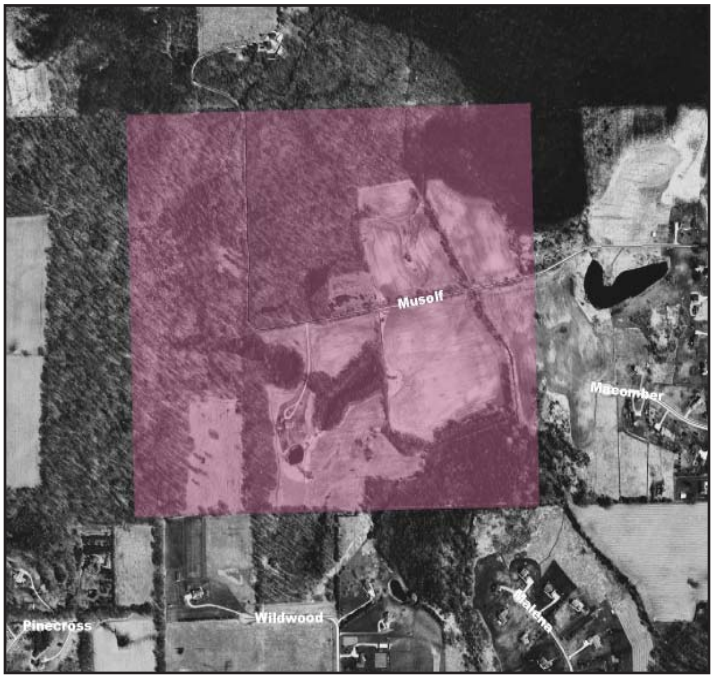


Data sources: 2000 digital aerial photography and parcels from Washtenaw County, MI

Figure 2-28. With TDR: Dexter Township sending site when preserved through TDR

Data sources: 2000 digital aerial photography and parcels from Washtenaw County, MI

Figure 2-29. With TDR: Scio Township sending site when preserved through TDR



Data sources: 2000 digital aerial photography and parcels from Washtenaw County, MI

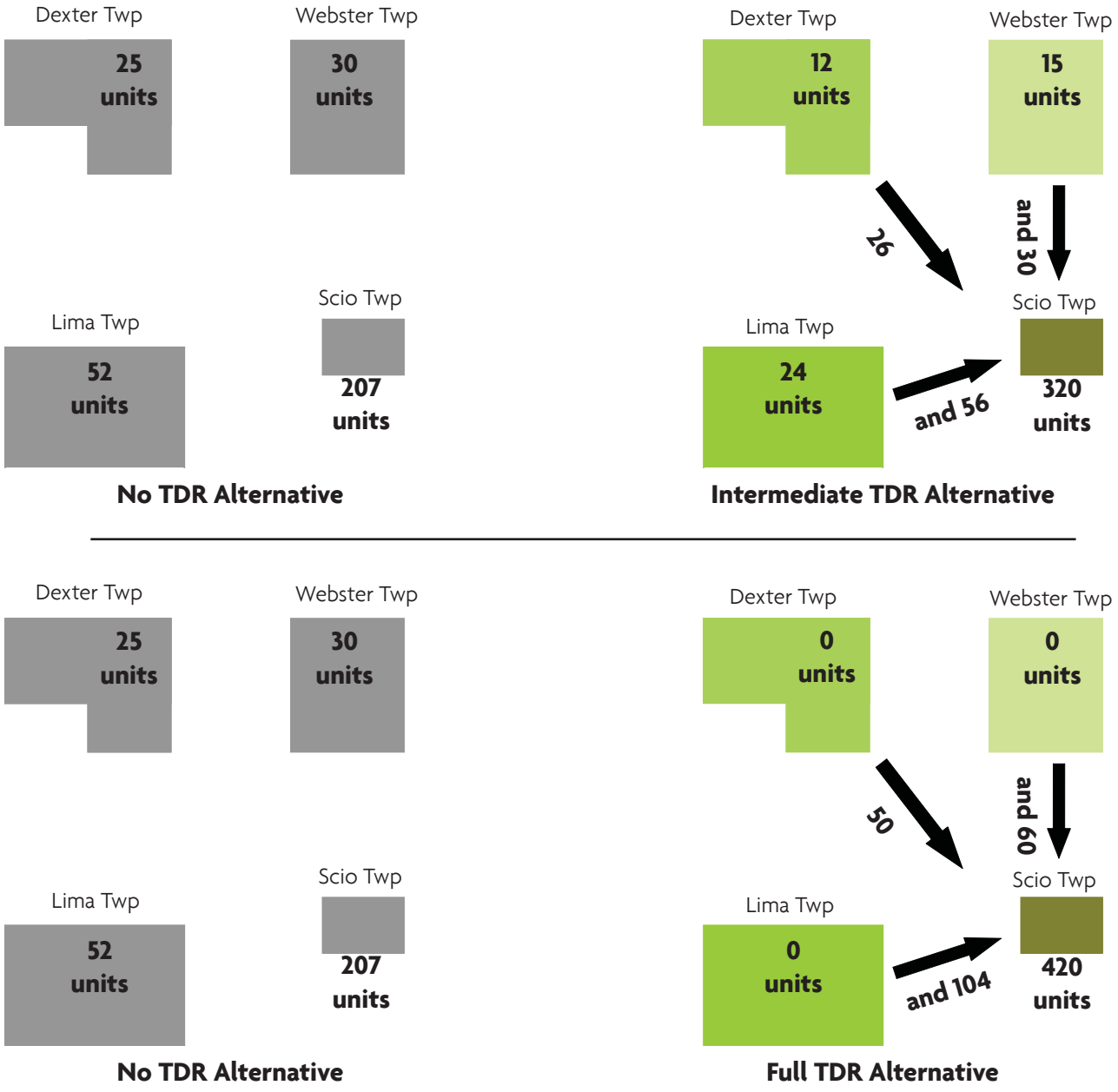
Table 2-3. With TDR density alternative: area, density, and number of units for Scenario 2: City of Ann Arbor

	Area (acres)	Density with TDR	# units with TDR
City of Ann Arbor Scenario			
Receiving site	0.56	N/A	164
Sending sites			
Scio Township OR	180	0	0
Webster Township OR	76	0	0
Dexter Township	177	0	0

Scenario 3: Scio Township

This scenario features two levels of density transfer: intermediate and full. Density under the intermediate TDR is 1-acre lots resulting in an additional 113 units for a total of 320 lots. Density under the full transfer of development rights is 0.5-acre lots resulting in adding another 100 units for a total of 420 lots. The additional units in the full TDR alternative come in the form of converting some of the single-family housing stock to two-family and four-family townhome units. The intermediate and full TDR alternatives are achieved by combining the rights transferred from all three sending sites.

Figure 2-30. Diagram of how units are transferred in Scenario 3: Scio Township



Intermediate TDR Alternative

For this alternative, all three sending sites are used to reach the increased number of units in the receiving site (320 units). The sending sites are developed partially and the remaining land (369 acres) is preserved. Figures 2-31 through 2-34 illustrate hypothetical site layouts for these sending sites under intermediate TDR density. The number of units created and transferred in this hypothetical TDR program is shown in Table 2-4.

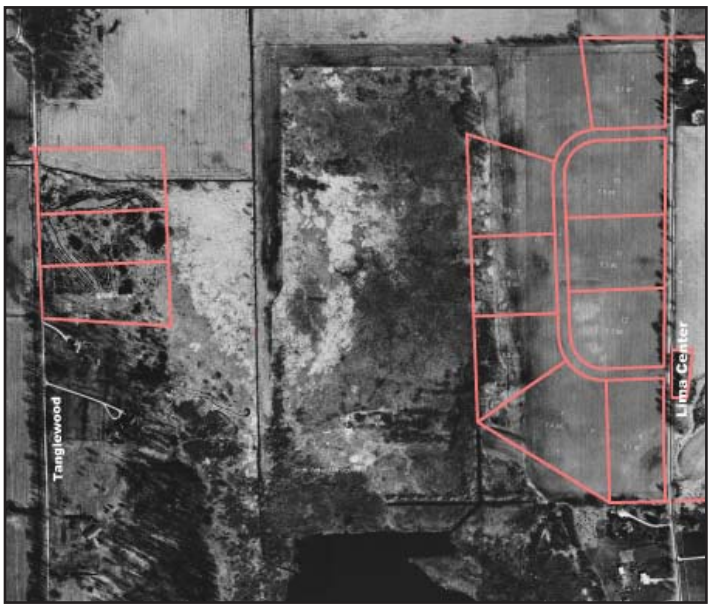
Figure 2-31. Intermediate TDR: Scio Township receiving site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Figure 2-32. Intermediate TDR: Webster Township sending site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Figure 2-33. Intermediate TDR: Dexter Township sending site with hypothetical site layout



Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Figure 2-34. Intermediate TDR: Lima Township sending site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Why would a land owner in a sending area choose to participate in a TDR?

1. Land owner is predisposed to participate in land preservation programs to allow current activity to continue in perpetuity whether the activity is farming or a passive use such as natural features.

2. Land owner is given sufficient incentive to sell his/her development rights. The TDR program in Montgomery County, MD provides incentives to land owners in sending areas. Pruetz notes that, in 1980, the County adopted a TDR program that changed the zoning of agricultural property from one unit per five acres to one unit per 25 acres.[vi] However, sending site owners were given the opportunity to sell their development rights at the previous zoning of one unit per five acres. This incentive has helped the County preserve more than 40,000 acres as of 2000 making it the most successful TDR program in the country.

Table 2-4. Intermediate TDR alternative: area, density, and number of units for Scenario 3: Scio Township

	Area (acres)	Density with TDR	# units w/ intermed. TDR
Scio Township Scenario			
Receiving site	320	1 lot per 0.5 acres	320
Sending sites			
Lima Township	358	1 lot per 40 acres	24
Dexter Township	177	0	12
Webster Township	78	0	15

Full TDR Alternative

For this alternative, all three sending sites are used to reach the increased number of units in the receiving site (420 units). All of the land in the sending sites (611 acres) is preserved. Figure 2-35 illustrates the hypothetical site layout for the receiving site under the full TDR density. Figure 2-36 shows the sending site preserved in Lima Township under full TDR density.

Figure 2-35. Full TDR: Scio Township Scenario receiving site with hypothetical site layout

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

Figure 2-36. Full TDR: Lima Township sending site when preserved through TDR

Data sources: 2000 digital aerial photography from Washtenaw County, MI; site layout from Carlisle/Wortman Associates, Inc.

What are the incentives to participate in a TDR program for developers?

Receiving area land owners can gain density. Also, developers may gain an administrative advantage through TDR program participation that allows them to move through the planning approval process more efficiently.

Table 2-5. Full TDR alternative: area, density, and number of units for Scenario 3: Scio Township

	Area (acres)	Density with TDR	# units w/ full TDR
Scio Township Scenario			
Receiving site	320	1 lot per 0.5 acres	420
Sending sites			
Lima Township	358	1 lot per 40 acres	0
Dexter Township	177	0	0
Webster Township	78	0	0

3. SIMULATION MODEL TO MEASURE IMPACTS OF SCENARIOS

The building blocks of the three development scenarios were presented in the Methodology section. The simulation modeling uses that foundation to run through a suite of indicators that measure fiscal, environmental, societal and transportation impacts of the residential developments. First, the impacts are measured without a TDR program in place. Then, the impacts are measured with a TDR program in place using the assumptions described earlier. The scenarios analyzed are:

- **Scenario 1: Highland Township**
  - 2 alternatives: No TDR, TDR
  - 2 sending sites, both needed to reach bonus density
- **Scenario 2: City of Ann Arbor**
  - 2 alternatives: No TDR, TDR
  - 3 sending sites, one needed to reach bonus density
- **Scenario 3: Scio Township**
  - 3 alternatives: No TDR, Intermediate TDR, and TDR
  - 3 sending sites, all needed to reach bonus density

Short-term and, when possible, long-term impacts are measured. The indicators were selected from a more extensive group of potential indicators that were considered by the research team and Advisory Committee and assessed individually for their added value and availability (Table 3-1). The indicators employed to measure the impacts are presented in Table 3-2.

Table 3-1. Brainstorm of indicators to analyze for measuring impacts of developments

Transportation	Environmental	Fiscal	Societal
traffic volume	impervious level	property taxes	farmland preservation
road construction	runoff	property values	public perception
road improvement	pollutants	development costs	recreation opportunity
	woodlands	infrastructure	economic diversity
	wetlands	agriculture production value	housing diversity
	fragmentation	school taxes	age diversity
	wildlife habitat	service costs	
	microclimate		
	energy use (footprint)		

A subset of indicators was selected by the research team and Advisory Committee to fit the resources and timeline of the project, as well as the tools available to the research team.

Table 3-2. Suite of indicators analyzed to measure impacts of developments

Fiscal	Environmental	Societal	Transportation
Community: Total revenue from development	Impervious surface	Distance to basic needs, motorized	Trip generation
Community: Total costs from development	Stormwater runoff	Distance to basic needs, non-motorized	Gravel road to pave
Community: Net annual fiscal impact from development	Pollutant load	Distance to block of >500 acres as farmland	Intersections to improve
Developer: Total project cost	Woodlands and wetlands	Distance to block of >75,000 acres as farmland	Sidewalks to add
Developer: Sellable unit cost	Wildlife habitat		Ongoing maintenance

These indicators are described on the following pages.

A. Fiscal Indicators

The impacts of proposed development, with and without TDR, on the fiscal interests of the community and developer were considered. The risks associated with a TDR program need to be acceptable to the parties involved in the transaction — the landowner, developer and community. In an actual development rights transfer, each party on the receiving side and the sending side needs to determine the costs and benefits to them in order to make the decision to participate in a TDR. Most often, the risks are measured in dollars and cents.

Fiscal Impacts to the Community

Fiscal impact analysis (FIA) seeks to determine the public costs and revenues that result from property investments in a community. This study performs fiscal impact analyses at the micro level. The study analyzes the fiscal effects of alternative development scenarios, namely a development scenario that uses TDR and an alternative development scenario absent TDR. The inclusion of FIA provides a practical perspective on the costs and revenues associated with the two development scenarios.

FIA attempts to measure both costs and revenues. Costs include school costs, service costs (typically roads, government, police, fire, sewer, water, recreation, waste), and debt service. Revenues include property taxes, miscellaneous taxes and fees, and state aid.

To calculate costs, this study employs an average costing method. This FIA assumes that current average costs per unit (in our case housing units) are appropriate estimates of future costs and revenues.

For each case study, the costs and revenues associated with the resulting new residential development are calculated. For each case, the "Without TDR" scenario calculates costs and revenues associated with the residential development in both the sending areas and the receiving area (at base density). Additionally, for each case, the "With TDR" scenario calculates the costs and revenues associated with the residential development in the receiving area (at bonus density).

While school costs typically are included in a FIA, school taxes are not an operating part of the millage in Michigan. In Michigan, school taxes are not part of the property tax levy, and therefore, are not part of the FIA undertaken for this study.

FIA Methods

The data needed to perform the FIA includes: median price of new home for each case study community; the number of new homes under each development scenario; the assessment rate (for Michigan 50%); the municipal tax rate; the total expenditures from the general fund; the current number of residential units; and the residential proportion of real property in the municipality. These data are used to calculate the estimated property tax revenue for each residential development scenario and the municipal service costs for each residential development scenario (Table 3-3). The net fiscal impact is simply the total revenue less the total costs.

Limitations of this Measure

A traditional FIA has a few important shortcomings. Costs such as those associated with transportation and environment are not considered in a traditional FIA. These costs often are not borne by the local municipality, but rather are costs associated with operations maintained by county and state levels of government. However, this study recognizes this limitation of FIA and includes an analysis of transportation impacts and their associated costs to remedy this shortcoming of FIA. In addition, no distinction is made in the FIA concerning the costs to provide services in high density areas versus low density areas.

Table 3-3. Fiscal Impact Assessment example for Scenario 1: Highland Township

DATA INPUT		Receiving "With TDR"
Market Value of Residential Development		
Median Price of New Home	**A**	**$300,000.00**
Number of new homes in development		
# of units	**B**	**71**
Assessment Ratio for tax purposes	**C**	**50.00%**
Town Tax Rate per $1000	**D**	**$5.57**
Total Expenditures from General Fund	**E**	**$5,946,294.00**
Existing Residential Units	**F**	**7,414**
Residential Proportion of Real Property in Town	**G**	**85.00%**
DATA CALCULATIONS		
REVENUE FROM NEW RESIDENTIAL DEVELOPMENT		
Revenue from Property Tax on Development		
Market Value of Development	**A*B**	**$21,300,000.00**
multiplied by		
Assessment Ratio	**C**	**50.00%**
Actual Assessed Value		**$10,650,000.00**
multiplied by		
Service Local Enhancement Millage	**D**	**$5.57**
Estimated Property Tax Revenue		$71,035.50
COSTS DUE TO NEW RESIDENTIAL DEVELOPMENT		
Town Shared Service expenditures	**E**	**$5,946,294.00**
multiplied by		
Residential portion of All Property	**G**	**85.00%**
Service Costs due to Residential		**$5,973,812.84**
divided by		
# of Residential Units	**F**	**7,414.00**
Service Cost per unit		**$805.75**
Number of Homes in New Development	**B**	**71.00**
Town Service Costs for Residential units		$57,208.08
NET FISCAL IMPACT FROM DEVELOPMENT		
Total Revenue from Residential Development		$71,035.50
Total Costs due to Residential Development		$57,208.08
Net Fiscal Impact per Year		$13,827.42

Fiscal Impacts to the Developer

The residential developments in this study are of the single-family, large lot type with the exception of the downtown Ann Arbor development. For those large lot developments, the land development community, rather than the building community, decides whether it makes economic sense to participate in a TDR program. Therefore, the fiscal impact analysis focuses on the land costs (horizontal costs) rather than the building costs (vertical costs), again with downtown Ann Arbor providing the exception.

The costs to the land developer were measured using the indicators of total cost for the project and cost for each sellable unit in the project. Creating a *pro forma* for each development alternative was necessary to arrive at these costs. The *pro forma* consists of general cost categories, namely land acquisition, soft costs (including fees and taxes), and improvements (see Table 3-4 for the complete template). Costs for the *pro forma* come from either the actual developer or comparable projects. When the true project costs were unavailable, a panel of experts consisting of a licensed engineer, municipal assessor, planner, landscape architect, and land developers and builders provided assumed development costs based on the particulars of the site layouts.

Developing defensible project costs for the development alternatives is a priority of this study. Realistic costs generated from local examples improve transferability of this information to other Michigan locations. This transferability is particularly useful for a community considering a TDR program without being dependent on land developers to provide specific project costs. The total project costs and per sellable unit costs are provided in Section 4 for each alternative among the three scenarios. These costs present the potential cost difference overall and per unit both with TDR and without TDR.

Among the assumptions underlying the *pro forma* costs is the assumption that soft costs for developers will change as a result of participating in a TDR. While costs associated with environmental compliance (e.g., wetland impacts) could decrease from not developing protected natural features, costs associated with the political approval process could increase due to more time needed to work through the transfer details with the community. Also legal relationships and associated costs could increase with TDR as there would be additional negotiations over contracts with sending site landowners and the community.

Limitations of this Measure

Bonus revenue from TDR is not included in the equation for developer fiscal impacts. While the TDR costs are not included, the absence is more than offset by the fact that the developer analysis does not include the increased revenue made possible by TDR. In order to measure the internal rate of return (IRR) for the developer, total revenues also are needed. If the total revenues are known, then one can figure out the profit that a developer should expect for any given scenario either with or without TDR. Additional study that gathers revenues based on comparables is warranted to measure the IRR.

Problem: Select a recently completed development to study or one not yet completed?

Ideally, recently completed residential developments would have served as the receiving sites for the study. Developers are more comfortable with providing cost information if the development is completed and units are occupied. However, the downturn in housing markets made it difficult to identify recently completed development projects. As a result, researchers requested cooperation from developers on not yet completed projects where negotiations with local governments still were underway. Not surprisingly, developers were wary about sharing costs with this study for fear doing so would compromise their business deals. In fact, the research team spent several weeks trying to persuade a large developer/builder to cooperate with the project but to no avail. The company contact expressed concern in sharing cost information that the company considers proprietary.

Solution: A panel of experts reviewed the hypothetical and actual site layouts for the receiving and sending sites involved in the scenarios and provided estimates for the development costs. The panel of experts allowed greater flexibility in selecting sites rather than being limited to the sites where developers were willing to share their costs.

Table 3-4. Land developer cost categories, pro forma template

General cost category	Value
Land Acquisition	
Soft Costs	
legal and consulting service fees	
engineering, other professional service fees	
taxes during construction	
insurance	
financing fees	
bonds and performance guarantees	
development fees or general and admin costs	
marketing and commissions	
working capital	
Improvements	
roads	
stormwater management system	
sanitary sewer system	
water system	
electric lines	
streetlights	
natural gas lines	
grading/land balancing	
sidewalks/pathways	
phone/cable lines	
infrastructure improvements fees	
testing fees	
municipal engineering review fees	
inspection fees	
landscaping	
Developer Fee	
Carrying Costs	
Total Project Cost	
Per Sellable Unit Cost	

B. Environmental Indicators

The impacts of proposed development, with and without TDR, on the terrestrial and aquatic environment were considered.

Impervious Surface

Stream research generally indicates that certain zones of stream quality exist in correlation to the level of impervious surface in a watershed. Most notably, at about 8 - 10% impervious cover sensitive stream elements are lost from the system. When the watershed reaches this threshold, the impacts of incremental increases in surface runoff noticeably affect the aquatic macroinvertebrate and fish populations and, subsequently, water-based recreation activities. A second threshold appears to exist at around 25 to 30% impervious cover, where most indicators of stream quality consistently shift to a poor condition (e.g., diminished aquatic diversity, water quality, and habitat scores). The percent of impervious surface is measured for each density alternative across the three scenarios.

Stormwater Runoff / Pollutant Load

The P-LOAD model was applied to all of the scenarios to estimate stormwater runoff and pollutant load. P-LOAD (where P stands for Pollutant) is a simple spreadsheet model that uses land use data, impervious surface percentages associated with that land use data, and annual rainfall data to determine runoff volume. The spreadsheet includes event mean concentrations (EMCs) of various pollutants developed by the Rouge River Wet Weather Demonstration Project for land uses in southeast Michigan (Table 4.2), for which it computes pollutant loads for each land use inputted. P-LOAD estimates pollutant loads for Total Phosphorus, Total Nitrogen, Total Suspended Solids, and Total Dissolved Solids.

P-LOAD uses the following equations to estimate pollutant loads:
L = 0.226*R*C*A
Where: L = Annual load (lbs)
R = Annual runoff (inches) = P*Pj*Rv
P = Annual rainfall (inches)
Pj = Fraction of annual rainfall events that produce runoff (usually 0.9)
Rv = Runoff coefficient (calculated based on impervious cover percentage (Rv=0.05+0.9*Imp%))
C = Pollutant concentration (mg/l)
A = Site (acres)
0.226 = Unit conversion factor

Woodlands and Wetlands Extent

Aerial photographs of the sites were analyzed to determine the extent of woodlands and wetlands, and then woodlands and wetlands changes were estimated with each site plan.

Wildlife Habitat

ESRI's ArcGIS 9.2 software was employed to overlay the Michigan Natural Features Inventory "biorarity" and "probability" indices (which rate each quarter-quarter section of a township for its probability of harboring endangered or threatened species or communities) to estimate the sites' potential for harboring threatened or endangered species or communities.

Limitations of this Measure

The P-LOAD model, while appropriate for this site-based study, is a simple, non-dynamic model to measure runoff and pollutant load. Temporal variation and detailed ecological processes that may result in different estimates are not measured by P-LOAD. The wildlife habitat data from MNFI is based on recorded observations of threatened and endangered species and community types, or "element occurrences". Thus, the accuracy of the data relies on the ability of the observers to accurately record their observations.

C. Societal Indicators

The impacts of proposed development, with and without TDR, on societal interactions were considered.

Proximity to Individual and Community Needs

Spatial analyses were conducted using ArcGIS to measure the distance from the sites to the nearest locations for nine common social destinations: public elementary school, public library, grocery store, pharmacy, post office, hospital, market, coffee shop, and ice cream store. The distances were measured assuming a single one-way trip per household. The site layouts were consulted to measure the midpoint of each site and the range of distances within each development based on the location of lots and the road network.

For Scenario 2: City of Ann Arbor and Scenario 3: Scio Township, the proximity of the sites to blocks of farmland was measured. A benchmark for a viable "agricultural district" is blocks of 500-acres where certain benefits can be available to neighboring farmers that create an environment conducive to farming and reduce land use conflicts. This indicator addresses the land use conflicts and nuisance issues that arise at the farm-development interface. At the county/ regional scale, a benchmark for a viable agricultural sector within a county/region is > 75,000 acres of agricultural land. This spatial analysis was conducted using ArcGIS 9.2. This indicator measures critical mass of farming activities.

Limitations of this Measure

Measuring the societal impact by calculating the distance traveled to nine typical destinations is fairly dependent on the underlying land use development form in each community. This indicator turns out to be less a measure of a TDR program itself because of its dependency on existing urban form, e.g. the suburban setting of the townships.

D. Transportation Indicators

The impacts of proposed development, with and without TDR, on the transportation system were considered. The focus was quantifying the costs to the community for enhancing the local transportation system to accommodate the new development and then maintaining the system into the future. The basic assumptions were:

- the new development would, at a minimum, require new transportation infrastructure in the form of new circulation roads and nonmotorized facilities (i.e., sidewalks) directly serving the new development;
- the new development would generate additional trips, which may overburden the existing road network requiring enhancements to that system (i.e., paved roads, additional travel lanes, and intersection improvements); and
- any additional infrastructure (either new roads and nonmotorized facilities directly related to the physical construction of the new development or additional paved surfaces, lanes, and intersection amenities related to the additional traffic generated by the new households) would require ongoing maintenance.

New Transportation Infrastructure

Using the proposed site layouts developed for the purposes of this study, the miles of new subdivision road were estimated. It was assumed that the cost of this construction would be borne by the developer, so no direct costs were anticipated for the community.

It was also assumed that sidewalks for use by both pedestrians and bicyclists would be constructed along both sides of the road, both within the new development and along existing roads within a one-mile buffer of the development. The linear distance of the new subdivision roads and existing roads within the buffer area was calculated, multiplied by two (to represent sidewalks along both sides), then multiplied by an average cost of $150,000 per mile to determine the anticipated cost to the community to construct sidewalks as necessitated by the new development. (Average costs were obtained from a national nonmotorized consortium.)

Trip Generation Due to New Households

According to SEMCOG's 2004 Household Survey (an in-depth survey of household travel characteristics and travel patterns), the average household in Southeast Michigan generates approximately 11 trips per day. These trips were broken down by trip purpose (work, shopping, school, and other) and distributed by time of day to estimate the likely number of trips into and out of the new developments during the peak one-hour period of the day (generally occurring in the evening). These new "peak-hour" trips were added to the volume of traffic currently known to exist on the surrounding road network and forecast into the future using anticipated growth rates through the year 2030. These adjusted volumes were then used to determine impacts on road surface and congestion. Trips include all modes of transportation whether motorized or nonmotorized.

Impact of Additional Trips on Road Surface

Some of the roads in the various development areas are gravel as opposed to having a paved surface (typically either asphalt or concrete). It is generally assumed that gravel roads can accommodate up to 800 vehicles per day; roads carrying traffic above that threshold require a paved surface to ensure adequate traversability and ride quality. Using this threshold and anticipated volumes, the lane miles of road to be paved were estimated and multiplied by an average cost of $584,000 per lane mile to determine the anticipated cost to the community to pave gravel roads as necessitated by the new development. (Average costs were developed from construction bid data in Southeast Michigan collected by SEMCOG.)

Impact of Additional Trips on Congestion

The average two-lane road can accommodate approximately 800 vehicles per hour per lane. By comparing the anticipated volume on the existing roads to the average capacity, a volume-to-capacity ratio (v/c) was calculated. Road lanes exceeding a certain v/c threshold (in this case, assumed to be 0.8) were considered congested. While a number of techniques can be utilized to reduce congestion, a worst-case approach was assumed in this case, namely, adding additional lanes to the road to accommodate excess traffic. Using this threshold and anticipated volumes, the number of lane miles required to reduce congestion were estimated and multiplied by an average cost of $1.1 million per lane mile to determine the anticipated cost to the community to widen roads as necessitated by the new development. (Average costs were developed from construction bid data in Southeast Michigan collected by SEMCOG.)

In addition to road segment capacity, intersection capacity can also impact congestion. Intersections are made up of approaches to the point of intersection — the major approach (or "main" street) is the roadway carrying the higher traffic volume, while the minor approach (or "cross" street) carries less traffic volume. The capacity of the intersection of two, two-lane roads is considered to be 500 vehicles per hour for the major approach (both directions) and 150 vehicles per hour for the minor approach (both directions). If the volume-to-capacity ratio for either of the approaches exceeds 0.8, the intersection was considered congested. Intersection capacity can be increased in a number of ways, including adding signalization (to intersections with stop or yield controls currently), adding right or left turn lanes, or enhancing operations at currently signalized intersections (e.g., adding a protected left-turn phase). Using this threshold and anticipated volumes, the number of intersections requiring improvement were estimated and multiplied by an average cost of $498,000 per intersection to determine the anticipated cost to the community to improve intersections as necessitated by the new development. (Average costs were developed from construction bid data in Southeast Michigan collected by SEMCOG.)

Maintenance Costs

All transportation infrastructure requires routine maintenance, including everything from spot pavement repairs to snow plowing to electrifying traffic signals. While some communities require that subdivision roads be maintained by those who live in the development, many communities do, in fact, bear this cost, in addition to the cost of maintaining public roads under their jurisdiction. For the purposes of this analysis, the miles of new subdivision roads, newly paved roads, and new lanes on existing roads were calculated, then multiplied by an average cost of $12,141 per mile to determine the anticipated cost to the community to maintain new infrastructure as necessitated by the new development. (The average costs were developed from state funding allocations and road mileage by county collected by SEMCOG.)

Limitation of this Measure

This analysis does not calculate the carbon emissions that would be generated from the various modes of transportation. Rather, the indicators selected to measure transportation impacts from the developments focus on quantifying the costs to the community for enhancing the local transportation system. Future study ought to expand the analysis to include carbon emissions estimates given the importance of this measure to global climate change.

4. RESULTS

This section presents the results of the simulation modeling for the three scenarios. An overview of the impact results by scenario is provided in Table 4-1 using an easy to read approach. In general, the hypothetical TDR alternatives created for this study show positive results across the four areas of impact – fiscal, environmental, societal and transportation. Detailed summaries of modeling results follow.

Table 4-1. Matrix of impact results and scenarios (key: ↑ represents a positive result overall with TDR; ↓ represents a negative result overall with TDR; ↔ represents a neutral result overall with TDR)

	SCENARIO		
INDICATOR	**1: Highland Township**	**2: City of Ann Arbor**	**3: Scio Township**
Fiscal			
Impact for Community	↑	↓	↔
Cost for Developer	↑	↑	↑
Environmental			
Impervious Surface	↑	↑	↑
Stormwater Runoff	↑	↑	↑
Suspended Solids	↑	↑	↑
Nutrients (TP and TN)	↑	↑	↑
Woodlands/Wetlands	↑	↑	↑
Wildlife Habitat	↑	↑	↑
Societal			
Miles to Destinations	↓	↑	↓
Agricultural Districts	N/A	↑	↑
Transportation			
Trips Generated	↓	↑	↓
Total Capital Costs	↑	↑	↑
Ongoing Costs	↑	↑	↑

A. Scenario 1: Highland Township Simulation Results

The results from analyzing the study sites in Highland Township are summarized in Table 4-2. The appendices contain the data from which the summary table is derived.

Table 4-2. Summary of impact analysis for Scenario 1: Highland Township

on next page

FISCAL IMPACTS

Fiscal Impacts - Community (Cost to Community)

Without TDR	With TDR	Change	% Change
-$8,180	-$13,827	-$5,648	-69.0

Fiscal Impacts - Developer

Without TDR			With TDR			Change	% Change
Total Project Cost	# lots	Per Sellable Unit Cost	Total Project Cost	# lots	Per Sellable Unit Cost		
$1,832,484	11	$167,000	$5,332,400	72	$74,100		
$3,921,420	10	$393,000					
$6,210,870	21	$296,000					
$11,964,754	42		$5,332,400	72		-$6,632,354	-55.4

ENVIRONMENTAL IMPACTS

Impervious Surface (in acres)

Without TDR	With TDR	Change	% Change
65.6	33.3	-32.3	-49.3%

Stormwater Runoff (in inches)

Without TDR	With TDR	Change	% Change
17.6	9.7	-7.9	-44.9%

Suspended Solids (in lb/yr)

Without TDR	With TDR	Change	% Change
34,192.2	20,553.0	-13639.2	-39.9%

Total Phosphorus (in lb/yr)

Without TDR	With TDR	Change	% Change
254.0	122.0	-132.0	-52.0%

Total Kjeldahl Nitrogen (in lb/yr)

Without TDR	With TDR	Change	% Change
1,521.7	798.6	-823.1	-50.5%

SOCIETAL IMPACTS

Total miles to all 9 social destinations

Without TDR	With TDR	Change	% Change
1,075.8	3,441.6	2,365.8	219.9

TRANSPORTATION IMPACTS

Trips Generated

Without TDR	With TDR	Change	% Change
445.8	764.2	318.4	71.4

Total Capital Cost

Without TDR	With TDR	Change	% Change
$29.7 million	$14.2 million	$15.5 million	-52.1

Total Maintenance Cost

Without TDR	With TDR	Change	% Change
$0.13 million	$0.06 million	$0.07 million	-53.8

Fiscal Impact Results

Community Costs

After taking into account the total revenue from residential development at the sites, as well as total costs due to development, the net fiscal impact to the community increases revenues by 69% with TDR, or $5,648. Without TDR, the sites as developed would bring the township $8,180 in revenue per year. With TDR, the developed site would bring the township $13,827 in revenue per year.

Developer Costs

The total project cost to the developer decreases by 55.4% when TDR is employed at the sites, for a savings of $6.6 million. The total project cost to develop all three sites (i.e., 42 lots) is $11.9 million. While the total project cost to develop the 72 lots at one site with TDR is $5.3 million. Per sellable unit cost decreases significantly when development rights are transferred. Per sellable unit costs for the three sites are $167,000-$393,000 without TDR; developers need to recoup these amounts in order to break even on their investment. Per sellable unit cost with TDR is $74,100.

Environmental Impact Results

Impervious Surface

The total amount of impervious surface across all the sites decreases by 32.3 acres when TDR is employed resulting in a 49.3% decrease over developing all three sites without TDR. Without TDR, the site layouts call for 65.6 acres of buildings and pavement. With TDR, the receiving site would be covered in 33.3 acres of impervious surface.

Stormwater Runoff

The reduction in impervious surface from transferring density from the sending sites results in a reduction of stormwater runoff, as well. Whereas developing the three sites would create 17.6 inches annually in runoff, developing one site through TDR generates 9.7 inches of runoff annually. The decrease in runoff through TDR is 7.9 inches or 44.9%.

Pollutants

Predictably, corresponding reductions in pollutant load for suspended solids, phosphorus and nitrogen are seen with decreasing impervious surface and stormwater runoff. Suspended solids decrease by 39.9%, or 13,639.2 pounds annually when TDR is employed. Total phosphorus decreases by 52%, or 132 pounds annually with TDR. Nitrogen, in the form of Total Kjeldahl Nitrogen, decreases by 50.8%, or 823.1 pounds annually with TDR.

Woodlands and Wetlands Extent

The extent of wetlands at the sending and receiving sites remains the same whether or not TDR is employed. The extent of woodland at the sites increases by 82.2% when TDR is used. The amount of stream length impacted on the sites remains unchanged since no streams traverse the sites.

Wildlife Habitat

The sending and receiving sites have a low probability of harboring endangered and threatened species or communities prior to development either with or without TDR.

Societal Impact Results

Distances by car to nine common destinations are greater with TDR than if all three sites are developed without TDR. Total miles to the destinations increase by 219.9%, or 2,365.8 miles, when only the receiving site is developed.

Transportation Impact Results

Trips Generated

Without TDR, the three developed sites generate 445.8 daily trips compared to 764.2 daily trips generated from the one site developed under a TDR. The change results in a 71.4% increase in trips generated since the number of units is doubled with TDR and the number of trips generated increases accordingly.

Total Capital Cost

The total capital cost consists of gravel roads to pave, sidewalks to construct, lane miles to add, and intersections to improve. Total capital cost for transportation decreases by 52.1%, or $15.5 million when TDR is employed. Total capital cost when all three sites are developed is $29.7 million. Total capital cost for transportation is $14.2 million when density is transferred under a TDR.

Total Maintenance Cost

Accordingly, the ongoing total maintenance costs for the transportation capital improvements decrease by 53.8%, or $70,000 annually. The annual cost to maintain transportation needs at the three sites is $130,000 without TDR compared to $60,000 at one site with TDR.

B. Scenario 2: City of Ann Arbor Simulation Results

The results from analyzing the study sites in the City of Ann Arbor under Alternative 1: Webster Township are summarized in Table 4-3. The appendices contain the data from which the summary table is derived.

Alternative 1: City of Ann Arbor and Webster Township

Table 4-3. Summary of impact analysis for Scenario 2: City of Ann Arbor and Webster Township (Alternative 1)

on next page

ALTERNATIVE 1: WEBSTER TOWNSHIP

Under this scenario either one sending area or another, or the other, transfers rights

FISCAL IMPACTS

Fiscal Impacts - Community (Cost to Community)

Without TDR	With TDR	Change	% Change
$203,034	$278,320	$75,286	37.1

Fiscal Impacts - Developer

Without TDR			With TDR			Change	% Change
Total Project Cost	# units	Per Sellable Unit Cost	Total Project Cost	# units	Per Sellable Unit Cost		
$8,402,552	114 units	$75,594	$8,897,176	104 units	$85,242		
$4,624,251	30 lots	$154,142					
$13,026,803			$8,897,176			-$4,329,627	-33.2

ENVIRONMENTAL IMPACTS

Impervious Surface (in acres)

Without TDR	With TDR	Change	% Change
19.7	2.1	-17.6	-89.5

Stormwater Runoff (in inches)

Without TDR	With TDR	Change	% Change
33.6	28.4	-5.2	-15.5

Suspended Solids (in lb/yr)

Without TDR	With TDR	Change	% Change
11,437.4	4,542.9	-6,894.6	-60.3

Total Phosphorus (in lb/yr)

Without TDR	With TDR	Change	% Change
54.3	12.3	-41.9	-77.3

Total Kjeldahl Nitrogen (in lb/yr)

Without TDR	With TDR	Change	% Change
308.9	66.4	-242.5	-78.5

SOCIETAL IMPACTS

Total miles to all 9 social destinations

Without TDR	With TDR	Change	% Change
1,883.30	823.30	-1,060.0	-56.3

TRANSPORTATION IMPACTS

Trips Generated

Without TDR	With TDR	Change	% Change
1,972	1,740	-232.0	-11.8

Total Capital Cost

Without TDR	With TDR	Change	% Change
$2,323,250	$0	-$2,323,250	-100.0

Total Maintenance Cost

Without TDR	With TDR	Change	% Change
$11,048	$0	-$11,048	-100.0

Fiscal Impact Results

Community Costs

After taking into account the total revenue from residential development at the sites, as well as total costs due to development, the net fiscal impact to the community increases costs by 37% with TDR, or $75,286 cumulative. Without TDR, the sites as developed would cost the township $203,034 per year. With TDR, the developed site would cost the City of Ann Arbor $278,320 per year.

Developer Costs

The total project cost to the developer decreases by 33.2% when TDR is employed at the sites, for a savings of $4.3 million. The total project cost to develop both sites without TDR (i.e., 144 lots) is $13.0 million. While the total project cost to develop the 164 lots at the receiving site with TDR is $8.7 million. Per sellable unit cost decreases significantly when development rights are transferred. The per sellable unit costs without TDR for the sending and receiving sites are $75,594 and $154,142, respectively; developers need to recoup these amounts in order to break even on their investment. Per sellable unit cost with TDR is $55,242.

Environmental Impact Results

Impervious Surface

Amount of impervious surface at the sites decreases by 17.6 acres when TDR is employed, for an 89.5% decrease over developing both the sending site in Webster Township and receiving site in the City of Ann Arbor without TDR. Without TDR, the site layouts call for 19.7 acres of impervious surface. With TDR, impervious surface totals 2.1 acres.

Stormwater Runoff

The reduction in impervious surface from transferring density from the sending site results in a reduction of stormwater runoff, as well. Whereas developing the both the sending and receiving site would create 33.6 inches annually in runoff, developing one receiving site through TDR generates 28.4 inches of runoff annually. The decrease in runoff through TDR is 5.2 inches or 15.5%.

Pollutants

Reductions in pollutant load for suspended solids, phosphorus and nitrogen are seen with decreasing impervious surface and stormwater runoff. Suspended solids decrease by 60.3%, or 6,894.6 pounds annually when TDR is employed. Total phosphorus decreases by 77.3%, or 41.9 pounds annually with TDR. Nitrogen, in the form of Total Kjeldahl Nitrogen, decreases by 78.5%, or 242.5 pounds annually with TDR.

Woodlands and Wetlands Extent

The extent of wetlands at the Webster Township sending site and the receiving site remains the same whether or not TDR is employed. The extent of woodlands at the sending site increases by 80% when TDR is used. The amount of stream length impacted on the sites remains unchanged since no stream traverses the receiving site and impact to the stream segment at the sending site can be avoided.

Wildlife Habitat

The receiving site has a low probability of harboring endangered and threatened species or communities since the site is developed already. The sending site in Webster Township has a high probability of harboring endangered and threatened species or communities.

Societal Impact Results

Distance to Destinations

Distances by car to nine common social destinations are less with TDR than if both the Webster sending site and City of Ann Arbor receiving site are developed without TDR. Total miles to the destinations decrease by 56.3%, or 1,060 miles, when only the receiving site is developed.

Distance to Farmland

Preservation of high quality agricultural land is a goal of TDR for this scenario, in addition to preservation of important natural features. The proximity of the sending and receiving sites to blocks of existing farmland, primarily contiguous, is measured in one-mile, two-mile, and five-mile radii around the sites. The Webster Township sending site, meets the minimum standard of 500 acres of farmland at all three distances: one-mile radius contains 2,126 acres; two-mile radius contains 7,301 acres; and five-mile radius contains 21,845 acres. Further, the sending site is located within a region where more than 75,000 acres are farmed actively; more than 400,000 acres are farmed actively in Washtenaw and Monroe counties alone. The region meets the benchmark for a viable agricultural sector.

Transportation Impact Results

Trips Generated

Without TDR, the developments associated with the sending site and the receiving site generate 1,972 daily trips compared to 1,740 daily trips generated from the one site developed under a TDR. The change results in a 11.8% decrease in trips generated.

Total Capital Cost

The total capital cost consists of gravel roads to pave, sidewalks to construct, lane miles to add, and intersections to improve. Total capital cost for transportation decreases by 100%, or $2.323 million when TDR is employed. Total capital cost when both the sending site and the receiving site are developed is $2.323 million. If TDR were employed, there would be no new development in the sending area, and the transportation network already exists in the receiving area, resulting in no new capital cost for transportation.

Total Maintenance Cost

The ongoing total maintenance costs for the transportation capital improvements also decrease by 100%, or $11,048 annually.

Alternative 2: City of Ann Arbor and Dexter Township

The results from analyzing the study sites in the City of Ann Arbor under Alternative 2: Dexter Township are summarized in Table 4-4. The appendices contain the data from which the summary table is derived.

Table 4-4. Summary of impact analysis for Scenario 2: City of Ann Arbor and Dexter Township (Alternative 2)

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ALTERNATIVE 2: DEXTER TOWNSHIP

Under this scenario either one sending area or another, or the other, transfers rights

FISCAL IMPACTS

Fiscal Impacts - Community (Cost to Community)

Without TDR	With TDR	Change	% Change
$196,157	$278,320	$82,163	41.9

Fiscal Impacts - Developer

Without TDR			With TDR			Change	% Change
Total Project Cost	# units	Per Sellable Unit Cost	Total Project Cost	# units	Per Sellable Unit Cost		
$8,402,552	114 units	$75,594	$8,897,176	184 units	$55,242		
$4,755,771	25 lots	$190,231					
$13,158,323			$8,897,176			-$4,461,147	-33.9

ENVIRONMENTAL IMPACTS

Impervious Surface (in acres)

Without TDR	With TDR	Change	% Change
24.4	1.7	-22.7	-93.2

Stormwater Runoff (in inches)

Without TDR	With TDR	Change	% Change
33.2	28.4	-4.8	-14.5

Suspended Solids (in lb/yr)

Without TDR	With TDR	Change	% Change
13,735.0	3,553.8	-10,181.2	-74.1

Total Phosphorus (in lb/yr)

Without TDR	With TDR	Change	% Change
68.1	9.9	-58.2	-85.0

Total Kjeldahl Nitrogen (in lb/yr)

Without TDR	With TDR	Change	% Change
379.1	52.3	-326.8	-86.2

SOCIETAL IMPACTS

Total miles to all 9 social destinations

Without TDR	With TDR	Change	% Change
1,922.3	823.3	-1,099.0	-57.2

TRANSPORTATION IMPACTS

Trips Generated

Without TDR	With TDR	Change	% Change
1,825	1,740	-85.0	-4.7

Total Capital Cost

Without TDR	With TDR	Change	% Change
$7,060,228	$0	-$7,060,228	-100.0

Total Maintenance Cost

Without TDR	With TDR	Change	% Change
$60,232	$0	-$60,232	-100.0

Fiscal Impact Results

Community Costs

After taking into account the total revenue from residential development at the sites, as well as total costs due to development, the net fiscal impact to the community increases costs by 41.9% with TDR, or $82,163 cumulative. Without TDR, the sites as developed would cost the township $196,157 per year. With TDR, the developed site would cost the City of Ann Arbor $278,320 per year.

Developer Costs

The total project cost to the developer decreases by 33.9% when TDR is employed at the sites, for a savings of $4.5 million. The total project cost to develop both sites without TDR (i.e., 139 lots) is $13.2 million. While the total project cost to develop the 164 lots at the City receiving site with TDR is $8.7 million. Per sellable unit cost decreases significantly when development rights are transferred. Per sellable unit costs for the sending and receiving sites are $75,594 and $190,231, respectively; developers need to recoup these amounts in order to break even on their investment. Per sellable unit cost with TDR is $55,242.

Environmental Impact Results

Impervious Surface

Amount of impervious surface at the sites decreases by 22.7 acres when TDR is employed, for a 93.2% decrease over developing both the sending site in Dexter Township and receiving site in the City of Ann Arbor without TDR. Without TDR, the site layouts call for 24.4 acres of buildings and pavement. With TDR, impervious surface covers 1.7 acres.

Stormwater Runoff

The reduction in impervious surface from transferring density from the Dexter sending site to the City receiving site results in a reduction of stormwater runoff. Whereas developing the both the sending and receiving site would create 33.2 inches annually in runoff, developing one receiving site through TDR generates 28.4 inches of runoff annually. The decrease in runoff through TDR is 4.8 inches or 14.5%.

Pollutants

Reductions in pollutant load for suspended solids, phosphorus and nitrogen are seen with decreasing impervious surface and stormwater runoff. Suspended solids decrease by 74.1%, or 10,181.2 pounds annually when TDR is employed. Total phosphorus decreases by 85.0%, or 56.2 pounds annually with TDR. Nitrogen, in the form of Total Kjeldahl Nitrogen, decreases by 86.2%, or 326.8 pounds annually with TDR.

Woodlands and Wetlands Extent

The extent of wetlands at the Dexter Township sending site increases by 60.3% under the TDR alternative. The extent of woodlands at the sending site remains the same whether or not TDR is employed. The amount of stream length impacted at the sending site decreases by 100%, or 1,900 ft under the TDR alternative.

Wildlife Habitat

The sending site in Dexter Township has a low probability of harboring endangered and threatened species or communities.

Societal Impact Results

Distance to Destinations

Distances by car to nine common social destinations are less with TDR than if both the Dexter sending site and City of Ann Arbor receiving site are developed without TDR. Total miles to the destinations decrease by 57.2%, or 1,099 miles, when only the receiving site is developed.

Distance to Farmland

The Dexter Township sending site meets the minimum standard of 500 acres of farmland at all three distances: one-mile radius contains 2,380 acres; two-mile radius contains 7,975 acres; and five-mile radius contains 23,426 acres. This sending site, among the three sending sites, is surrounded by the most active farmland. As with the Webster Township sending site, the Dexter Township site is located within a region where more than 75,000 acres are farmed actively; more than 400,000 acres are farmed actively in Washtenaw and Monroe counties alone.

Transportation Impact Results

Trips Generated

Without TDR, the developments associated with the sending and receiving sites generate 1,825 daily trips compared to 1,740 daily trips generated from the one site developed under a TDR. The change results in a 4.7% decrease in trips generated.

Total Capital Cost

The total capital cost consists of gravel roads to pave, sidewalks to construct, lane miles to add, and intersections to improve. Total capital cost for transportation decreases by 100%, or $7.1 million when TDR is employed. Total capital cost when both the sending site and the receiving site are developed is $7.1 million. If TDR were employed, there would be no new development in the sending area, and the transportation network already exists in the receiving area, resulting in no new capital cost for transportation.

Total Maintenance Cost

The ongoing total maintenance costs for the transportation capital improvements also decrease by 100%, or $60,232 annually.

Alternative 3: City of Ann Arbor and Scio Township

The results from analyzing the study sites in the City of Ann Arbor under Alternative 3: Scio Township are summarized in Table 4-5. The appendices contain the data from which the summary table is derived.

Table 4-5. Summary of impact analysis for Scenario 2: City of Ann Arbor and Scio Township (Alternative 3)

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ALTERNATIVE 3: SCIO TOWNSHIP

used cluster option for Scio Township sending site

FISCAL IMPACTS

Fiscal Impacts - Community (Cost to Community)

Without TDR	With TDR	Change	% Change
$196,812	$278,320	$81,508	41.4

Fiscal Impacts - Developer

Without TDR			With TDR			Change	% Change
Total Project Cost	# units	Per Sellable Unit Cost	Total Project Cost	# units	Per Sellable Unit Cost		
$8,402,552	114 units	$75,594	$8,897,176	164 units	$55,242		
$5,928,882	35 lots	$169,397					
$14,331,434			$8,897,176			-$5,634,258	-39.3

ENVIRONMENTAL IMPACTS

Impervious Surface (in acres)

Without TDR	With TDR	Change	% Change
20.0	3.2	-16.8	-84.2

Stormwater Runoff (in inches)

Without TDR	With TDR	Change	% Change
32.3	28.2	-4.1	-12.7

Suspended Solids (in lb/yr)

Without TDR	With TDR	Change	% Change
10,690.7	5,438.7	-5,252.0	-49.1

Total Phosphorus (in lb/yr)

Without TDR	With TDR	Change	% Change
50.3	15.4	-35.0	-69.5

Total Kjeldahl Nitrogen (in lb/yr)

Without TDR	With TDR	Change	% Change
289.2	82.9	-206.4	-71.4

SOCIETAL IMPACTS

Total miles to all 9 social destinations

Without TDR	With TDR	Change	% Change
2,465.8	823.3	-1,642.5	-66.6

TRANSPORTATION IMPACTS

Trips Generated

Without TDR	With TDR	Change	% Change
2,071	1,740	-331.0	-16.0

Total Capital Cost

Without TDR	With TDR	Change	% Change
$4,430,800	$0	-$4,430,800	-100.0

Total Maintenance Cost

Without TDR	With TDR	Change	% Change
$6,071	$0	-$6,071	-100.0

Fiscal Impact Results

Community Costs

After taking into account the total revenue from residential development at the sites, as well as total costs due to development, the net fiscal impact to the community increases costs by 41.4% with TDR, or $81,508 cumulative. Without TDR, the sites as developed would cost the township $196,812 per year. With TDR, the developed site would cost the City of Ann Arbor $278,320 per year.

Developer Costs

The total project cost to the developer decreases by 39.3% when TDR is employed at the sites, for a savings of $5.6 million. The total project cost to develop both sites without TDR (i.e., 149 lots) is $14.3 million. While the total project cost to develop the 164 lots at the City receiving site with TDR is $8.7 million. Per sellable unit cost decreases significantly when development rights are transferred. Per sellable unit costs without TDR for the receiving site and sending site are $75,594 and $169,397, respectively; developers need to recoup these amounts in order to break even on their investment. Per sellable unit cost with TDR is $55,242.

Environmental Impact Results

Impervious Surface

Amount of impervious surface at the sites decreases by 16.8 acres when TDR is employed, for a 84.2% decrease over developing both the sending site in Scio Township and receiving site in the City of Ann Arbor without TDR. Without TDR, the site layouts call for 20.0 acres of buildings and pavement. With TDR, impervious surface covers 3.2 acres.

Stormwater Runoff

The reduction in impervious surface from transferring density from the Scio sending site to the City receiving site results in a reduction of stormwater runoff. Whereas developing both the sending and receiving sites would create 32.3 inches annually in runoff, developing the receiving site through TDR generates 28.2 inches of runoff annually. The decrease in runoff through TDR is 4.1 inches or 12.7%.

Pollutants

Reductions in pollutant load for suspended solids, phosphorus and nitrogen are seen with decreasing impervious surface and stormwater runoff. Suspended solids decrease by 49.1%, or 5,252 pounds annually when TDR is employed. Total phosphorus decreases by 69.5%, or 35.0 pounds annually with TDR. Nitrogen, in the form of Total Kjeldahl Nitrogen, decreases by 71.4%, or 206.4 pounds annually with TDR.

Woodlands and Wetlands Extent

The extent of wetlands at the Scio Township sending site increases by 1.1% under the TDR alternative, when the cluster option is used at the sending site. By comparison, the wetlands extent increases 6.6% with TDR when the standard split is used at the sending site. The extent of woodlands at the sending site (cluster option) increases 63.6% when TDR is employed; woodlands increases by 100% at the sending site compared to the standard split. The amount of stream length impacted at the sending site decreases by 100%, or 3,000 ft under the TDR alternative for both the cluster and standard split options.

Wildlife Habitat

The sending site in Scio Township has a low probability of harboring endangered and threatened species or communities.

Societal Impact Results

Distance to Destinations

Distances by car to nine common social destinations are less with TDR than if both the Scio sending site and City of Ann Arbor receiving site are developed without TDR. Total miles to the destinations decrease by 66.6%, or 1,642.5 miles, when only the receiving site is developed.

Distance to Farmland

The Scio Township sending site meets the minimum standard of 500 acres of farmland at all three distances: one-mile radius contains 1,772 acres; two-mile radius contains 6,257 acres; and five-mile radius contains 21,059 acres. This sending site, among the three sending sites, is surrounded by the most active farmland. As with the Webster Township sending site, the Dexter Township site is located within a region where more than 75,000 acres are farmed actively; more than 400,000 acres are farmed actively in Washtenaw and Monroe counties alone.

Transportation Impact Results

Trips Generated

Without TDR, the developments associated with the sending and receiving sites generate 2,071 daily trips compared to 1,740 daily trips generated from the one site developed under a TDR. The change results in a 16% decrease in trips generated.

Total Capital Cost

The total capital cost consists of gravel roads to pave, sidewalks to construct, lane miles to add, and intersections to improve. Total capital cost for transportation decreases by 100%, or $4.4 million when TDR is employed. Total capital cost when both the sending site and the receiving site are developed is $4.4 million. If TDR were employed, there would be no new development in the sending area, and the transportation network already exists in the receiving area, resulting in no new capital cost for transportation.

Total Maintenance Cost

The ongoing total maintenance costs for the transportation capital improvements also decrease by 100%, or $6,071 annually.

C. Scenario 3: Scio Township Simulation Results

The results from analyzing the study sites in Scio Township under two alternatives (Alternative 1: Intermediate TDR, and Alternative 2: Full TDR) are summarized in Table 4-6 and 4-7. The appendices contain the data from which the summary table is derived.

Alternative 1: Intermediate TDR – Scio Township and Webster, Dexter and Lima Townships

Table 4-6. Summary of impact analysis for Scenario 3: Scio Township with Webster, Dexter and Lima townships (Intermediate TDR Alternative)

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ALTERNATIVE 1: With TDR at Intermediate Level

FISCAL IMPACTS

Fiscal Impacts - Community (Cost to Community)

Without TDR	With TDR	Change	% Change
$34,498	$36,848	$2,350	6.8

Fiscal Impacts - Developer

Without TDR			With TDR				
Total Project Cost	# units	Per Sellable Unit Cost	Total Project Cost	# units	Per Sellable Unit Cost	Change	% Change
$20,978,915	207 lots	$101,347	$16,430,389	320 lots	$51,345		
$4,624,251	30 lots	$154,142	$2,787,275	15 lots	$185,818		
$4,755,771	25 lots	$190,231	$3,491,043	12 lots	$290,920		
$8,399,952	52 lots	$161,538	$6,498,105	24 lots	$270,798		
$38,758,889			$29,207,822			-$9,551,067	-24.6

ENVIRONMENTAL IMPACTS

Impervious Surface (in acres)

Without TDR	With TDR	Change	% Change
221.0	155.8	-65.2	-29.5

Stormwater Runoff (in inches)

Without TDR	With TDR	Change	% Change
31.0	28.2	-2.8	-9.0

Suspended Solids (in lb/yr)

Without TDR	With TDR	Change	% Change
109,539.1	78,497.5	-31,041.6	-28.3

Total Phosphorus (in lb/yr)

Without TDR	With TDR	Change	% Change
747.9	583.1	-164.7	-22.0

Total Kjeldahl Nitrogen (in lb/yr)

Without TDR	With TDR	Change	% Change
4,695.0	3,723.0	-972.9	-20.7

SOCIETAL IMPACTS

Total miles to all 9 social destinations

Without TDR	With TDR	Change	% Change
12,514.1	13,177.5	663.4	5.3

TRANSPORTATION IMPACTS

Trips Generated

Without TDR	With TDR	Change	% Change
3,222	9,125	5,903.0	183.2

Total Capital Cost

Without TDR	With TDR	Change	% Change
$18,708,059	$18,708,059	$0	0.0

Total Maintenance Cost

Without TDR	With TDR	Change	% Change
$147,117	$134,127	-$12,990	-8.8

Fiscal Impact Results

Community Costs

After taking into account the total revenue from residential development at the sites, as well as total costs due to development, the net fiscal impact to the community increases costs by 6.8% with TDR, or $2,350 cumulative. Without TDR, the sites as developed would cost the township $34,496 per year. With TDR, the single developed site would cost the township $36,846 per year.

Developer Costs

The total project cost to the developer decreases by 24.6% when TDR is employed at the sites, for a savings of $9.6 million. The total project cost to develop all four sites without TDR (i.e., 314 lots) is $38.8 million. While the total project cost to develop the 371 lots with intermediate TDR is $29.2 million. Per sellable unit costs for the four sites range from $101,347 to $190,231 without TDR; developers need to recoup these amounts in order to break even on their investment. Per sellable unit cost with intermediate TDR for the four sites ranges from $51,345 to $290,920; per sellable unit cost for the development in Scio Township decreases by half while per sellable unit cost for the developments at the other three township sites increases significantly.

Environmental Impact Results

Impervious Surface

Amount of impervious surface at the sites decreases by 65.2 acres when intermediate TDR is employed, for a 29.5% decrease over developing all of the sending sites and the receiving site in Scio Township without TDR. Without TDR, the site layouts call for 221.0 acres of buildings and pavement. With intermediate TDR, the sending and receiving sites would be covered in 155.8 acres of impervious surface.

Stormwater Runoff

The reduction in impervious surface from transferring density from the sending sites results in a reduction of stormwater runoff, as well. Whereas developing all of the sending sites and receiving site would create 31.0 inches annually in runoff, developing the single receiving site through intermediate TDR generates 28.2 inches of runoff annually. The decrease in runoff through intermediate TDR is 2.8 inches or 9.0%.

Pollutants

Reductions in pollutant load for suspended solids, phosphorus and nitrogen are seen with decreasing impervious surface and stormwater runoff. Suspended solids decrease by 28.3%, or 31,041.6 pounds annually when intermediate TDR is employed. Total phosphorus decreases by 22.0%, or 164.7 pounds annually with intermediate TDR. Nitrogen, in the form of Total Kjeldahl Nitrogen, decreases by 20.7%, or 972.9 pounds annually with intermediate TDR.

Woodlands and Wetlands Extent

The extent of wetlands at the three sending sites and the receiving site increases by 48.5% when the intermediate TDR alternative is used instead of developing the sites without TDR. The extent of woodlands at the sites increases by 497.2% when intermediate TDR is used. The amount of stream length impacted on the sites decreases by 15.6% under intermediate TDR.

Wildlife Habitat

The receiving site has a high probability of harboring endangered and threatened species or communities. The sending site in Webster Township has a high probability of harboring endangered and threatened species or communities, while the sending sites in Dexter and Lima townships have low probabilities.

Societal Impact Results

Distance to Destinations

Distances by car to nine common social destinations are slightly greater with intermediate TDR than if all of the sending sites and receiving site are developed without TDR. Total miles to the destinations increase by 5.3%, or 663.4 miles, when only the receiving site is developed.

Distance to Farmland

Preservation of high quality agricultural land is a goal of TDR for this scenario, in addition to preservation of important natural features. The proximity of the sending and receiving sites to blocks of existing farmland, primarily contiguous, is measured in one-mile, two-mile, and five-mile radii around the sites. As was stated earlier for Scenario 2, the Webster Township and Dexter Township sending sites meet the minimum standard of 500 acres of farmland at all three distances and are located within a region that meets the benchmark for a viable agricultural sector. In addition, the Lima Township sending site is surrounded by 2,179 acres of active farmland within a one-mile radius, 7,150 acres within a two-mile radius, and 22,410 acres within a five-mile radius.

Transportation Impact Results

Trips Generated

Without TDR, the four developed sites generate 3,222 daily trips compared to 9,125 daily trips generated from all four sites developed under an intermediate TDR. The change results in a 183.2% increase in trips generated.

Total Capital Cost

The total capital cost consists of gravel roads to pave, sidewalks to construct, lane miles to add, and intersections to improve. Total capital cost for transportation is unchanged when intermediate TDR is employed. Total capital cost when all four sites are developed is $18.7 million.

Total Maintenance Cost

The ongoing total maintenance costs for the transportation capital improvements decrease by 8.8%, or $12,990 annually. The annual cost to maintain transportation needs at the four sites is $147,117 without TDR compared to $134,127 at the four sites with intermediate TDR.

Alternative 2: Full TDR – Scio Township and Webster, Dexter and Lima Townships

Table 4-7. Summary of impact analysis for Scenario 3: Scio Township with Webster, Dexter and Lima townships (Full TDR Alternative)

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ALTERNATIVE 2: With TDR at Full Level

FISCAL IMPACTS

Fiscal Impacts - Community (Cost to Community)

Without TDR	With TDR	Change	% Change
$34,498	$40,151	$5,656	16.4

Fiscal Impacts - Developer

Without TDR			With TDR			Change	% Change
Total Project Cost	# units	Per Sellable Unit Cost	Total Project Cost	# units	Per Sellable Unit Cost		
$20,978,015	207 lots	$101,347	$17,079,360	420	$40,665		
$4,624,251	30 lots	$154,142					
$4,755,771	25 lots	$190,231					
$8,399,852	52 lots	$161,536					
$38,758,889			$17,079,360			-$21,679,529	-55.9

ENVIRONMENTAL IMPACTS

Impervious Surface (in acres)

Without TDR	With TDR	Change	% Change
221.0	70.9	-150.1	-67.9

Stormwater Runoff (in inches)

Without TDR	With TDR	Change	% Change
31.0	12.5	-18.5	-59.7

Suspended Solids (in lb/yr)

Without TDR	With TDR	Change	% Change
109,539.1	58,318.8	-51,220.3	-46.8

Total Phosphorus (in lb/yr)

Without TDR	With TDR	Change	% Change
747.9	300.2	-447.6	-59.9

Total Kjeldahl Nitrogen (in lb/yr)

Without TDR	With TDR	Change	% Change
4,666.0	1,835.8	-2,857.2	-60.9

SOCIETAL IMPACTS

Total miles to all 9 social destinations

Without TDR	With TDR	Change	% Change
12,514.1	13,708.8	1,194.7	9.5

TRANSPORTATION IMPACTS

Trips Generated

Without TDR	With TDR	Change	% Change
3,222	10,330	7,108.0	220.6

Total Capital Cost

Without TDR	With TDR	Change	% Change
$18,706,059	$3,187,663	-$15,520,396	-83.0

Total Maintenance Cost

Without TDR	With TDR	Change	% Change
$147,117	$63,497	-$83,620	-56.8

Fiscal Impact Results

Community Costs

After taking into account the total revenue from residential development at the sites, as well as total costs due to development, the net fiscal impact to the community increases costs by 16.4% with TDR, or $5,656 cumulative. Without TDR, the sites as developed would cost the township $34,496 per year. With TDR, the developed site would cost the township $40,151 per year.

Developer Costs

The total project cost to the developer decreases by 55.9% when TDR is employed at the sites, for a savings of $21.7 million. The total project cost to develop all four sites without TDR (i.e., 314 lots) is $38.8 million. While the total project cost to develop the 420 lots at the receiving site with TDR is $17.1 million. Per sellable unit costs for the four sites ranges from $101,347 to $190,231 without TDR; developers need to recoup these amounts in order to break even on their investment. Per sellable unit cost with TDR is $40,665.

Environmental Impact Results

Impervious Surface

Amount of impervious surface at the sites decreases by 150.1 acres when TDR is employed, for a 67.9% decrease over developing all three sending sites and the receiving site in Scio Township without TDR. Without TDR, the site layouts call for 221.0 acres of impervious surface. With TDR, impervious surface covers 70.9 acres.

Stormwater Runoff

The reduction in impervious surface from transferring density from the sending sites results in a reduction of stormwater runoff, as well. Whereas developing all of the sending sites and receiving site would create 31.0 inches annually in runoff, developing the single receiving site through TDR generates 12.5 inches of runoff annually. The decrease in runoff through TDR is 18.5 inches or 59.7%.

Pollutants

Reductions in pollutant load for suspended solids, phosphorus and nitrogen are seen with decreasing impervious surface and stormwater runoff. Suspended solids decrease by 46.8%, or 51,220.3 pounds annually when TDR is employed. Total phosphorus decreases by 59.9%, or 447.6 pounds annually with TDR. Nitrogen, in the form of Total Kjeldahl Nitrogen, decreases by 60.8%, or 2,857.2 pounds annually with TDR.

Woodlands and Wetlands Extent

The extent of wetlands at the three sending sites and the receiving site increases by 54.9% when the full TDR alternative is used instead of developing the sites without TDR. The extent of woodlands at the sites increases by 508.9% when the full TDR alternative is used. The amount of stream length impacted on the sites decreases by 21.6% under the full TDR alternative.

Wildlife Habitat

The probabilities of the sending and receiving sites to harbor endangered and threatened species or communities were described under the intermediate TDR alternative.

Societal Impact Results

Distance to Destinations

Distances by car to nine common social destinations are slightly greater with TDR than if all of the sending sites and receiving site are developed without TDR. Total miles to the destinations increase by 9.5%, or 1,194.7 miles, when only the receiving site is developed.

Distance to Farmland

As was stated above, the three sending sites meet the minimum standard of 500 acres of farmland at all three distances and are located within a region that meets the benchmark for a viable agricultural sector.

Transportation Impact Results

Trips Generated

Without TDR, the four developed sites generate 3,222 daily trips compared to 10,330 daily trips generated from developing the receiving site under TDR. The change results in a 220.6% increase in trips generated.

Total Capital Cost

The total capital cost consists of gravel roads to pave, sidewalks to construct, lane miles to add, and intersections to improve. Total capital cost for transportation with TDR decreases by 83%, or $15.5 million. Total capital cost when all four sites are developed without TDR is $18.7 million. Total capital costs for developing the receiving site is $3.2 million.

Total Maintenance Cost

The ongoing total maintenance costs for the transportation capital improvements decrease by 56.8%, or $83,620 annually. The annual cost to maintain transportation needs at the four sites is $147,117 without TDR compared to $63,497 at the four sites with TDR.

5. DISCUSSION

Why is the Huron River Watershed Council, a river protection organization, looking at transfer of development rights?

The Huron River is considered the cleanest urban river in Michigan due, in large part, to the undeveloped land in its headwaters. However, existing built land and new poorly planned development threatens the integrity of the Huron River system by contributing pollutants and stormwater runoff that degrade the river and its streams, lakes, wetlands, and groundwater. Protecting the remaining unbuilt areas of the Huron River Watershed is crucial to maintaining the quality of the Huron River system.

Transfer of development rights holds potential value as a land preservation tool to protect natural areas and agricultural land in the Huron River Watershed and throughout Michigan. Communities participating in a TDR program identify the natural areas that perform important functions to maintain the ecological processes that keep the watershed healthy. Functions such as providing drinking water, filtering pollutants, stabilizing shorelines, moderating flood waters, and providing wildlife habitat are provided by lakes, wetlands, rivers, floodplains, groundwater recharge areas, woodlands and grasslands. Density transfers take the pressure of development off of these lands that are the backbone of our "Green Infrastructure". In the same way, TDR can help preserve agricultural land identified for protection by a community.

The Huron River Watershed is home to some of Michigan's most dynamic and fastest growing communities. Several key ingredients necessary to a successful TDR program are present in these communities and suggest a readiness to employ this land preservation tool:

1. Presence of communities that are innovative and open to emerging policy tools that help shape growth patterns
2. Presence of communities with substantial environmental and cultural values (e.g., City of Ann Arbor and surrounding townships participate in the Greenbelt program; Washtenaw County and townships passed PDR ordinances to preserve agricultural land; Oakland County is implementing a Green Infrastructure Program)
3. Communities with development pressures (e.g., Livingston County remains Michigan's fastest growing county, growth continues in Highland Township and the Ann Arbor metropolitan area)

Yet, to date, there are few working examples of TDR in Michigan or the Huron River Watershed.

Project Findings

In general, the TDR alternative was advantageous for most of the indicators measured for each of the three scenarios. Table 4-1 provides a visual summary of the results of the simulation modeling presented in Section 4. The four areas measured – fiscal, environmental, societal and transportation – showed a reduced impact when TDR was employed in most situations.

As summarized in Table 4-1, the impacts of the development with TDR were generally positive for Scenario 1: Highland Township; only two indicators had increased impact with TDR (miles traveled to nine destinations; trips generated) and those results had much to do with the location of the sending and receiving sites rather than the TDR program itself as will be discussed later in this section. For Scenario 2: City of Ann Arbor, the impacts of the development with TDR showed a decrease across all areas. The sole exception is the cost to the community which increased with the TDR alternative; this unexpected increase can be explained by the incomplete nature of the traditional Fiscal Impact Analysis used to measure fiscal impacts for a community as was discussed in Section 3. For Scenario 3: Scio Township, the impacts of the developments with a full TDR program were generally positive; costs to the community increased slightly and the trips generated increased substantially due to the net increase in 106 residential units under the TDR alternative. The intermediate TDR program measured for Scenario 3 showed the impacts of the developments trending downward but the benefits were not as pronounced as with the full TDR alternative. In the intermediate TDR alternative, all four sites would be developed to some extent which created more impact than if only one of the sites was developed.

Consistently, environmental impacts are reduced significantly when TDR is employed across all scenarios. For Scenario 1: Highland Township, 308 acres would be preserved including 113 acres of woodlands and 65 acres of wetlands. While the density would increase at the receiving site, the two sending sites would remain undeveloped resulting in the reduction of impacts to the environment by 40% to 52%. For Scenario 2: City of Ann Arbor, 430 acres would be preserved including 183 acres of farmland, 27 acres of woodland and 220 acres of wetlands. Additionally, nearly 5,000 feet of stream would be protected from development in the sending sites and the Webster Township sending site would maintain its habitat that has a high probability of providing habitat to threatened and endangered species and community types. While the density would increase at the receiving site, the sending sites would remain undeveloped resulting in the reduction of impacts to the environment by 13% to 93%, depending on which sending site is used. For Scenario 3: Scio Township, 611 acres would be preserved including 432 acres of farmland, 130 acres of woodlands and 194 acres of wetlands. While the density would increase at the receiving site, the sending sites would

remain undeveloped resulting in the reduction of impacts to the environment by 9% to 30% with the intermediate TDR alternative, or 47% to 68% with the full TDR alternative.

This study finds a clear cost advantage for the developer engaged in a transfer of development rights. Across all of the scenarios, the costs associated with developing the sites decrease substantially with the TDR alternative. Under a TDR program, the developer incurs the costs to develop the receiving site and the actual cost to buy the development rights from the land owners in the sending sites. While this study does not include the actual cost to buy a right, it can reasonably be assumed that the developer would be motivated financially to participate in a TDR since the additional cost to buy the rights would still be less than developing all study sites in any one scenario. For example, the average price for development rights is $16,240/acre in the Ann Arbor area, according to the City of Ann Arbor Greenbelt Program. Furthermore, the study does not estimate the revenues generated by the developments for the developer. Adding revenues to the equation likely would increase the financial incentives for a developer to participate in a TDR program.

Another key finding of the study is that the results are affected by the locations of the sending and receiving areas because the impacts are spatially dependent. In general, TDR generates the greatest benefits for the Ann Arbor scenario due to the close proximity to the amenities of urban living and less dependency on car travel. Impacts with TDR are not uniformly positive in suburban townships when the receiving sites are located away from existing infrastructure or when service areas are spread out.

Measuring the societal impact by calculating the distance traveled to nine typical destinations is fairly dependent on the underlying land use development form in each community. This indicator turns out to be less a measure of a TDR program itself because of its dependency on existing urban form, e.g. the suburban setting of the townships. This finding underscores the need to be discerning in applying a TDR program so that anticipated benefits of land preservation can be realized.

A few factors help to explain why a few impacts increase with TDR in some scenarios, specifically, the costs to the community and trips generated.

By using a 2:1 allocation rate in the TDR alternatives, the total number of units increases beyond that number that would have resulted without TDR. More units results in more expenditures by the community to provide services to those residences. Increasing the number of units, and therefore, the number of people, increases the trips generated as well. The allocation rate helps to explain how the number of trips generated in Scenario 3: Scio Township increases 200% with TDR since more residential units result with the TDR alternative versus without TDR (a net of 106 units).

A closer look at the method used to measure community costs reveals that it is not telling the whole fiscal impact story. A traditional Fiscal Impact Analysis (FIA) has a few important shortcomings that explain why TDR does not appear favorable to a community's bottom line in the simulation modeling. Neither transportation nor environmental costs are considered in a traditional FIA.

Transportation costs often are not borne by the local municipality, but rather are costs associated with operations maintained by county and state levels of government. However, this study recognizes this limitation of FIA and includes an analysis of transportation impacts and their associated costs to remedy this shortcoming of FIA. This study finds that TDR provides a cost advantage for short-term and long-term transportation needs. Moreover, a traditional FIA makes no distinction concerning the costs to provide services in high density areas versus low density areas. Previous studies show that costs to provide services in low density areas are higher than in high density areas. A Cost of Community Services for Highland Township completed during this study by another researcher demonstrates a more complete accounting of costs and revenues per land use than the FIA approach and is included in the appendices to this report. A Cost of Community Services study, because of its detailed analysis, is a more desirable approach to measuring fiscal costs but it is also much more resource intensive.

How can a study of potential TDR impacts be comprehensive?

The main challenge in studying the potential impacts of TDR is to do so in a comprehensive manner. What does it mean to be comprehensive? The study needs to exhibit spatial, temporal, and multi-dimensional variation because the subject matter, land use decision-making, is comprised of these variables. Decisions related to land use affect a particular geographical area (spatial) that will change the short-term and long-term activities occurring in that area (temporal) in several sectors such as transportation, housing, and environment (multi-dimensional).

The process of choosing a robust suite of indicators to measure the impacts of fiscal, environmental, societal and transportation was dynamic and challenging. This study identified a variety (25) of potential measures (discussed in Section 3) at the onset of the project. Not all potential measures turned out to be appropriate or the most valuable for assessing the impacts of the developments. Also, some measures could not be considered adequately within the constraints of the study's resources. The 15 measures selected for inclusion in the study, then, are considered useful and appropriate measures of the impacts of the developments and within the scope of the study given that the necessary data exists, and the needed experts were available to synthesize and present the data relevant to their area of expertise.

In the end, striving to compile a comprehensive suite of indicators to measure the impacts of the developments resulted in disparate units of measurement. A consistent single unit of measure, such as currency, across all of these indicators was not feasible. Ideally, a universal valuation method would be used to measure impacts across all measures. For example, various valuation methods are available for measuring environmental impacts to translate pollutants prevented or generated into actual costs (dollars). While the study quantifies environmental impacts, no monetary costs are associated with these impacts. Consequently, the impacts, while comprehensive, are presented in their appropriate units of measure (i.e., dollars, impervious surface, runoff and pollution loads, and vehicle trips).

How does the issue of scale and location affect the impact analysis results?

These scenarios are conducted on a case-by-case basis. The results of the impact analysis show great variability across the scenarios (Highland Township, City of Ann Arbor, and Scio Township) and the alternatives. Even within a single scenario, such as Scenario 1: Highland Township, the impact analysis results are dependent on the receiving and sending site designations. Simply choosing a substitute sending site, with the same receiving site likely would yield different impacts. All of the impacts are spatially dependent, so the locations of the sending and receiving sites drive the results. However, one of the advantages of TDR is that while sending areas and receiving areas are identified, the actual sending and receiving sites are determined by the market of willing buyers and sellers. Further research should include a multitude of sending parcels within an identified sending zone and a multitude of receiving parcels within an identified receiving zone.

The results of the impact analysis for Scenario 1: Highland Township appear to be affected by the locations of the sending and receiving sites. The receiving site is located in the corner of the township while the sending sites are more centrally located in Highland near major commercial routes. The increase in total miles to nine common social destinations from without TDR to with TDR reveals that the receiving site is located farther from existing infrastructure than the sending sites that are located closer to infrastructure in the township.

Impervious surface values change depending on the site characteristics (land cover, acreage) of each sending site even though they are not being developed. Land cover characteristics vary per site resulting in different levels of imperviousness. The City of Ann Arbor receiving site is impervious already, so a transfer of density to this site results in a net loss of impervious surface levels since no development will occur in the sending area.

The results of the impact analysis for Scenario 2: City of Ann Arbor reveal that the relative impacts vary due, in part, to the increasing distance of the sending sites from downtown Ann Arbor and increasing rural landscape. The slight decrease in traffic volume with Alternative 2 is due, in large part, to the already low volume on county roads within a one-mile radius of the Dexter Township site. Cost of improving and maintaining roads may be a key factor in choosing among the three sending sites. Maintenance costs are a function of the cost to maintain additional miles of road. The cost to maintain roads increases at the sending sites located in less developed areas due to lack of existing infrastructure and the need for additional miles to meet travel demand.

The importance of the location of the sending and receiving sites is highlighted further in the transportation impacts. When costs for transportation indicators stay the same whether or not

TDR is used, it is because the transportation improvements still need to be made when part of the sending sites are developed. The transportation indicators consider the infrastructure and traffic volume within a one-mile radius of the study sites rather than just the sites alone. As a result, the impacts of the sending and receiving sites need to be considered within this larger spatial context. For example, the number of units in a sending site development in one location could trigger road improvement thresholds resulting in road and intersection improvements (e.g., improving a gravel section to paved). While, in another location with less traffic volume, the same number of units being developed may not trigger that threshold.

This notion of threshold triggers may be seen in Scenario 2: City of Ann Arbor. The Webster Township alternative includes 30 lots of potential development in the sending area, and the transportation total capital cost without TDR is $2.3 million. While the Dexter Township alternative includes only 25 lots of potential development in the sending area, the transportation total capital cost without TDR is $7.1 million. In the Scio Township alternative with its 35 lots of potential development in the sending area, the total capital cost is $4.4 million. This seeming inconsistency could be a result of the Dexter Township sending area being located in an area (one mile outside the sending area) where traffic volume is high enough that the additional 25 lots moves the volume beyond the point at which relatively expensive transportation improvements are required, such as paving the existing non-paved roads. Yet, the Webster Township sending area may be located in an area (one mile buffer) where the traffic volume is low enough that the additional 30 lots do not move the volume beyond the threshold that requires transportation improvements.

Opportunities for future study

Several opportunities to expand and refine the scope of this study have been described throughout the report. Future studies on this topic would be enhanced by conducting further analyses that determine the cost of the development right transferred from the sending area to the receiving area in order to make the fiscal impact to the developer more robust. Initial data on typical value of development rights per acre was collected for this study.

Also, further research should include a multitude of sending parcels within an identified sending zone and a multitude of receiving parcels within an identified receiving zone in order to simulate more closely the market of willing buyers and sellers engaged in a TDR program. For example, several communities within a county that have demonstrated interest in exploring TDR as a land preservation tool could be brought together to create a mock TDR program that addresses the various technical issues (e.g., how to allocate development rights, where development should be transferred and at what densities, and from where development should be transferred).

A professional evaluation was conducted over the 18-month course of this project by a third party in order to gain feedback on several issues. In general, the evaluation gathered feedback from audiences concerning their perceptions, expectations and concerns related to TDR. Audiences were also asked about what other smart growth tools are of interest to local officials and about their sources of information about tools for managing growth. Feedback was received from audiences in the study communities and from around Michigan. The results of the evaluation could serve as a rich vein for mining key audiences' perceptions of TDR in Michigan that would help steer future efforts to increase the use of TDR across the state and to demonstrate the broad interest for state enabling legislation.

Applicability of this study

The intent of this study was to compare the impacts of development both with and without a TDR program in place among communities in the Huron River Watershed. The goal of the investigation was to examine the relative impacts of TDR and its relative application among different communities, not to design an ideal TDR program. Based on the results of the simulation modeling and considering the caveats inherent in the study, this study demonstrates that, in most cases, TDR reduces the impacts of residential development while bringing to bear private funds for land preservation to meet communities' land use goals.

The Huron River Watershed Council views TDR as an underutilized land preservation tool to protect natural areas and agricultural land in the Huron River Watershed and throughout Michigan. Protecting the remaining unbuilt areas of the Huron River Watershed is crucial to maintaining the quality of the Huron River system. To save the Huron River Watershed from irreparable damage, HRWC is focused on changing the current patterns of development toward more river-friendly choices, specifically encouraging higher density where the infrastructure exists, and encouraging natural feature, open space and farmland preservation in rural areas.

HRWC, for its part, will continue to share the results of this study with key audiences throughout the Huron River Watershed and Michigan to increase familiarity with this land preservation tool. Further, HRWC will seek out partnerships with local governments that demonstrate interest in TDR in order to further understanding of how TDR can benefit watershed communities. Finally, the experience gained by HRWC from embarking on this project and the interest generated in TDR by this study will aid the organization in beginning to influence statewide enabling legislation.

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