TRANSPORTATION & REGIONAL GROWTH

a study of the relationship between transportation and regional growth

A collaboration among:

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Urban Design, Transportation, Environment and Urban Growth:

Transit-Supportive Urban Design Impacts on Suburban Land Use and Transportation Planning

Report #11 in the Series:

Transportation and Regional Growth Study

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16. Abstract (Limit: 200 words)

This report summarizes the development and utilization of enhancements to the regional transportation model to measure the individual and accumulative impacts of transit-supportive urban design strategies. The report has three main sections: 1) urban design analysis of four transit-supportive development proposals; 2) development of model enhancements in the form of a subarea model; and 3) use of the subarea model to analyze a subregional transit-supportive growth scenario.

The urban design analysis demonstrated that transit-supportive development principles are adaptable to suburban settings and that use of the principles does improve land use mixes and walkability. It also confirmed that guidelines for transit-supportive development can be used to create a network of suburban sites that meets city and regional goals.

The subarea transportation model proved sufficiently sensitive to detect changes in tripmaking patterns at the site and subregional scales. Two types of tripmaking contributed to these changes: short-distance trips between transit-supportive developments and walk or bicycle trips within developments.

Results from the subregional analyses most clearly demonstrated the benefits of transit-supportive development strategies. At the subregional scale, the model tracked travel interactions between transit-supportive development sites, which revealed the accumulative benefits. If the entire region were modeled accordingly, it is expected that benefit indicators would show even greater improvements.

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As with any research project, this has been a team effort. The authors wish to acknowledge Nancy Miller, Regina Bonsignore, Matthew Finn, Frank Fitzgerald, Sinok Lao, and Kim Peterson for their contributions to the urban design analysis; Viggen Davidian and David Kennedy for development of the technical components of the forecasting model and estimating process; Jason Zimmerman, Gia Pionek, and David Windle for their contributions in land use planning and Geographic Information Systems; and Mark Filipi and Steve Wilson for sharing their expertise and knowledge of the regional transportation model.

Finally, the authors also wish to thank the North Metro I-35W Corridor Coalition, which includes the cities of Arden Hills, Blaine, Circle Pines, Mounds View, New Brighton, Roseville, and Shoreview and Ramsey County. Elected officials and staff provided information, data, and feedback at critical junctures in the research process and their communities were the first metropolitan communities to use the subarea transportation model produced as part of this research.

Preface

The Transportation and Regional Growth Study is a research and educational effort designed to aid the Twin Cities region in understanding the relationship of transportation and land use. Many regions of the country are experiencing rapid commercial and residential development, often accompanied by population growth and growth in the total area of land developed. This has caused a range of concerns, including the direct costs of the infrastructure needed to support development and the social and environmental side effects of development patterns.

This study is an effort to better understand the linkages between land use, community development and transportation in the Twin Cities metropolitan area. It is designed to investigate how transportation-related alternatives might be used in the Twin Cities region to accommodate growth and the demand for travel while holding down the costs of transportation and maximizing the benefits. The costs of transportation are construed broadly and include the costs of public sector infrastructure, environmental costs, and those costs paid directly by individuals and firms. Benefits are also broadly construed. They include the gains consumers accrue from travel, the contribution of transportation and development to the economic vitality of the state, and the amenities associated with stable neighborhoods and communities.

The University of Minnesota's Center for Transportation Studies is coordinating the Transportation and Regional Growth Study at the request of the Minnesota Department of Transportation and the Metropolitan Council. The project has two components. The first is a research component designed to identify transportation system management and investment alternatives consistent with the region's growth plans. It has six parts:

1. Twin Cities Regional Dynamics
2. Passenger and Freight Travel Demand Patterns
3. Full Transportation Costs and Cost Incidence
4. Transportation Financing Alternatives
5. Transportation and Urban Design
6. Institutional and Leadership Alternatives

The first three research areas are designed to gather facts about the transportation system and its relationship to land use in the Twin Cities metropolitan area. The other three research areas will use these facts to investigate alternatives in financing, design and decision making that could have an impact on this relationship. Results of this research is and will be available in a series of reports published for the Transportation and Regional Growth Study.

The study's second component is a coordinated education and public involvement effort designed to promote opportunities to discuss the relationship between transportation and growth based on the research results. It is believed that this dialogue will help increase knowledge and raise the level of awareness about these issues among the study's many audiences including decison-makers who make policy, agency professionals who implement policy, stakeholder groups who try to influence policy and members of the general public who experience the consequences of those policies.

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Executive Summary

Transit-supportive development is an emerging strategy for metropolitan regions seeking to balance growth and sustainability. Portland, Salt Lake City, and Sacramento are examples of regions seriously exploring its potential. The Minneapolis-St. Paul metropolitan region has been moving in a similar direction. In 1995, the State of Minnesota passed the Livable Communities Act, which focuses on increasing the supply of affordable housing, cleaning up brownfields, and fostering transit-supportive development demonstration projects in the metropolitan region. The Metropolitan Council, which administers the Livable Communities Act programs and is responsible for regional planning, is applying transit-supportive design principles of the demonstration projects at the regional scale to update the *Regional Blueprint 2030.*

Region-wide implementation of transit-supportive development strategies will require coordination of land use decision-making at the local level with transportation infrastructure planning and transit service delivery decision-making at the county and regional levels. Coordination will be especially needed in suburban areas where existing and proposed land use plans and development patterns are not always conducive to the land use mix and transportation network needed to support even minimal transit service.

Robust land use and transportation information will be needed to support such coordinated decision-making. Since the regional transportation model is the primary information engine for regional policy and investment decisions, it is the most likely candidate to support these inter-jurisdictional discussions. In general terms, the model translates land use and socioeconomic data into transportation findings, which then are translated into road construction projects and transit service delivery, and which, in turn, inform development decision-making. This interrelated sequence of findings and decisions, repeated regularly as part of public transportation planning and funding cycles, influences urban and suburban form and associated transportation efficiencies or inefficiencies.

The characteristics that make travel demand forecasting models efficient at the regional level, however, reduce their sensitivity to changes at the neighborhood level. This limitation is particularly evident in suburban and exurban parts of the region where model traffic analysis zones (TAZs) tend to be large and model highway and transit networks tend to be sparse. Accordingly, a series of enhancements are needed for the regional model to estimate the travel behavior associated with transit-supportive urban design strategies at both neighborhood and subregional scales. This research sought to develop these enhancements by relating them to those urban design characteristics that the model has a proclivity to measure: land use, density, access to transit and walkability.

The subregion formed by the North Metro I-35W Corridor Coalition (Coalition) served as the study area for this research. It is in the northeast quadrant of the region and includes the cities of Arden Hills, Blaine, Circle Pines, Mounds View, New Brighton, Roseville and Shoreview. These cities contain the full range of suburban development patterns, from the tightly planned industrial suburb of the late 19th century to residential subdivisions with cul-de-sacs to unurbanized agricultural land prime for development. Also, the Coalition has developed extensive subregional land use and demographic databases that are compatible with Geographic Information Systems (GIS) software. The level of detail and reliability of these data and the amount of joint planning already completed made the subregion an excellent study area for this research.

Development of Enhancements for the Regional Transportation Model

The approach used in this research has been to pursue a series of model enhancements, but to do so in the framework of a subarea model. The enhancements were designed to enable better evaluation of transit-supportive urban design and to address the relationship between land use density and type, vehicle trip-reduction and transit usage, shorter-distance tripmaking, pedestrian activity, and proximity to transit.

This approach was selected to take advantage of the way in which a focused subarea model is designed to add detail to a portion of the regional model. The added detail in a focused subarea model provided a finer-grained system of TAZs and transportation networks, which allowed for a finer-grained assignment of trips in the subarea.

To construct the focused model, various elements of the regional model were refined or modified for the subregion within the focused model. The refinements fell into spatial and relational types of activities within the model and off-line estimation techniques that iteratively adjusted the model results.

- *Spatial activities* involved subdividing regional model analysis zones into smaller pieces and adding more roads and transit routes to the model network. Both of these activities added detail to the model results without significantly altering the sensitivity of the model to land use patterns. A series of five steps for subdividing traffic analysis zones were identified and implemented to create a zone structure with adequate detail. The finer-grained zone structure provided for additional road network to be added to the model.

- *Relational activities* increased the sensitivity of the model to the interaction between land use mix, density, and short-distance tripmaking. The relational activities drew from two primary data sources:
  - — The availability of more finely grained socioeconomic data for the Coalition subregion allowed for exploration of the sensitivity of the trip generation and distribution components of the regional model.
  - — The information developed through the urban design analysis component of this research provided the basis for estimating the effects of density, walkability and connectivity within the subarea model.

- *The off-line estimation techniques* were developed to address the likely increases in primary walk and bicycle trips from transit-oriented urban design land use strategies and to account for the fact that these non-auto trips would likely be inappropriately assigned as auto trips by the forecasting model under its current structure. This research developed two similar off-line adjustments that were applied to the productions and attractions (by zone) individually to address design relationships within a zone and/or concurrently to address design relationships with adjacent zones. A series of relative factors were used to reduce trips generated between each of the travel demand model's TAZs based on the following key independent variables:
  - — Population Density of the production TAZ
  - — Employment Density of the attraction TAZ
  - — Jobs/Housing Balance of each TAZ, reflected by the ratio of both TAZs' employment to population for both productions and attractions
  - — Distance between each TAZ, measured by distance between the center of each TAZ
  - — Transit Accessibility for each TAZ, reflected by the percentage of TAZ population that is within a reasonable walking distance of a transit stop for both productions and attractions

The focused model was successfully validated against the calibrated regional model. Volumes were extracted from both models at a series of screenlines within the subarea. Comparison of the screenline volumes showed that the variation between total volumes crossing the screenlines was in the range of less than three percent. The off-line estimation techniques were tested against four focus areas within the subarea and were determined to be reflecting reasonable levels of trip reduction for non-auto use within the areas of transit-oriented development.

Transit-Supportive Urban Design

For the purposes of this study, two scales of transit-supportive urban design were analyzed: subregional organization of transit-supportive development and the internal design of transit-supportive development sites.

Transit-supportive developments have a common organizational structure that concentrates mixed-use within a one-quarter mile walking distance of the major transit center. The core's land use mix parameters are keyed to the type and level of transit service provided to the development. The land use orientation in the surrounding areas, however, is weighted toward either jobs or housing. This land use choice is one of the critical connections between regional and local goals. Another critical connection is the size and the density of the core area and type and level of transit service.

The urban design investigation relied on preliminary planning information from the Coalition and on two types of planning documents—local comprehensive plans and regional transportation policy and planning documents. Since Coalition cities already had identified areas likely to develop or redevelop by 2020, these areas served as the land supply base for developing the growth scenarios. Future land use maps, from each city's comprehensive plan, were used to determine which areas were more appropriate for transit-supportive development and what should be the land use orientation in areas surrounding the core. The regional transportation policies were used to classify the site as transitway, inner suburban or outer suburban.

In regional transit policies, transitways were distinguished as light raiI, rapid bus, or commuter rail. In the case of the study area, there was only one site on a designated future transitway. The site was located in Roseville in the Twin Lakes Redevelopment Area, adjacent to the Northeast Diagonal (Minneapolis East). Decisions to designate a transit-supportive site as either inner or outer suburban followed the intent of the policy. To be designated inner suburban meant that within twenty years, there would be a strong likelihood that local service could be supported throughout the day. Outer suburban designation meant that it was likely that within twenty years the development would be served only during peak hours and/or by local routes with limited service. These two factors were used to select the most appropriate mix of land uses and densities for the transit-supportive development site. Growth projections for 2020 were calculated for each transit-supportive development area in the subregion, allocated to individual subdivided TAZs (subTAZs), and entered into the subarea model.

Urban design analyses of transit-supportive development proposals for four sites within the subregion informed development of the subarea model and explored the viability of transit-supportive development in suburban redevelopment and greenfield locations specific to the Minneapolis-St. Paul metropolitan region. Two scales of sites were studied: micro, in the sense that sites were moderate in both land area and development intensity; and macro, in the sense that sites were either large in land area or planned to be intensively developed. Transit-supportive principles of mixed use, organization, and connectivity were used to measure and enhance current proposals for each site. Enhancements included modifying block size, increasing the number of full intersections, relocating mixed-use areas closer to probable transit routes, and modifying single land uses. The outcomes included verification that transit-supportive development can work comfortably in existing suburban conditions and within different scales and types of suburban sites.

The comprehensive result of the urban design analyses was a transit-supportive, subregional growth scenario for the I-35W Corridor Coalition. The scenario included 19 transit-supportive development sites in addition to general areas of single-use development or redevelopment. To accommodate the increased and intensified development, transportation systems were enhanced or expanded in the subarea model. These modifications included: new road network; new linkages in the minor arterial network, such a bridges across freeways; increases in existing transit service; and new transit service where it didn't exist.

Study Conclusions

The subarea model was used to run two comparative analyses of growth scenarios for the I-35W Corridor Coalition. One analysis compared a conventional suburban growth scenario with a transit-supportive growth scenario. The other analysis compared two transportation systems options for the same transit-supportive growth scenario. (The growth scenario was nearly identical to the transit-supportive scenario used in the first analysis; the difference being one transit-supportive development site was removed.) Findings from these analyses have been synthesized into the following conclusions about the dynamics between transit-supportive urban design and transportation planning in suburban settings.

Regional Transportation Model Enhancements

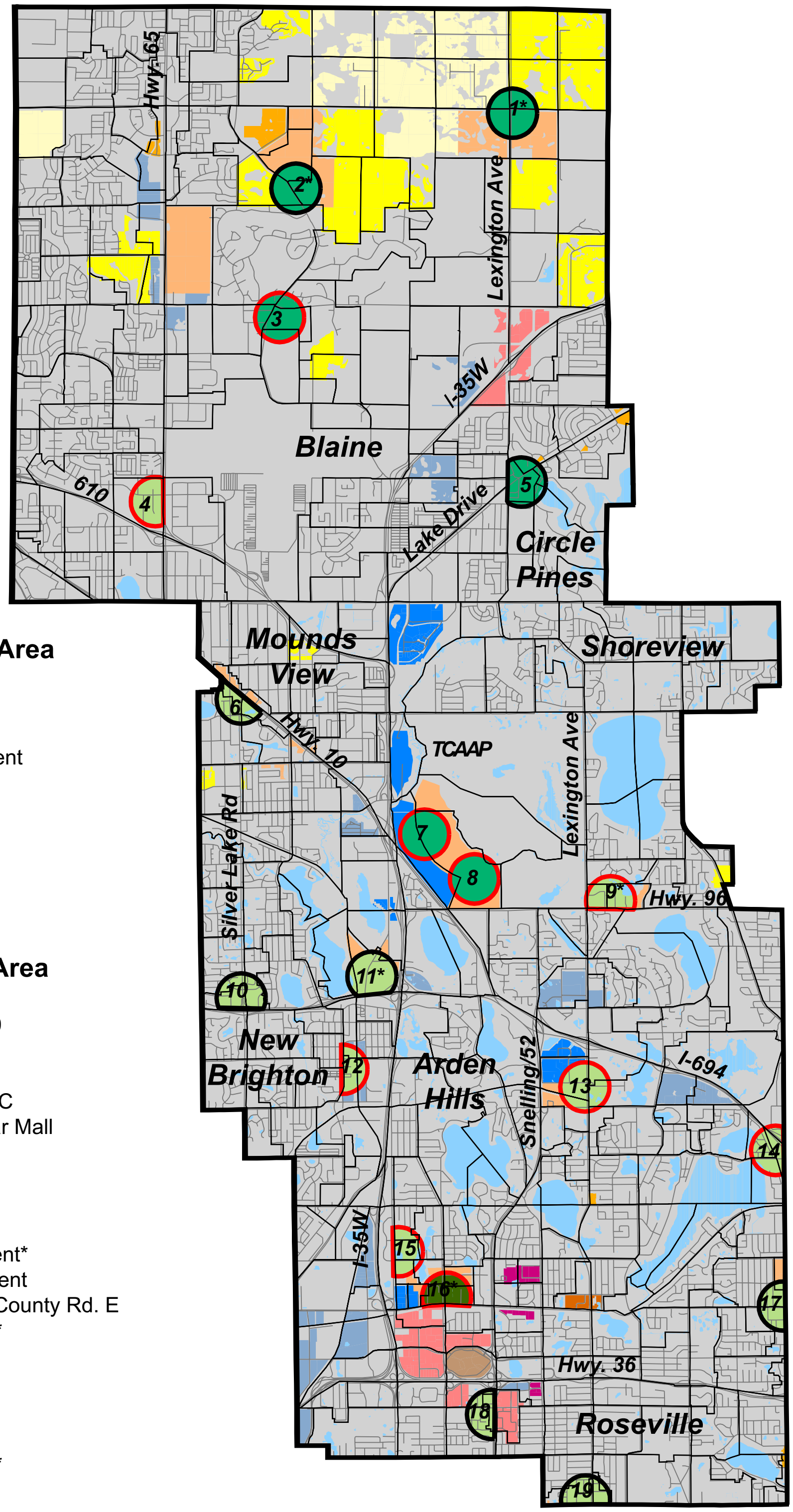
- It was possible to develop a subarea transportation model that was sufficiently sensitive to transit-supportive design characteristics to show changes in tripmaking patterns. While these changes were most clearly demonstrated at the subregional scale, the estimation techniques were also demonstrated to be effective for tracking travel changes at the neighborhood scale. Two types of tripmaking patterns were evident—short-distance trips between neighborhoods and trips within neighborhoods. Previously, within the regional model, these types of trips were not modeled in detail, but were estimated by factors and not assigned to the highway network. The detailed network and zone structure of the subarea model provided the means for directly assigning short distance trips between neighborhoods and the estimation techniques provided the means for differentiating which of those trips were likely short enough that they would be made primarily by non-auto modes (walk, bicycle, etc.).

- The subarea model used estimations based on national data for calculating travel demand effects. A significant next step for the regional model would be validation to this region. Data required for the validation effort would include case studies of transit-supportive developments to determine actual mode use and the frequency and length of trips made by residents and users of the centers. Data would have to be collected in sufficient detail and volume to be statistically significant. The information collected would be used to calibrate the values used in the estimation techniques to determine primary walk trips.

- The current system of transit planning for the region has resulted in a functional hierarchy of transit service types that are based on cost-effectively serving the conventional patterns of development in the region. To a large extent, transit service in the outer suburban area is designed to serve the commute market to the core cities' employment concentrations. The pattern of transit-supportive developments proposed for the subregion is shown to substantially change the underlying patterns of tripmaking to make the hierarchical transit service pattern ineffective in serving a substantial portion of the (modified) demand in the subregion. This condition, in turn, suggests that an increased level of transit service planning needs to occur concurrent with the land use planning process to ascertain what types of transit service can most effectively serve the proposed pattern of mixed-use centers.

Transit-Supportive Growth Scenario
North Metro I-35W Corridor Coalition

This illustration is the final transit-supportive growth scenario and subTAZ structure that was analyzed using the subarea transportation model. The circles indicate transit-supportive developments and are identified below.



Outer Suburban Transit Service Area

Housing Oriented

1. Blaine—Lexington and Main Street*
2. Blaine—Lexington and Radisson Road*
5. Circle Pines—Town Center Redevelopment

Jobs Oriented

3. Blaine—New City Hall Site
7. Arden Hills—TCAAP
8. Arden Hills—TCAAP

Inner Suburban Transit Service Area

Housing Oriented

6. Mounds View—Silver Lake and Hwy. 10
10. New Brighton—Brighton Village Center
11. New Brighton—Northwest Quad*
17. Roseville—Rice Street and County Rd. C
18. Roseville—Snelling across from Har Mar Mall
19. Roseville—Lexington and Larpenteur

Jobs Oriented

4. Blaine—Old City Hall Site
9. Shoreview—Town Center Redevelopment*
12. New Brighton—Old Hwy 8 Redevelopment
13. Arden Hills/Shoreview—Lexington and County Rd. E
15. Roseville—Twin Lakes Redevelopment*

Transitway

Jobs Oriented

16. Roseville—Twin Lakes Redevelopment*

**Indicates study sites used to develop subarea transportation model*

- With proper data inputs, it was found that the regional model has a high level of sophistication in tracking mode choice. The utility functions that govern the mode choice calculation are highly sensitive to travel time and to cost. The model effectively searches out shortest travel time paths by auto and by transit and also factors in costs to the user. For a particular trip, the model recognizes that it may be faster to drive, but that the cost for parking at the destination sufficiently offsets the driving time savings to make a transit trip more attractive. For trips within the suburban and outer suburban areas of the region, the offsetting effect of parking costs is effectively eliminated since parking is largely free. As these conditions of mode choice and transit assignment were explored through the modeling process, it became increasingly evident that the current transit service patterns were not attracting transit use for trips that largely stayed within the subregion. This resulted in a pattern of higher auto use for captured trips and is a reason why the aggregate transit mode choice results are not as high as desired.

- Essential to the success of the subarea model were detailed data inputs. The robust nature of the Coalition databases supported detailed land use analyses that were input into the model. These data were available for the entire subregion, which provided for consistent modeling across the subregion. Without the added detail available in the socioeconomic data for the subregion, the model effort would have proportionately distributed the inputs for the larger parent zones to the subdivided zones. With the detailed data available, the subdivided zones were able to more accurately reflect the land use and development patterns, particularly in transit-supportive development areas.

Transit-Supportive Urban Design

- The transit-supportive growth scenario developed for the Coalition subregion demonstrated that there are some viable locations for such developments in suburban communities. These locations are consistent with local comprehensive plans and regional transportation goals and policies. Many of these sites lie in areas not currently identified for increased transit service in policy documents. Cities and the Metropolitan Council will need to work cooperatively and aggressively to plan and implement successful transit-supportive developments.

- The transit-supportive development areas were key to the positive findings of the subregional analysis. They provided the density and the activity needed to capture trips within the subregion and to convert trips from auto to walking. The detailed subTAZ structure was necessary to tracking this shift in the modeling process. Collectively at the subregional level, the pattern of transit-supportive developments was shown to increase the regional attractiveness of the subregion to employment trips from outside the subregion. While this resulted in a net increase in total tripmaking, it also demonstrated the role that development in the subregion could have in satisfying regional demand. The transit-supportive developments were shown to positively affect the jobs/housing balance in the subregion, such that trips were attracted from within the subregion to transit-supportive development. This latter effect caused the increase in trip capture within the subregion.

In summary, results from testing the subarea model with inputs from the micro and macro development sites and from use of the model for subregional analyses suggested the following for transit-supportive land use and transportation planning in suburban areas:

- Transit-supportive development shows its greatest potential when it is planned and implemented in the aggregate. Therefore, to fully understand the benefits of transit-supportive development will require a regional planning and data collection effort that will bring the regional model to a uniform level of specificity for the entire area.

- Interjurisdictional planning will be needed. The regional model assumes that land use and transportation are working in concert. When adjustments to inputs were made on both sides of the equation, positive results were achieved. Counties, the Metropolitan Council, and the Minnesota Department of Transportation can play critical roles in facilitating this planning by being flexible with road design standards, but cities must respond with equal commitment to corresponding land use and design standards.

- To realize the benefits of transit-supportive development, it is in the interests of suburban communities to plan cooperatively for transit-supportive development. Subregional modeling indicated that transit-supportive development works best in concert with similar sites, and for one community to make significant strides with a development site depends upon other communities doing the same.

Section 1. Introduction

1.1 Background

Since the energy and growth crisis of the 1970s, the notion of compact, mixed-use development has been on the table as a viable alternative to single land use, auto-oriented development. Developed by Peter Calthorpe and his colleagues[1], the Pedestrian Pocket was one form of this response and the concept is now known by terms such as new urbanism, neo-traditional neighborhood design, livable communities, transit-oriented development, and transit-supportive development. It is a fundamental building block of the Smart Growth movement and is embraced by many professionals, practitioners and community leaders as a sustainable urban form that improves quality of life by preserving and restoring the environment, reducing dependence on fossil fuels, improving air quality, offering diverse housing choices, and reinstating public spaces to community life.

The existing Twin Cities region's development pattern and suburban form are antithetical to the constructs of the Pedestrian Pocket. Suburban densities are uniformly low, the few concentrations of activity are typically single-use oriented, and those areas with concentration are not transit friendly. To re-orient these development patterns and to reorganize the suburban landscape will require robust land use and transportation information. This information must be able to address questions regarding the transportation impacts and benefits of new development patterns at the local and regional levels. In other words, it must have sufficient detail to support a substantive dialogue between and among local governments, which make land use and site design decisions, and regional and state governments, which make regional transportation infrastructure and services delivery decisions.

The regional transportation model is the primary information generator for regional policy and investment decisions. In general terms, the model translates land use and socioeconomic data into transportation findings, which then are translated into road construction projects and transit service delivery, and which, in turn, inform development decision-making. This interrelated set of decisions, repeated regularly as part of public transportation planning and funding cycles, influences urban and suburban form and associated transportation efficiencies—or inefficiencies.

The regional model, however, is designed for large-scale transportation planning and has limited value for local planning. The grain of the data is coarse, and it is difficult to disaggregate the data to a level that is meaningful for analyzing smaller geographic areas. On the other hand, the highly dispersed nature of tripmaking in this region and the comprehensive, sophisticated nature of the model makes it a desirable tool for analysis.

Developing new strategies to make the model an effective vehicle for interjurisdictional use is the emphasis of this research component of the Transportation and Regional Growth Study. Research explores which of the land use and urban design characteristics embedded in transit-supportive development should be represented in the regional model and how the model might be enhanced to detect, aggregate, and analyze the impacts of local development decisions on the regional transportation system.

1.2 Study and Paper Organization

This paper focuses on an urban design analysis of transit-supportive development and development of a subarea transportation model. It also includes a discussion of findings from a land use and transportation study that used the subarea model to analyze two growth scenarios—one of which was based on transit-supportive principles—for the North Metro I-35W Corridor Coalition (Coalition). This discussion is included because the full effects of transit-supportive design and the subarea model's sensitivity to its fine-grained characteristics are best demonstrated when aggregated to the subregional scale. Accordingly, the paper consists of three major sections. Section 2 reports on the concepts of transit-supportive urban design and their application in four case study sites. Section 3 focuses on development and testing of the subarea transportation model. Section 4 describes a method for developing a transit-supportive subregional growth scenario and summarizes findings from using the subarea transportation model to measure transportation impacts at the subregional level. The last section draws conclusions about the impacts of transit-supportive design on suburban land use and transportation planning.

The study area for the urban design analysis and subarea model development was the subregion created by the Coalition. The subregion is located in the northeastern quadrant of the Minneapolis-St. Paul Metropolitan region (fig. 1.1). It includes seven suburban communities—Arden Hills, Blaine, Circle Pines, Mounds View, New Brighton, Roseville, and Shoreview. Cities range in population from 5,000 to almost 45,000 and have a full spectrum of development patterns.

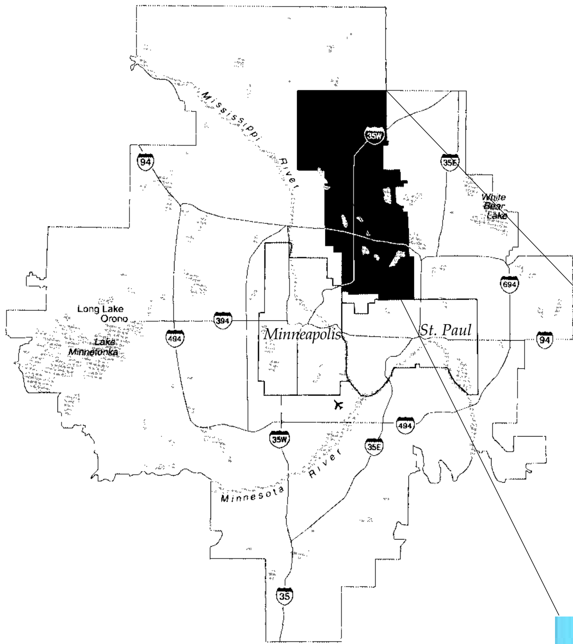
The two subregional development scenarios analyzed with the subarea model were developed by the Coalition through a growth study for the year 2020. One scenario uses conventional suburban development principles while the other applies principles of transit-supportive development and smart growth. Land area available for development or redevelopment as well as job and household density factors were held constant between the two scenarios. What varied were land use patterns and development type. The jobs and household/population increases over the baseline year 2000 vary significantly between the two scenarios. The conventional scenario generates 41,305 more jobs while the smart growth scenario generates 59,300 more jobs. With regard to household growth, the conventional scenario generates 12,208 households more than 2000 and the smart growth scenario generates 27, 717 more households.

Synthesis of findings from the two studies reveals that the benefits of transit-supportive development are detectable when sufficiently detailed land use and socioeconomic data is used in the calculations that generate subarea model inputs and when the area analyzed is sufficient in size and uniformly modeled across its entirety. This paper attempts to summarize the research supporting this statement and the implications for land use and transportation planning at the regional scale.

Section 1. Notes

1. Douglas Kelbaugh, *Common Place: Toward Neighborhood and Regional Design* (Seattle and London: University of Washington Press, 1997).

North Metro I-35W Corridor Coalition



Coalition Statistics, 2000
83 sq. mi.
59,308 households
153,815 residents
6,920 businesses
99,270 jobs

Source: North Metro I-35W Corridor Coalition.

Figure 1.1. North Metro I-35W Corridor Coalition, Subregional Study Area.

Section 2. Transit-Supportive Urban Design

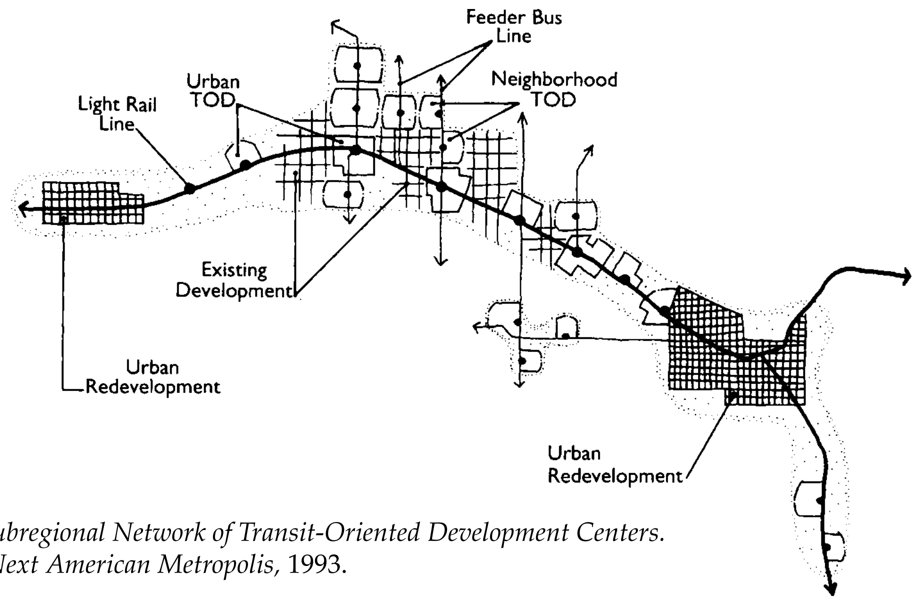


Figure 2.1. Subregional Network of Transit-Oriented Development Centers.
Source*: The Next American Metropolis,* 1993.

2.1 Overview

Transit-supportive or transit-oriented development (TOD)[1] implies a particular set of urban design and land use characteristics conducive to generating non-automotive tripmaking. Peter Calthorpe is largely credited with refining the concept into an urban design strategy that has been adapted to promote use of all forms of mass transit—fixed rail as well as buses. Calthorpe's publication, *The Next American Metropolis,* outlines the fundamental principles and urban form of transit-supportive development and proposes how such developments interact to create a regional web of movement and activity.

Basic tenets of transit-supportive development in *The Next American Metropolis*[2] are grounded in the traditions of urbanism and place making and are listed below.

- Organize growth on a regional level to be compact and transit-supportive.
- Place commercial, housing, jobs, parks, and civic uses within walking distance of transit stops.
- Create pedestrian-friendly street networks which directly connect local destinations.
- Provide a mix of housing types, densities, and costs.
- Preserve sensitive habitat, riparian zones, and high quality open space.
- Make public spaces the focus of building orientation and neighborhood activity.
- Encourage infill and redevelopment along transit corridors within existing neighborhoods.

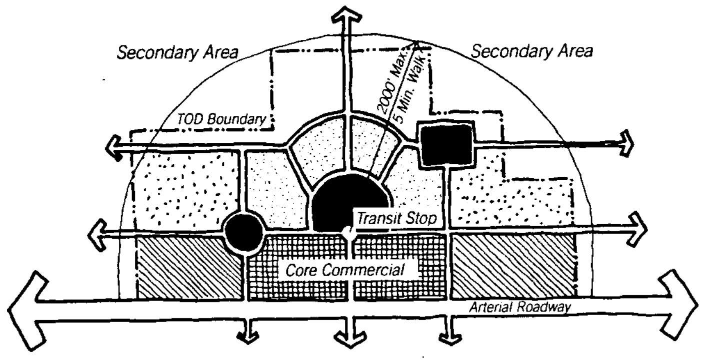


Figure 2.2. Transit-Oriented Urban Design Schematic. Source: *The Next American Metropolis.*

Calthorpe translates these principles into a schematic diagram (fig. 2.2) that illustrates the spatial organization and density strategies of transit-supportive development. A transit stop, located at the center of the development, is framed by a higher density, higher floor-to-area (FAR) mixed-use core. Surrounding the core is a secondary area with lower densities and land uses, which are oriented to either jobs or housing. Open and public spaces are considered essential to community life and are sited in both the core and secondary areas. The circulation system for pedestrians and vehicles emphasizes connectivity,[3] which maximizes the number of alternative routes to one destination. The high level of walkability encourages residents or workers to combine daily errands into a single walking, transit or auto trip. The one-half and one-quarter mile radii, which determine the extent of a TOD and its core area, are based on established distances that people will walk to transit stops. A TOD can range from 60 to 420 acres and is appropriate for redevelopment as well as greenfield sites. From a regional transportation perspective, TODs are critical system links since they are multi-modal transfer points as well as trip origin and destination points.

Specific design strategies are used in conjunction with the conceptual organizational structure to plan transit-supportive developments. Of these strategies, connectivity and block size, roadway design, land use mix and density, building type and orientation, pedestrian and bicycle environments, and parking requirements and facilities seem to have the greatest influence on transportation modeling equations. Characteristics of these design strategies are described in this paper because they are integral to the urban design analysis conducted in this research.

The Value of Density—Population needed to support a…

restaurant	2,000	library	500
convenience store	2,000	elementary school	1,800
service station	5,000	neighborhood park	3,000
supermarket	6,500	playground	5,000
video rental	11,400	middle school	5,000
movie theater	29,000	playfield	20,000

The numbers above represent national standards and have not been adjusted to reflect local markets, laws, or public policies. They were taken from a variety of sources, which are listed in the endnotes for this section. [4]

Connectivity and Block Size

TOD circulation systems are planned to maximize connectivity and mobility[5] (fig. 2.3). Typical suburban development maximizes use of cul-de-sacs to create a sense of privacy. While effective for adding value to residential properties and minimizing traffic on residential streets, cul-de-sacs interrupt the local network, thus forcing trips onto a limited number of collector streets and minor arterials (fig. 2.4). Transit-supportive design does not mandate use of the gridiron nor does it prohibit use of cul-de-sacs. It does, however, make liberal and strategic use of the intersection and the pedestrian pathway. Where topography presents constraints to road alignments, road patterns respond accordingly (fig.2.5). Although these curvilinear patterns may appear "suburban," an analysis would reveal more intersections and greater connectivity than found in conventional suburban development. In transit supportive developments, cul-de-sacs have pathways that link them to transit or the larger network of trails and paths (fig 2.6).

Block length and presence of alleys has a great influence on circulation and connectivity. The preferred block length is no more than 500 feet with a total area not exceeding seven acres.[6] If development must have longer blocks, pedestrian circulation is accommodated by internal block networks and pathways.

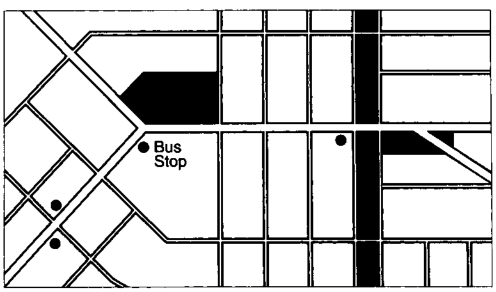


Figure 2.3. Transit-oriented Street Pattern. Source*: Transit-Supportive Land Use Planning Guidelines.* Ontario Ministry of Transportation, 1992.

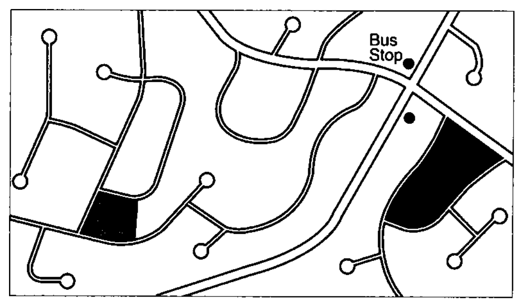


Figure 2.4. Conventional Street Pattern. Source*: Transit-Supportive Land Use Planning Guidelines.* Ontario Ministry of Transportation, 1992.

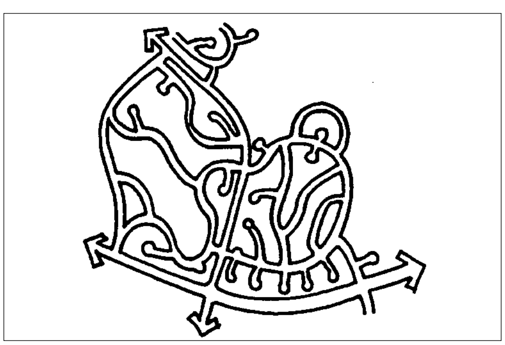


Figure 2.5. Adjusting Gridiron to Topography. Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

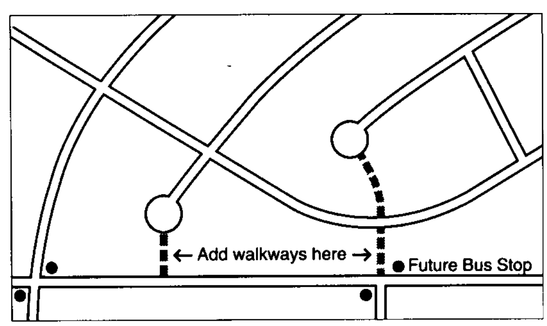


Figure 2.6. Pathways Connecting Cul-de-Sacs to Transportation Networks. Source*: Transit-Supportive Land Use Planning Guidelines.* Ontario Ministry of Transportation, 1992.

Transit-Oriented Development and Roadway Design

Transit-oriented development assumes roadway designs that are sensitive to mixed land uses and building types, pedestrians and bicycles, and efficient movement between developments. The existing roadway network—regional to local—is organized as a hierarchical system designed to serve different trip purposes and lengths. Longer trips between states and between regional subareas are served by major arterials (freeways); trips from house to community shopping centers are served by minor arterials and collectors.

Suburban minor arterials are critical to this network and have direct impact on suburban TODs. They are the roadway framework around which development and redevelopment has occurred and will occur. Arterial segments serving the core of a TOD necessitate a design speed of 35 m.p.h. because of the high levels of pedestrian and transit activity and mixed land uses. Arterial segments that connect TODs should have design speeds of 45 to 55 m.p.h. to accommodate efficient movement of buses between suburban TODs. If the segment connects TODs that are a relatively short distance apart—one mile with no stops for example—45 m.p.h. would be appropriate. If distances are longer than one mile, a 55 m.p.h. design speed may be more practical. *Design and Development Principles for Livable Suburban Arterials* contains roadway design prototypes for 35, 45, and 50 m.p.h.

Figure 2.7 is the 35 m.p.h. design prototype. The cross-section has four 11′ travel lanes and bicycle or parking lanes. A 35 m.p.h. design speed is conducive to land use activity near the street, and a 10′ to 15′ wide sidewalk could accommodate street furniture, outdoor eating, and transit shelters.

Figure 2.8 illustrates the 45 m.p.h. design prototype. The cross-section has four 12′ travel lanes, a center median that is replaced by turn lanes at key intersections, and a lane for parking or bicycles. The 5′ to 6′ planting area supports large street trees that create a canopy. The 6′ sidewalk is comfortable for walking.

Figure 2.9 is the 55 m.p.h. design prototype. The cross-section has four 12′ to 14′ travel lanes and a center median ranging from 6′ to 22′ wide. A 10′ reaction zone separates bicycle and pedestrian trails from the roadway. Activity is pushed back from the street edge.

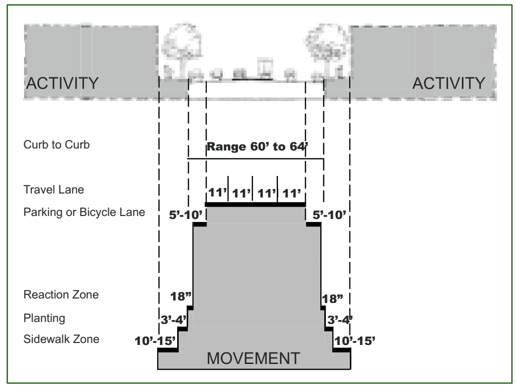


Figure 2.7. 35 m.p.h. Roadway Prototype.

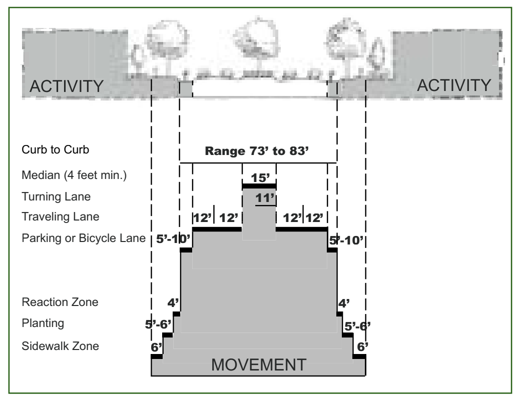


Figure 2.8. 45 m.p.h. Roadway Prototype.

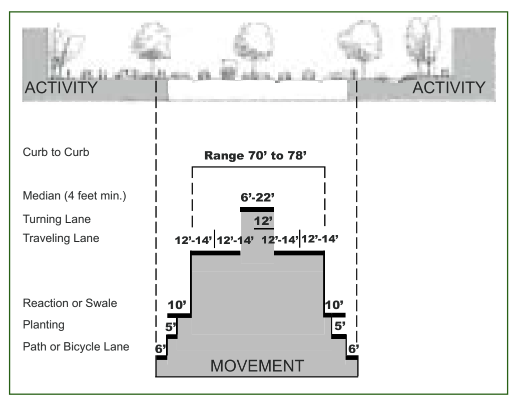


Figure 2.9. 55 m.p.h. Roadway Prototype.

Figures 2.7-9. Source: *Design and Development Principles for Livable Suburban Arterials*. Design Center for American Urban Landscape, 2001.

Land Use Mix and Density

Transit-oriented design strategies mix land uses vertically as well as horizontally, stay within established density ranges, and reduce surface parking. Each strategy has multiple benefits. For example, mixed land use improves the ratio of housing to jobs, offers opportunities for live-work building types, provides lifecycle housing options, stretches activity over more hours each day, and creates shared-parking opportunities. All contribute to improved environmental outcomes through reduction in vehicle miles traveled, improved air quality, and opportunities to expand and enhance open space and improve water quality. These strategies can and must be applied to all scales of planning, to ensure maximum benefits. Illustrations begin at the community scale and move to the individual site.

A community, which has been master planned to optimize transit and walkability, has a transit center[7] at the core (fig. 2.10). Adjacent to the center are commercial, office, and higher desnity residential land use types which are connected by a grid street network. The transit center is serviced by a circulator system, which is supplemented by car/van pool lots. The school is centrally located so it is walkable for the entire community. Open space areas are linked by corridors and buffer the river from development.

In contrast to the connectivity and integration characteristic of the transit-supportive master plan, the typical community master plan separates land uses and relies on loop roads and cul-de-sacs to create a sense of privacy (fig. 2.11). The open spaces are segmented and small, which minimizes habitat quality and animal movement. Transit service provision is limited to a few stops and are not accessible by foot for residents. Pedestrian network connections are limited at best.

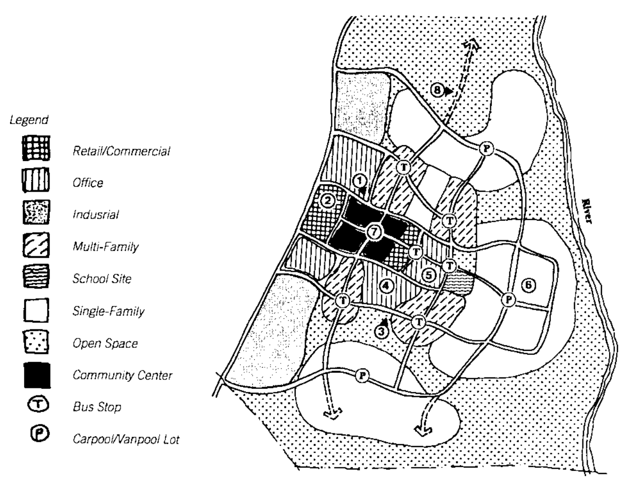


Figure 2.10. Transit-Supportive Master Planned Community. Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

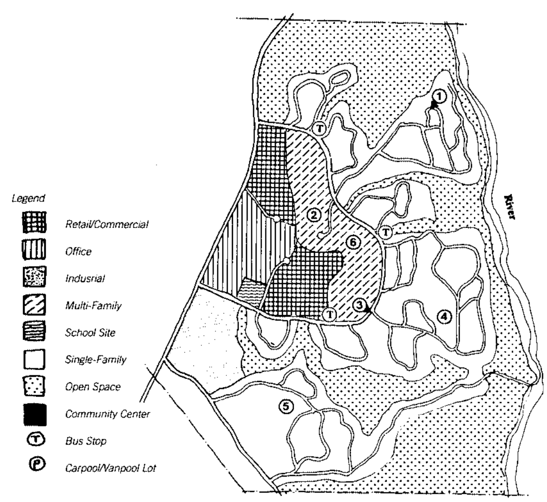


Figure 2.11. Conventional Master Planned Community. Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

Planned Unit Developments (PUDs) are a common planning and zoning strategy in suburban communities. It allows a larger area to be planned and developed with minimal delay once the concept plan is approved.

In transit-supportive design, higher intensity land uses are clustered at the main crossroads and housing is immediately adjacent (fig. 2.12). This land use plan improves walkability and creates opportunities for street life. Transit stops are located on arterial and collector streets and accessible to all areas of the development. The street pattern is based on a grid; single-family residential blocks are designed to have alleys. An internal trail network links different areas within the development to open space and the commercial core.

The typical suburban PUD has characteristics similar to its planned community counterpart (fig. 2.13). Land uses are highly segregated and there are few internal linkages. Single-family housing lots are organized around a series of cul-de-sacs. The fragmented street network does not encourage walking and the lack of a center limits the level of transit service provision. Open space has no particular role in the development design.

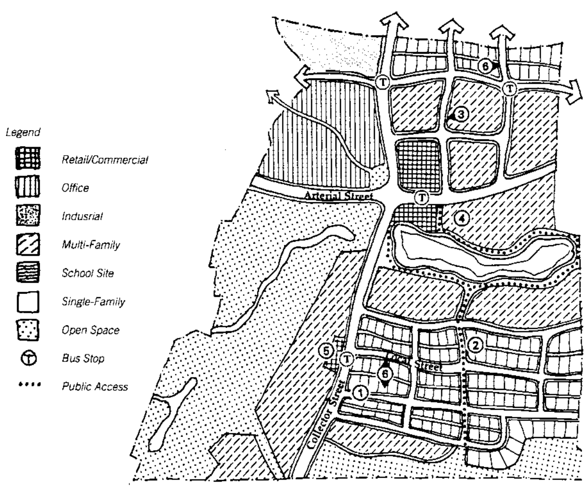


Figure 2.12. Transit-supportive Planned Unit Development. Source: *Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

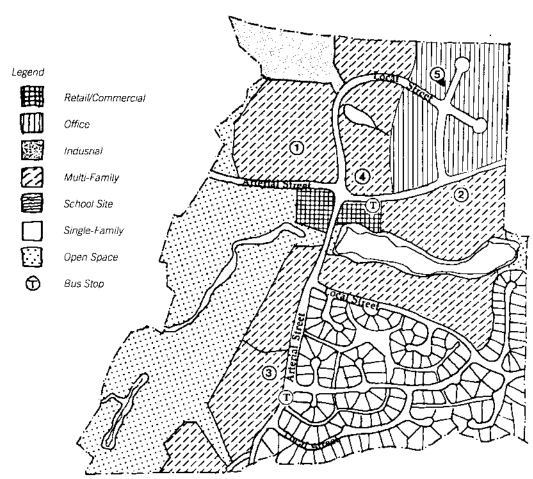


Figure 2.13. Conventional Planned Unit Development. Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

Density yields many benefits, among them being transportation options. Basic bus service can be provided with a minimum density of seven dwellings per net residential acre.[8] If densities reach 15 dwellings per acre, frequent local service is viable.[9] For light rail, a minimum of nine dwellings per net residential acre is needed and rapid transit requires 12 dwellings per net residential acre. Levels of transit service are also influenced by regional geographies, such as distribution of employment clusters, location relative to the regional core, and demographic patterns. The drawings below illustrate how density can be achieved without losing the suburban appeal of trees and human-scale[10] buildings.

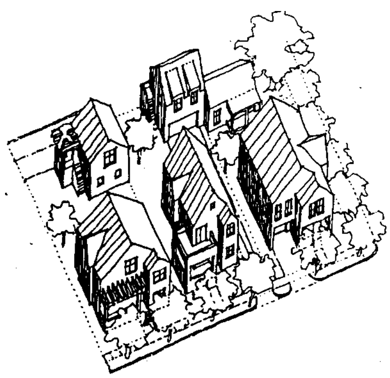


Figure 2.14. 7–15 dwellings/acre. Source*: Planning More Livable Communities with Transit Oriented Development.* Metropolitan Council, 2000.

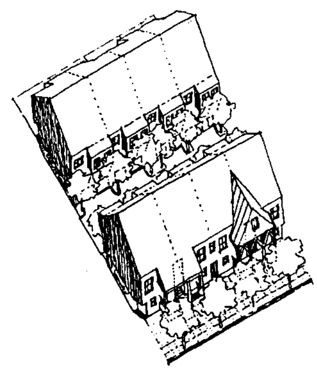


Figure 2.15. 20–35 dwellings/acre. Source*: Planning More Livable Communities with Transit Oriented Development.* Metropolitan Council, 2000.

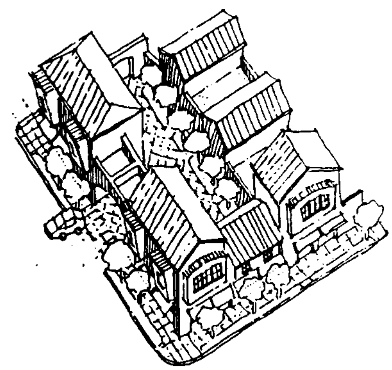


Figure 2.16. 20–35 dwellings/acre. Source*: Planning More Livable Communities with Transit Oriented Development.* Metropolitan Council, 2000.

Employment densities, which have a greater influence on trip-making than residential densities, begin at 20 employees per acre for intermediate bus service.[11] For frequent bus service, the employment density threshold is 50 employees per net employment acre, although 75 employees per acre is preferred. Light rail transit requires a minimum of 125 employees per net employment acre around transit stations. Transit-supportive development typically achieves these density levels through high floor to area ratios (FAR). If the development has surface parking, the FAR range is 0.5 to 1.0. The preferred FAR range, however, is 1.0 to 2.0 with structured parking.

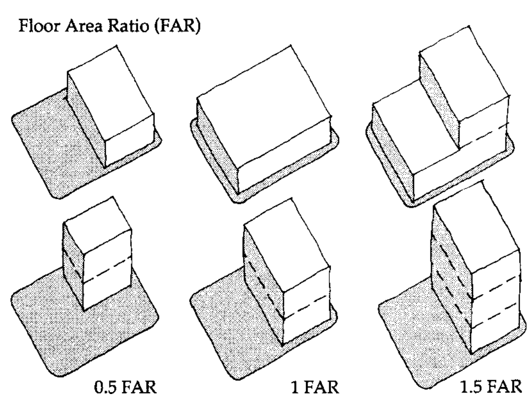


Figure 2.17. Comparison of FAR Configurations. Source*: Planning More Livable Communities with Transit Oriented Development.* Metropolitan Council, 2000.

Building type and orientation are integral to transit-supportive development. To achieve the land use mixes and densities desirable for the core area, buildings must be designed accordingly, but with consideration for their suburban context. Within the core, which is pedestrian-oriented, buildings should achieve a minimum transparency[12] of 40 percent. Setback for core buildings should range from 1′ to 10′, which allows for pedestrian and transit activity but contributes to the human-scale quality of the street. In residential areas adjacent to the core where higher densities are still desirable but single-family dwellings dominate, multi-family housing design should be modified to have compatible massing. These areas are also ideal for live-work buildings which retain a residential street character while diversifying land use.

Building orientation is another critical element of transit-supportive urban design. When buildings face the street, they are more accessible to pedestrians and transit riders because there is a direct, well-defined connection (fig. 2.18, fig. 2.19). Orientation also contributes to a sense of place, which makes the core an attractive transportation destination. In the case of commercial and industrial developments, building orientation and setback should be close to the street. The main entrance of buildings should be oriented to the street, which is more conducive to transit riders who sometimes face inclement weather.

When site conditions or other constraints take precedence over location and orientation, transit-supportive design advocates for an amenity-rich pedestrian plan that has well-defined, safe pedestrian paths that have good protection from the weather.

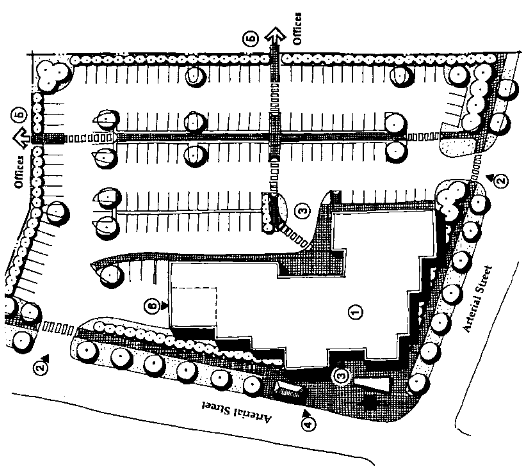


Figure 2.18. Preferred Orientation and Setback for Commercial/Industrial Buildings. Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

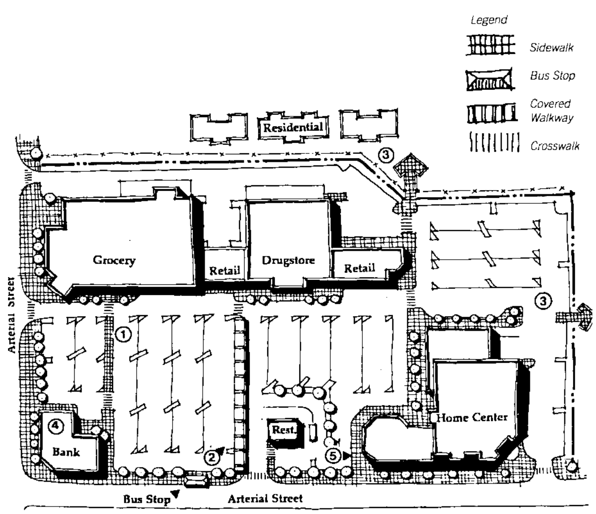


Figure 2.19. Preferred Transit-Oriented Neighborhood Shopping Center Site Design. Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

Transit, Pedestrian and Bicycle Environments

In transit-supportive design, needs of transit riders, pedestrians, and bicycles are balanced with those of the automobile.[13] Transit considerations include location of the stop and/or station, adequate sidewalk space for transit furniture and movement, and building orientation. Pedestrian concerns focus on direct paths with visible landmarks or goals, protection from cars, protection from the weather, connectivity, adequate widths for different land use activities, and occasional resting spots.

Bicycles are used for both commuting and recreation and, thus, have multiple design considerations. Bicycle commuters need routes and facilities that accommodate speed and offer some separation from other users of the facility. If bicycles are used as one leg of a commute that includes transit, riders need secured lockers for storage or bike racks on buses to transport bikes. Bicycles are also used to make household errands, to reach a park or recreational facility, or for recreation and exercise. In these instances, bike paths do not necessarily need to accommodate high speeds, but they do need to be safe and have excellent connectivity.

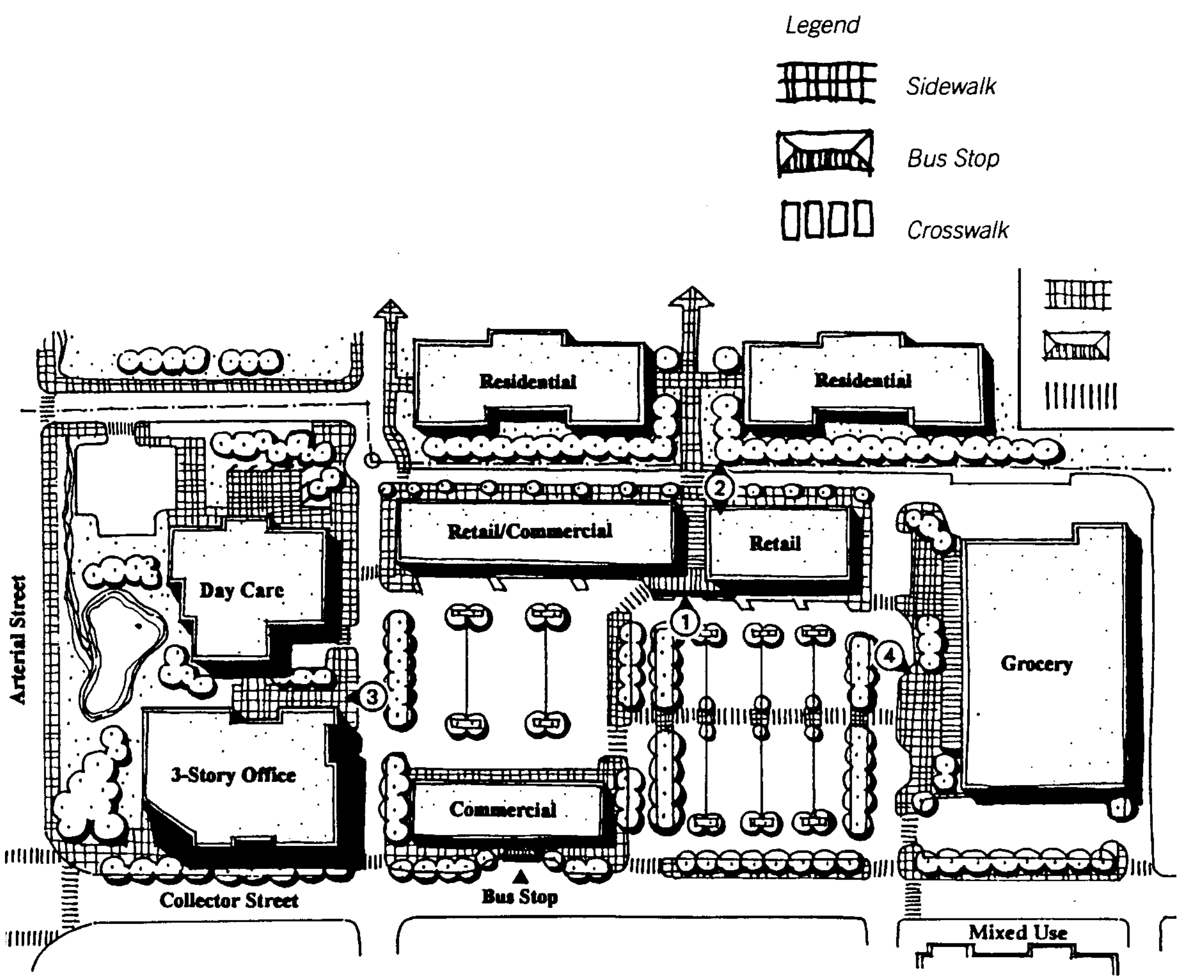


Figure 2.20. Pedestrian and Bicycle Pathways in Transit-Oriented Neighborhood Commercial Center.
Source*: Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

Parking Requirements and Facilities

Although transit-supportive development seeks to increase the use of all transportation modes, the automobile is still assumed to be the primary mode for many decades to come. Therefore, short and long-term automobile storage is a primary design concern. Typically, cars are parked on-street, in a surface lot, or a parking building. Transit-supportive development designs offers strategies for each situation. On-street parking is critical to mixed-use cores. It offers convenient short-term parking for customers, buffers pedestrians from traffic, and reduces the area needed for parking lots. Parking lots should not front the entire length of the arterial street; where appropriate, there should be human-scale commercial buildings and transit stops with amenities (fig. 2.21). Parking lots should have a carefully planned and clearly marked pedestrian circulation system and a landscape architecture plan that aids storm water management. Parking buildings are needed if the development is going to achieve higher densities and a higher FAR. In this case, parking buildings should have a design program that includes ground-floor retail or offices on street-facing sides (fig. 2.22). This design strategy supports street life and complements the pedestrian environment.

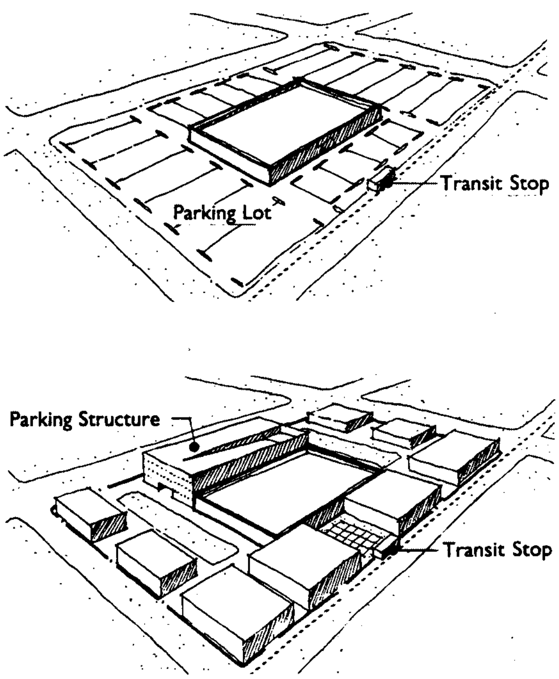


Figure 2.21. Structured Parking Advantages.
Source: *Planning More Livable Communities with Transit-Oriented Development.* Metropolitan Council, 2000.

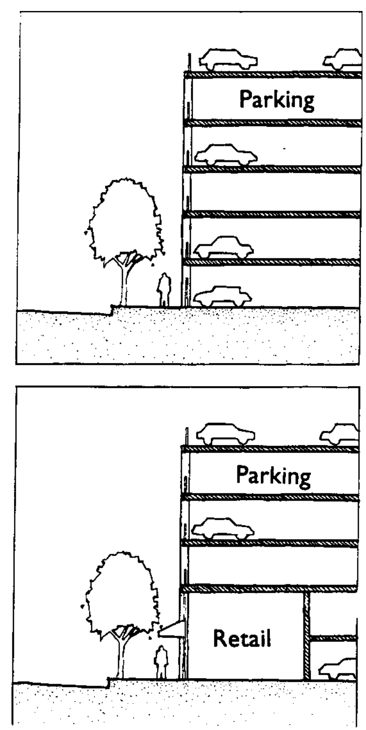


Figure 2.22. Structured Parking Design.
Source: *Planning More Livable Communities with Transit-Oriented Development.* Metropolitan Council, 2000.

2.2 Urban Design Case Studies

The Twin Cities regional transportation model relates travel behavior to the type and scale of the activity where it is generated. In this sense, the model is very place-oriented and activity-specific. For example, the Minneapolis and St. Paul downtowns, where job densities are high, act as trip magnets or generators during periods of peak travel. Transit-supportive development principles change the physical characteristics and activities of places. Since the regional transportation model is the commonly used tool for measuring such changes, this study proposed to develop regional model enhancements that would detect and integrate transit-supportive development changes into the regional model (see Section 3).

Four urban design case study sites were used to inform development of the proposed regional model enhancements and to test their sensitivities to the impacts of transit-supportive development. Two scales of development were tested: micro and macro. The distinction between micro and macro scales related to the level of activity and/or the physical area of the place. For example, a macro site could be physically large with only a few areas that are intensively developed or it could be physically small but very intensively developed, yet both generate high levels of activity. These scales represent the range of development opportunities found across the metropolitan region.

The list of prospective study sites within the North Metro I-35W Corridor Coalition subregion was limited to areas already under consideration by either a city or a developer for transit-supportive development. The rationale for this research approach follows.

1. Considerable background information about the site was available.
2. Current market trends indicated that these sites were viable locations for mixed-use development.
3. If development research existed, it could be used as a starting point for estimating viable job and household densities for the site.
4. There was the potential for immediate implementation of the product of this research.

The four selected sites were categorized as follows:

Micro-Scale Case Study Sites
- Northwest Quadrant, New Brighton
- Town Center, Shoreview

Macro-Scale Case Study Sites
- Twin Lakes, Roseville
- Northeast Blaine

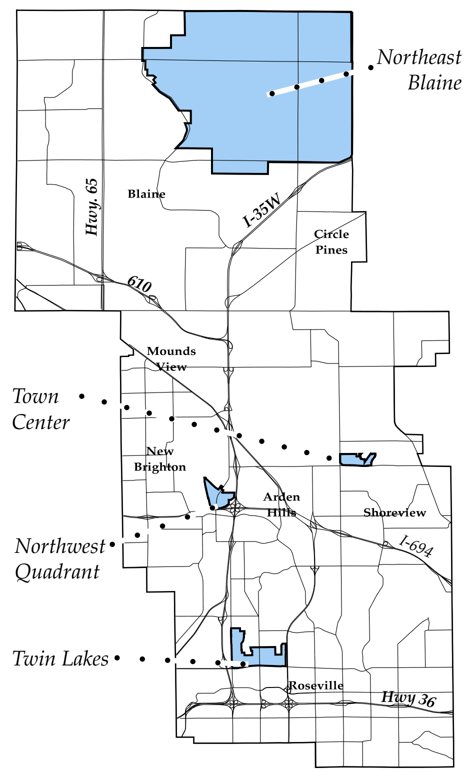


Figure 2.23. Subregional Study Area and Case Study Site Locations.

The objective of the urban design analyses was to develop a transit-supportive design for testing the subarea transportation model. Development of these urban designs relied upon standard design methods to establish context, issues, and opportunities and upon relatively new guidelines and measurement methods. This process was divided into eight steps.

Step 1. Analyzed and described existing conditions in each case study area under the following urban design categories: a) transportation, b) economy, c) neighborhood, d) neighbors, and e) environment. This analysis focused on the subregional scale and had a systems orientation. Subregional data were mapped using Geographic Information Systems software. Each site was analyzed against the subregional context to determine site attributes or absence of attributes (see Appendix A). This analysis generated an initial list of issues and opportunities for each area and revealed how sites were similar and distinctive across scales and urban design categories.

Step 2. Narrowed the range of analysis to the site and immediate surroundings of the case study area. Specific characteristics of the site were considered and translated into a list of issues and opportunities relative to its redevelopment or development.

Step 3. Began the translation of urban design characteristics into transportation modeling terms. Using characteristics such as block length and area, and the number of full intersections, designs were evaluated for their walkability (see page 38 for details).

Step 4. Focused on land use, density, and yield characteristics of each design. For land use, analysis focused on commercial, residential, mixed use, and open space/parks. Densities were based on net acreage by land use. Employment yields were measured in employees per acre and dwelling unit per acre was also represented in total population.

Step 5. Compared each study area's walkability, land use, and density measures against transit-supportive guidelines recommended by the Metropolitan Council (see page 52 for details). The results of this comparison were used to revise designs for testing the subarea model.

Step 6. Revised the design of each study area to achieve transit-oriented guidelines. To generate a transit-supportive test-design for each case study area, both existing and proposed-redevelopment land-use patterns were measured against current transit-supportive design standards. The standards are outlined in a number of guides and primers on transit-supportive, transit-oriented and livable community design published by local, regional and federal governments. Those guides often quote from and rely on the same sources and, consequently, show widespread agreement on best practices for transit-supportive design. The Metropolitan Council's *Guidebook on Smart Growth: Planning More Livable Communities with Transit-Oriented Development* (St. Paul: Metropolitan Council, 2000)—prepared in association with Calthorpe and Associates—served as the primary guide for this study. Another guidebook, *Liveable Neighbourhoods Community Design Code* (Perth: Western Australian Planning Commission, 1997), provided the model used for calculating transit-supportive design zones for each case study area.

Both the existing land uses and proposed development plans of each case study area were analyzed to generate figures that quantify walkability, connectivity, and land-use mix and density. Those figures were compared, within and among the sites, to the Metropolitan Council standards. That comparison served as the baseline for developing revised designs for each case study area that meet transit-supportive design standards. The revised designs were used to test the subarea transportation model

Step 7. Completed the comparative analysis of walkability and land use among the urban designs proposed for each study area.

Step 8. Calculated net job, household, and population data for each case study area and assigned the data to the appropriate subdivided traffic assignment zone in the subarea transportation model.

These steps have been synthesized and grouped for the purposes of this report. Each area is presented as a case study. There is an introductory description of the site, a listing of selected issues and opportunities, a summary of findings of the walkability and land use analyses that led to revised site design, and a synopsis of the walkability and land use and density impacts of the revised design.

Because the walkability and land use analyses were instrumental to the development of the subarea model, these analyses are discussed in separate subsections. Each subsection begins with a description of the methodology used, which is followed by the comparative analysis of existing conditions and the proposed designs for each case study area.

Northwest Quadrant, New Brighton

Figure 2.24. Northwest Quadrant, looking south with downtown Minneapolis in distance

The redevelopment area, which lies in the northwest quadrant of the intersection of interstates 35W and 694, encompasses approximately 100 acres. Current land uses are industrial and commercial, and include a 30-acre asphalt plant adjacent to Long Lake, several smaller-scale businesses adjacent to “Old Highway 8,” and the Brighton Crossroads Golf Range. Old Highway 8 is the only minor arterial serving the site. It is a former state highway that links the redevelopment area with Rush Lake to the north and Olde Town New Brighton to the south, across I-694. Railroad lines define the western and northern boundaries of the site, and isolate the area from Long Lake—and the regional park and residential neighborhoods that surround it.

The Northwest Quadrant is identified as a redevelopment area in the city’s long-range plan for the Old Hwy. 8 Corridor. The city, which is actively seeking to redevelop this area, selected Dahlgren, Shardlow & Uban (DSU) to prepare a master plan for the site. The city’s intent is to redevelop the area with mixed use, residential, and commercial/light industry. DSU’s 2001 conceptual plan and preliminary development analysis included 500 multi-family and townhome units, primarily on the western side of the site overlooking Long Lake Park, and 72,000 sq. ft. of commercial space and 650,000 sq. ft. of office space on the eastern side of the site where there is good visibility from the freeway.

Figure 2.25. Case study location.

Selected Issues and Opportunities

Transportation

- Although interstates 35W and 694 border the site, neither road is directly accessible. The driver must go either north to Hwy. 96 or south to County Road E-2 to use on/off ramps to I-35W. Once on I-35W, there is an interchange with I-694.
- There are no east-west road connections across I-35W, but there is potential to build a bridge, which would link the site with a growing commercial area in Arden Hills.
- Park-and-Ride for express bus service is located approximately 2 miles north of the site.
- One local bus route serves the site, but there are no marked stops within the area.
- Old Hwy 8 is the only minor arterial serving the site. It is a 4-lane minor arterial, posted 40 m.p.h.
- Railroad tracks run across northern edge of site and bridge I-35W. There is an opportunity to make a pedestrian and bicycle connection between the site and Arden Hills.

Economy

- The site is part of a subregional industrial and commercial corridor extending north and south along both sides of I-35W.
- While the site has excellent visual access from the freeways, built and environmental barriers—interstates, railroads, wetlands, etc.—limit physical access.
- There are a few long-standing community businesses located in the site which, if integrated into the redevelopment, could serve as a catalyst for new commercial activity strategy.

Neighborhoods and Amenities

- Mix of stable residential neighborhoods and housing types near but not adjacent to site.
- New Brighton Civic Center—Olde Town—is located just south of the site, across I-694. The New Brighton Family Service Center is used frequently for public and private events. The city hall, a private school, and a neighborhood-scale commercial center are all located in this area.
- Long Lake Regional Park is another notable amenity adjacent to the site. The park includes trails, public facilities, a swimming area, and a sizable area managed as open space.

Figure 2.26. Old Highway 8 streetscape.

Figure 2.27. Asphalt plant in Northwest Quadrant.

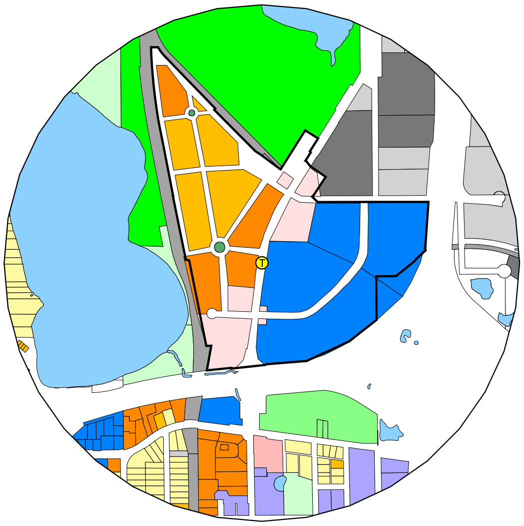


Figure 2.28. Northwest Quadrant Land Use, Concept Design.

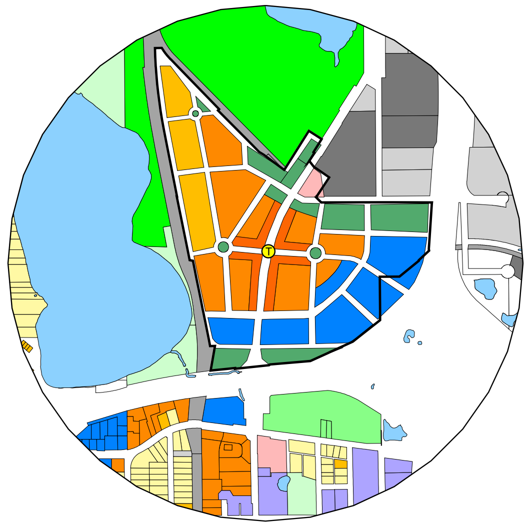


Figure 2.29. Northwest Quadrant Land Use, Revised Design.

Selected Issues and Opportunities ***(continued)***

Neighbors

- Within the case study area there is no housing.
- In the New Brighton Olde Town neighborhood, there are single-family detached and attached homes plus multi-family housing. About 23% of the households are single seniors and about 16% of the households have children.

Environment

- Site could be connected to regional natural system and trails.
- Surrounding lakes and wetlands are vulnerable to run-off/contamination.
- Asphalt plant has pollution clean-up issues.

Transit-Supportive Characteristics of Design Revisions

Activity and Land Use Mix

- An 11-acre mixed-use core and transit stop was added along Old Hwy. 8 near the center of the site.
- Residential development was added to the eastern side of the site, and commercial development was added to the western side of the site.
- The addition of residential land uses and mixed-use buildings has the potential for adding between 1,500 and 2,000 residents to the case study site, which currently has no residents. This influx of residents will increase both the level of current activity as well as the length of time during which the site will be active each day.

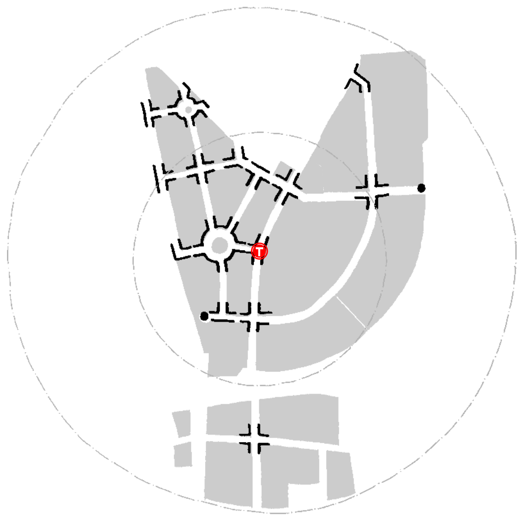


Figure 2.30. Northwest Quadrant Walkability Analysis, Concept Design.

Figure 2.31. Northwest Quadrant Walkability Analysis, Revised Design.

- Commercial intensity— F.A.R. as well as employment density— was increased to meet minimum guidelines and to increase the number of walkable destinations. The densities associated with the type of proposed development could potentially increase the employee population from 317, existing to 4,620.

Movement

- Blocks on the east side of the site were reduced in size and streets and sidewalks were added to improve connectivity and walkability. The longest block is 800′ as opposed to 1,900′ and the largest parcel area was reduced from 28 acres to 16 acres. These design changes increased the number of full intersections from 15 to 29, which greatly increases the number of route options.
- The railroad bridge across I-35W was converted into a recreational trail, connecting the site with the growing subregional trail network and enhancing general access to Long Lake Regional Park.
- Streets were aligned with those in the development on the east side of I-35W to reserve the opportunity for linking the roadway network with bridges across the freeway.

Environment

- A green corridor was added to the northern and southern edges of the site. The design extends the Long Lake Regional Park open space into the site.
- Formal green public space was added in the centers of round-abouts shown in the revised design.

Town Center, Shoreview

Figure 2.32. View of town center looking west. Ramsey County Highway 96 forms the southern edge.

The study area lies in the northeast quadrant of the intersection of Lexington Avenue and Highway 96 and encompasses approximately 80 acres. Current land uses are commercial, light industrial and institutional. A strip mall that is prime for redevelopment occupies the southwest corner of the site—behind a sight-blocking berm—at the intersection of Lexington and Highway 96. Recently-built senior housing defines the northeast triangle of the site, just west of the Shoreview Commons community center. Between those two anchors is a mix of office and light industrial buildings. A residential neighborhood and Lake Martha define the northern boundary of the site.

The City of Shoreview has identified this area as a redevelopment area in its comprehensive plan. The area is part of a long-range planning study for the Hwy. 96 corridor in Shoreview. The city, through a joint effort with the I-35W Corridor Coalition, contracted with Calthorpe Associates to lead a community planning process that would generate an illustrative plan for the Town Center. Approximately 35 residents and business owners participated; the proposed concept plan used in this report is the result of this process. While both the concept design and the revised design are based on transit-supportive principles, community input determined such things as the location of the transit stop and the land use mix.

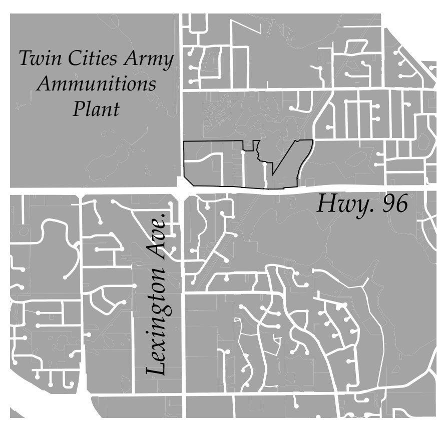


Figure 2.33. Case study location.

Selected Issues and Opportunities

Transportation

- Highway 96, the southern border of the site, is a four-lane, divided road designed to move traffic between major destinations. It was designed to be multi-modal, although signalized pedestrian crossings are limited. There are trails and pedestrian paths along the site. The City of Shoreview implemented extensive streetscape designs to make the road attractive and to calm traffic.
- The site is served by four bus routes, and there is a Park-n-Ride lot adjacent to the east end of the site.
- There are pedestrian paths/sidewalks along Highway 96, Lexington Avenue, Tanglewood Drive, and Victoria Street, which are linked to trails throughout the city.

Economy

- Several light-industrial businesses, employing over 800 persons, are located on site.
- Parts of site are in low-lying areas not clearly visible from the road.
- There is a major utility line that crosses the site.
- Yet-to-be-defined redevelopment of areas within the Twin Cities Army Ammunition Plant will impact multiple aspects of redevelopment opportunities for this site.

Neighborhoods and Amenities

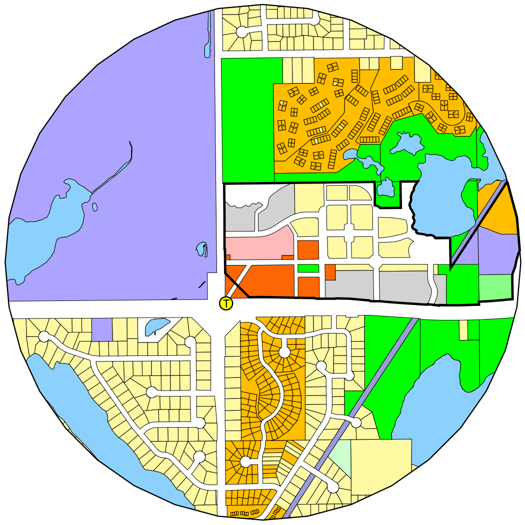
- Site is surrounded by a stable neighborhoods of townhomes and single-family homes.
- Recently-built senior housing located in northeast triangle of site.
- In spite of close proximity to the site, surrounding neighborhoods are not well connected with pathways or roads.
- Shoreview Commons Community Center, a Ramsey County Branch Library, and Snail Lake Marsh County Park are adjacent to eastern edge of site.

Neighbors

- Within the 1/2-mile radius of the site's center are more than 700 homes. Housing types include townhomes (54%) and single family detached(46%). Almost 100% of the homes are owner-occupied.

Figure 2.34. Looking west along Highway 96; wetland complex adjacent to site.


Figure 2.35. Surface parking lot in front of shopping center.



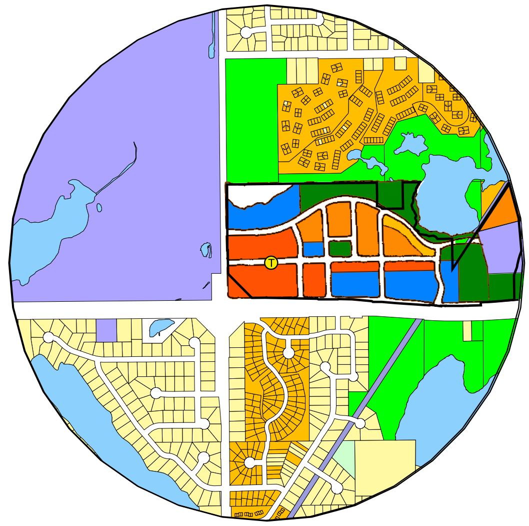


Figure 2.36. Town Center Land Use Analysis, Concept Design.

Figure 2.37. Town Center Land Use Analysis, Revised Design.

Selected Issues and Opportunities (*continued*)

- About 65% of households are made up of 2 person, or fewer, and just over 20% of households have children.
- Neighborhoods adjacent to the site have experienced little turnover in homeownership in the last 10 years.
- Townhome associations adjacent to site are active and participated in the design process led by Calthorpe Associates.

Environment

- The site is surrounded by large wetland complexes, which are part of a larger open space corridor. There is an opportunity to design and build redevelopment in a way that protects and conserves these natural systems.
- Natural systems could be utilized as trail corridors.

Transit-Supportive Characteristics of Design Revisions

The illustrative plan prepared by Calthorpe and Associates proposes a transit-supportive, pedestrian-friendly redevelopment of the site that increases the mix and density of land uses, and creates a "Main Street"-focused town center for Shoreview. The study process included three community workshops. Business owners, residents, government departments and agencies with interests in the site, as well as community leaders, participated in the workshops. Ehlers and Associates, a public finance consulting firm, compared the fiscal impacts of the transit-supportive design to continuation of current land uses in the area. The mixed-use concept was found to have greater long-term financial benefits to the city.

Activity and Land Use

- The transit stop was moved from the Highway 96 and Lexington Avenue to a more pedestrian-friendly interior site, to make transit more accessible to the potential new employee and residential populations.

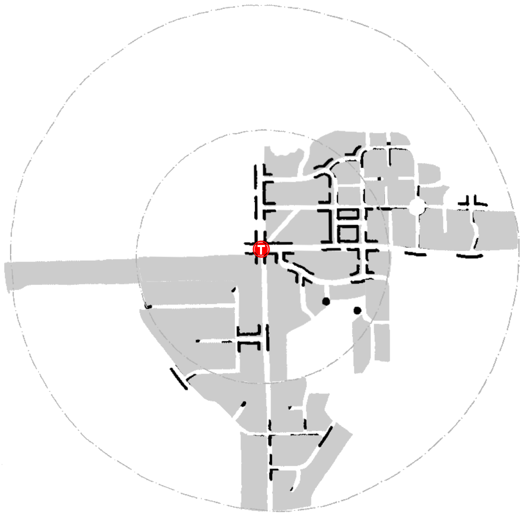


Figure 2.38. Town Center Walkability Analysis, Concept Design.

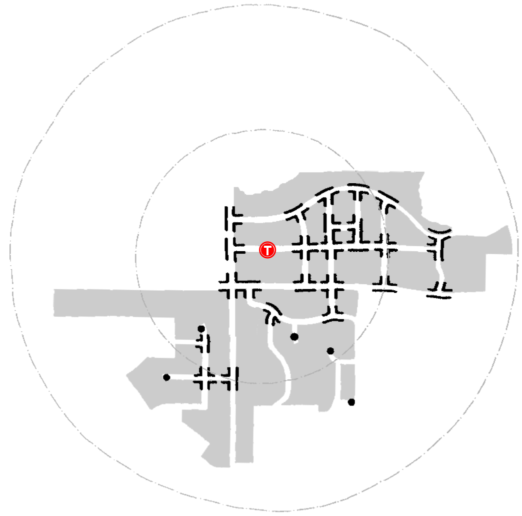


Figure 2.39. Town Center Walkability Analysis, Revised Design.

- In the case study area, residential densities were increased from 25 to 40 persons per net residential acre to compensate for the conversion of some residential land uses to open space. Within the 1/2-mile radius study circle, that only increased the persons per net residential acre from 13 to 14.
- The concept design added different types of job-generating land uses. Less emphasis was placed on industrial land uses and more emphasis was placed on commercial land uses. Theconcept design proposed increaseing the number of jobs within the case study area 706, existing to 2,072. The revised design reduced the total number of commercial and industrial land use acres from 17, which was prospoed in the concept design, to 14 and increased the number of employees per net commercial/ industrial acre from 86 to 89.

Movement

- The primary change in movement patterns between existing conditions and the concept design is the creation of a "Main Street" that parallels Hwy 96. The internal network of streets that links to Main Street allows for circulation without using Hwy 96. The revised design retains this basic concept and makes only minor changes.
- The concept design proposes a complex block pattern and road network. The revised design simplifies this structure without significantly compromising connectivity. The number of full intersections is reduced from 28 in the concept plan to 25 in the revised plan and the block lengths remain basically the same.

Environment

- The additional open space at the northern edge of the site creates a clearly definable edge to the site and provides greater protection for the existing wetlands.
- Design of the street next to that open space as a city parkway ensures public access to the amenity.
- The additional green space on the eastern edge of the site improves the habitat connection between wetlands north and south of Highway 96.

East and West Twin Lakes, Roseville

Figure 2.40. Twin Lakes Redevelopment Area, looking northeast.

The study site, which lies just east of I-35W and the recently-developed Centre Pointe business park, encompasses approximately 110 acres. It is bound on the west and east by Cleveland and Snelling Avenues, respectively, and on the south by County Road C. Residential neighborhoods and Langton Lake define the northern perimeter of the Twin Lakes site. Current land uses are primarily industrial, with truck transfer stations occupying much of the area. Recently, the Twin Lakes area has been the focus of an intense environmental clean-up and redevelopment process by the City of Roseville. In June 2001, the City Council approved the Twin Lakes Alternative Urban Areawide Review (AUAR), afterwhich it was sent to the Minnesota Environmental Quality Board for final approval. The AUAR plan proposes a mix of land uses, including office, medical, housing, service and high-tech flex to replace the current industrial land uses. The new development in Twin Lakes will complement other recent redevelopment in the area, which includes the new Veritas Software campus and Centre Pointe business park.

Because of the physical size of Twin Lakes, the area was divided into two transit-supportive sites. Each site has its own transit center. Each site was analyzed and redesigned to achieve transit-supportive standards.

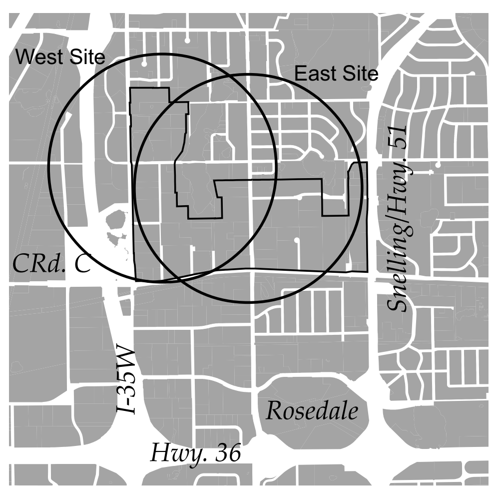


Figure 2.41. Case study location.

Selected Issues and Opportunities

Transportation

- The site has direct access to I-35W and is conveniently accessible to Highway 36 and several minor arterials. It is part of a larger regional employment center that began developing in the 1940s.
- Ramsey County Road C is being improved.
- Although the site has several sidewalks and trails surrounding it, there are very few in or through the site. There are opportunities to link the site to the surrounding network.
- The site is served by several bus routes, all of which are on the periphery.
- The railroad line that borders the southern edge of the site is designated as a transitway in Met Council's 2020 Transportation Policy Plan. A planning study is underway to identify potential development sites and recommend the most appropriate transportation mode for this facility.

Economy

- Rosedale, a healthy regional commercial center, is 1/2 mile south of the site.
- Regional economic development trends have already spurred redevelopment activity in and surrounding the Twin Lakes area. Centre Pointe is a prime example.
- The site is part of a larger employment center, which generates synergies for redevelopment of Twin Lakes.
- Twin Lakes is centrally located in Twin Cities region. It is within 5 miles of downtown Minneapolis and the University of Minnesota and 7 miles of downtown St. Paul.

Neighborhood and Amenities

- Immediately north of the site is Langton Lake Park, a city park with trails, activity areas, and habitat areas.
- Presbyterian Homes, a major provider of senior housing and care, has two substantial facilities within 1 mile of Twin Lakes.
- Rosedale Mall is within 1 mile of the site. It and surrounding retail development form a regional shopping center that is well established and draws activity into the evening.

Figure 2.42. Looking southwest over intersection of County Road C and Fairview Avenue.

Figure 2.43. Most of the older industrial sites are paved and have minimal water retention strategies employed.

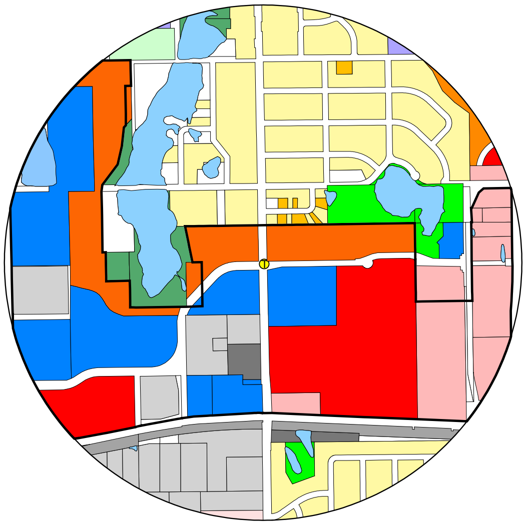


Figure 2.44. Twin Lakes—East Land Use Analysis, AUAR Concept Design.

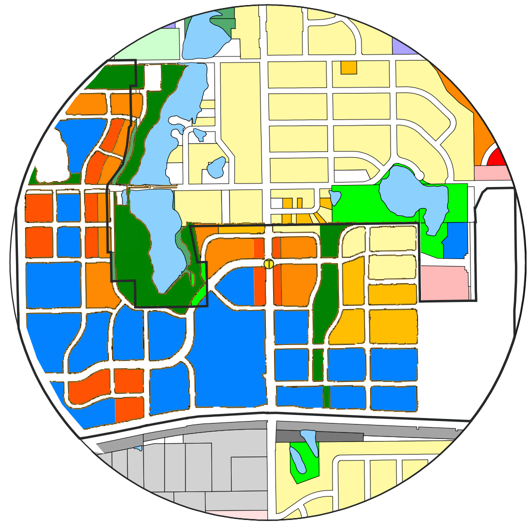


Figure 2.45. Twin Lakes—East Land Use Analysis, Revised Design.

Selected Issues and Opportunities *(continued)*

Neighbors

- The site is bounded on the north by well-established residential neighborhoods, many of which developed between 1950 and 1975.
- Nearby institutional neighbors include Northwestern College and Bethel College.

Environment

- Langton Lake and Lake Johanna to the north are attractive, natural amenities.
- Past uses of the site for trucking and industry have contaminated many areas, which will need clean-up before redevelopment can occur.
- Use of best practices for environmental design would significantly reduce the current run-off which impacts the vitality of surrounding wetlands and natural systems.

Transit-Supportive Characteristics of Design Revisions

Activity and Land Use

- In the transit-supportive design, the transit stop was located on Fairview Avenue and in a mixed-use core.
- The mixed-use core was clustered around the transit stop to provide better access and improve walkability.
- Higher density residential housing was relocated for convenient access to transit and the services and businsses located in the mixed use center.
- Changes in land use and densities increased the residential population in the study area from 2,264 in the AUAR concept to 2,863 in the transit-supportive design.
- The employee population, on the other hand, decreased from 7,896 in the AUAR concept to 6,213 in the transit-supportive design.

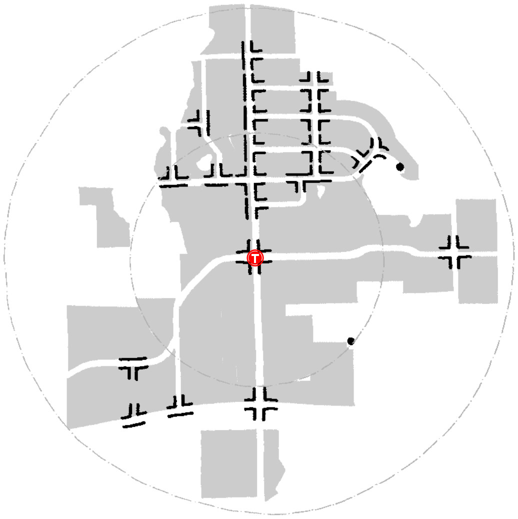


Figure 2.46. Twin Lakes—East Walkability Analysis, AUAR Concept Design.

Figure 2.47. Twin Lakes—East Walkability Analysis, Revised Design.

Movement

- Blocks were subdivided and the road network expanded to improve walkability and connectivity for all transportation modes. The longest block length was reduced from 1,950′ to 1,100′ and the largest parcel area was reduced from 21 acres to 11 acres.
- The road network was expanded to improve connectivity throughout the site. The total number of full instersections increased from 22 to 55 within walkable area.

Environment

- The acres of parks and open sapce increased from 6 to 29. The low-lying area in the eastern side of the site was added to the existing natural resources network. This addition increased opportunities for environmentally-friendly treatment of run-off. A street provides the edge to the area and ensures public access.

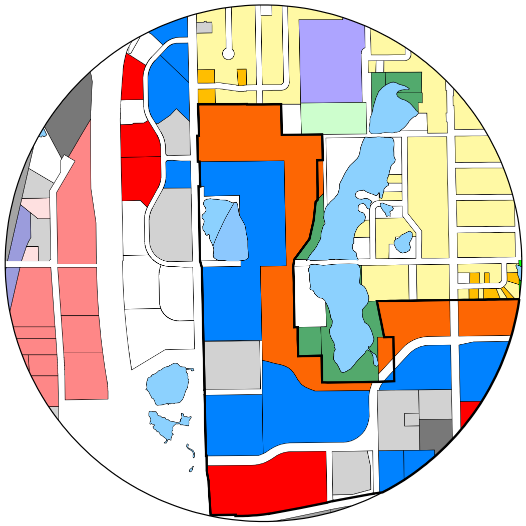


Figure 2.48. Twin Lakes—West Land Use Analysis, AUAR Concept Design.

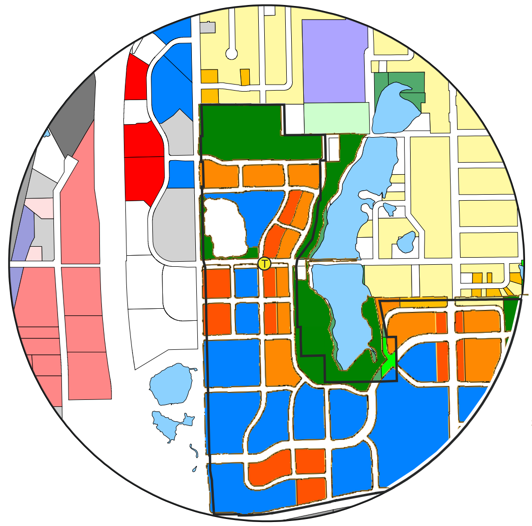


Figure 2.49. Twin Lakes—West Land Use Analysis, Revised Design.

Transit-Supportive Characteristics of Design Revisions

Activity and Land Use

- Mixed-use activity was increased throughout the site, especially near the transit stop, along the western side of Langton Lake, and at the southern edge of the site. This strategy supports the transition between the predominantly residential uses around the lake to the largely commercial and office uses near the freeway.
- Twenty-four acres of residential land uses were added to the western side of Langton Lake. Placement of housing next to the park maximizes public investment in the natural resource and adds to the mix of activity over the course of a day.
- Housing densities were increased to meet minimum set out in guidelines.

Movement

- Blocks were subdivided and the road network was expanded in the are surrounding the transit stop and throughout the core. The largest block area was reduced from 18 acres to 12 acres and the longest block length was reduced from 2,600′ to 1,400′.

Environment

- Land designated as parks and open space increased from jsut a few acres to 29 acres. The added park and open space land use is at the northern edge of the site. It creates a visual and physical connection between the more intense land uses in and adjacent to the western side of the site and the natural resources of Langton Lake. Trails through this area would provide improved access to this public amenity.

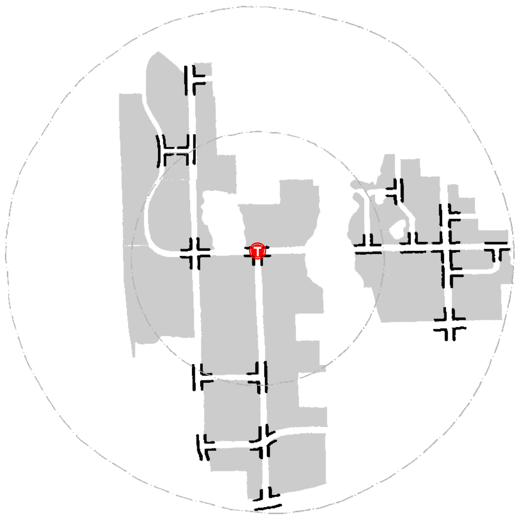


Figure 2.50. Twin Lakes—West Walkability Analysis, AUAR Concept Design.

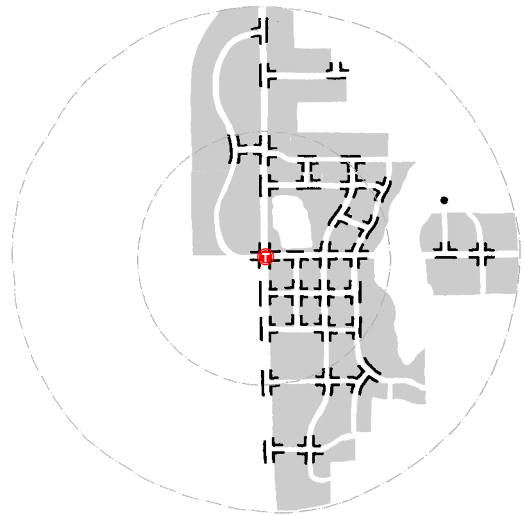


Figure 2.51. Twin Lakes—West Walkability Analysis, Revised Design.

West Meadows and Lochness Lake in Northeast Blaine

Figure 2.52. Northeast Blaine, looking northwest across the intersection of Lexington Avenue and Main Street.

The study site, which encompasses approximately 5,000 acres, lies outside the Metropolitan Urban Services Area (MUSA), but within an area designated by the Metropolitan Council as the Urban Reserve. The City of Blaine expects that most of the area will require access to public water and sewer service by 2020. Agricultural land uses dominate the landscape. Hobby farms, large-lot residential and some industrial uses are interspersed among the farms. Development is encroaching at the edges of the site. The proposed widening of Lexington Avenue and reconstruction of bridges at the intersections of I-35W and 95th Avenue and Main Street will only intensify the pressure further.

The Design Center has been working with the City of Blaine and its residents to plan for future development in this area. The Design Center has generated land-use proposals for two sites within N.E. Blaine: the Lochness Lake neighborhood, at the intersection of Lexington Avenue and Main Street, and the West Meadows neighborhood, which is south of Main Street between Lexington Avenue and Radisson Road. These proposals, which are based on transit-supportive development principles, were used to test the subarea model.

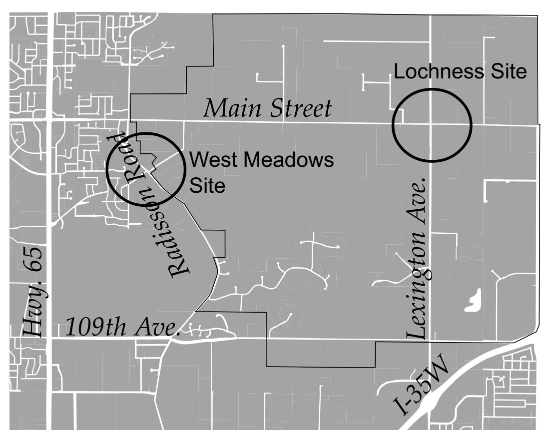


Figure 2.53. Case study location.

Selected Issues and Opportunities

Transportation

- The planned widening of Lexington Avenue will make the northeast area more accessible for development.
- Metro Transit has funding to construct a new and enlarged park-and-ride facility at 95th Avenue and I-35W. This will enable increases in express bus service.

Economy

- There are several new developments underway throughout the city, such as Blaine Town Center, the Village, and Club West.
- Currently, there are few workplaces located in Northeast Blaine and the city council would like to increase the balance between jobs and housing as the area develops.
- Much of the economy in this area was based on agriculture. Sod farms still dominate the landscape.

Neighborhoods

- The 23,000-acre Carlos Avery Wildlife Management Area is located within 2 miles of the northern boundary of Blaine.
- There is a utility corridor south of Main Street, which could be part of an open space system.
- There are no schools in the area and new development will require school districts to prepare strategies for facilities and/or transportation.

Neighbors

- Residences in the area are primarily rural or on large lots of several acres. There are a few residential enclaves built in the 1970s and some newly-developed subdivisions on the southern edge of the site.

Figure 2.54. Large-lot residential development.

Figure 2.55. Sod farm.

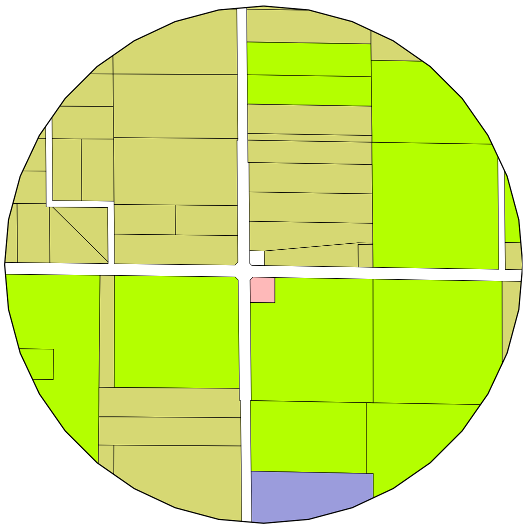


Figure 2.56. Lochness Lake Land Use Analysis, Existing Conditions.

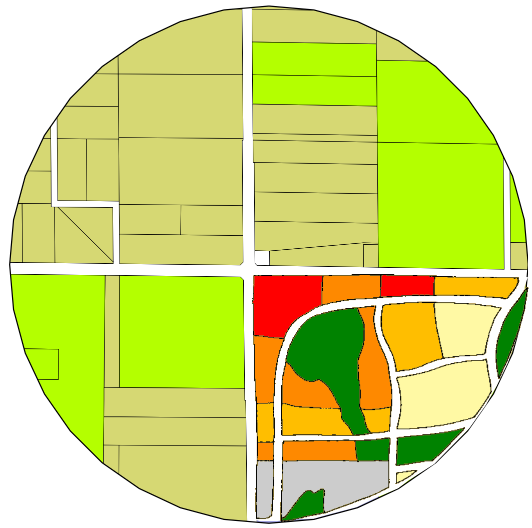


Figure 2.57. Lochness Lake Land Use Analysis, Transit-Supportive Design.

Selected Issues and Opportunities *(continued)*

Environment

- The Rice Creek Chain of Lakes to the south, the Carlos Avery Wildlife Management Area to the north, and the complexes of wetlands and uplands in the area form a diverse habitat corridor, which is a natural resource for the entire region.
- The area is part of the Anoka Sand Plain and has high water tables, which often require extensive excavation to prepare construction sites.
- A recently completed natural resource inventory identified a number of high quality plant communities and rare and endangered species.

Transit-Supportive Characteristics of Design Revisions

The Lochness Lake case study area is held by a prospective developer; it is located in the southeast quadrant of the intersections of Lexington Avenue and Main Street. The case study transit-supportive design was limited to this area because it is the only parcel likely to redevelop in the near future. Transit-supportive design principles are the basis for the design. Community input from workshops facilitated by the Design Center were used to inform development of the design used in this study.

Activity and Land Use

- The transit stop was located near the intersection of Lexington Avenue and Main Street.
- The mixed-use core of the design was located near the same intersection. It is anticipated that daily traffic volumes would be relatively high, thus making mixed-use the most compatible land-use choice.
- Higher density residential land uses were sited adjacent to open space.

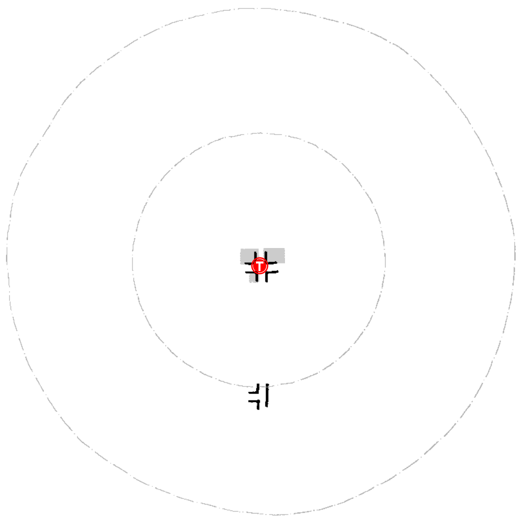


Figure 2.58. Lochness Lake Walkability Analysis, Existing Conditions.

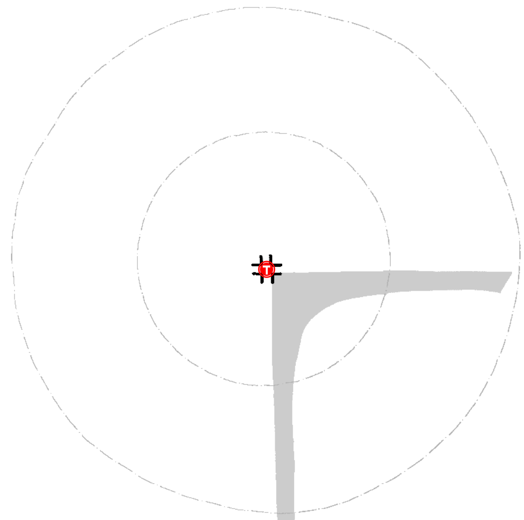


Figure 2.59. Lochness Lake Walkability Analysis, Transit-Supportive Design.

- Overall, housing for 2,072 residents was proposed for this site, which is 31 residents per net residential acre. This level of density should easily support a moderate level of transit service to the site.

Movement

- Since there is no existing infrastructure for this site, the county spacing standard of 1/2 mile for full intersection was applied. (This standard does allow for limited access along the 1/2 mile road segment.) The result of using this standard was the design of an internal circulation network, part of which includes a collector street that parallels Lexington Avenue and Main Street.
- Mutli-use trails and sidewalks would provide access to the transit stop.

Environment

- A habitat corridor was designed as a central feature of the development. In addition to providing open space for residents, it connects the site to larger natural resource networks adjacent to the site.

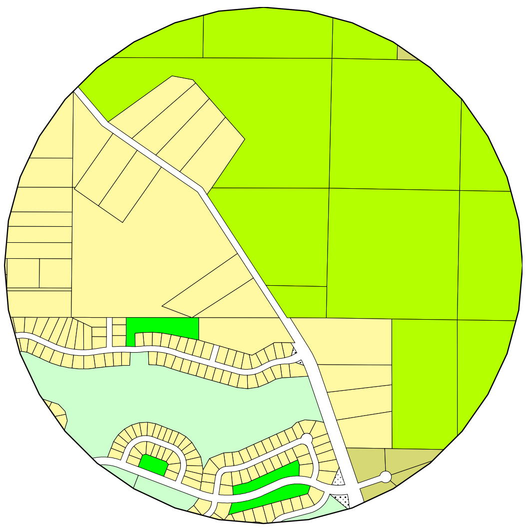


Figure 2.60. West Meadows Land Use Analysis, Existing Conditions.

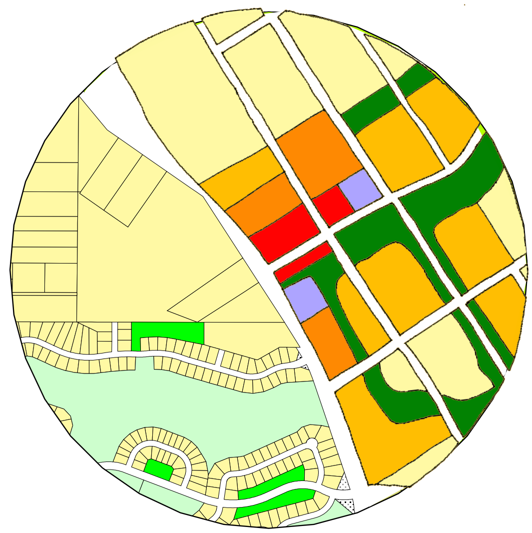


Figure 2.61. West Meadows Land Use Analysis, Transit-Supportive Design.

Transit-Supportive Characteristics of Design Revisions

The West Meadows case study site is on the western edge of the larger Blaine study site. This site was selected for transit-supportive development because the area surrounding it is slated for more intensive development and because Radisson Road is an important minor arterial slated for future improvements that will support multi-modal transportation. Community input from workshops facilitated by the Design Center also identified this general area as a logical place to locate more intensive development.

Activity and Land Use

- The transit stop was located near Radisson Road, an important north-south minor arterial.
- The core of the development was located at the intersection of Radisson Road and a proposed collector street for the development. Eight acres of commercial land use was set aside for office and retail uses. The average number of employees per net commercial acres is 22, for a total of 163 employees.
- Higher density residential development was located in areas immediately surrounding the core. In the case study area, enough housing was added for 4,188 new residents.

Movement

- The street network was based on a grid. Full intersections with Radisson Road were based on standard spacing for minor arterials.
- Transit services will likely connect to the park-and-ride facility located at 95th and I-35W.

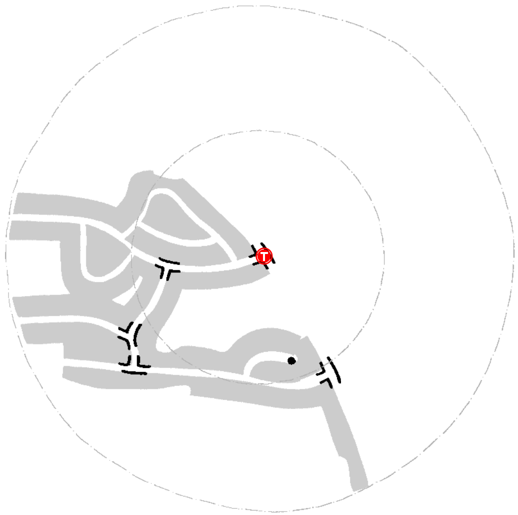


Figure 2.62. West Meadows Walkability Analysis, Existing Conditions.

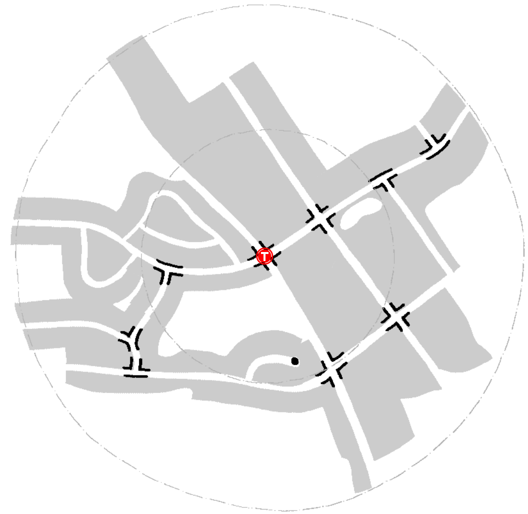


Figure 2.63. West Meadows Walkability Analysis, Transit-Supportive Design.

Environment

- The open space connects to the larger network being planned by the city. Use of parkways to edge these spaces ensure public access.
- In some cases, the open space is in the middle of the block. This design strategy allows it to become green infrastructure for water management purposes
- Narrow "fingers" of open space extend into residential and office neighborhoods to provide access and location for wetland and open water features.

2.3 Walkability Analysis

Walkability is a measure of how pedestrian-friendly, or walkable, a development is. Residences and employment must be within a walkable distance—generally considered to be 1/4-mile, or a 5-minute walk of bus or rail transit center or 1/2-mile, or a 10-minute walk of a transit station—for transit-oriented designs to function well (fig. 2.65). Improving the walkability of the designs proposed for the case study sites was a primary objective of the urban design component research. The revised designs were used to test the regional transportation model enhancements.

To revise the proposed designs, both the existing land uses and proposed development of each case study area were analyzed. This exercise generated figures that quantified walkability and connectivity. Those figures were compared within and among the sites to the Met Council standards. That comparison served as the baseline for developing revised designs for each case study area that met transit-supportive design standards. The final revised design was then analyzed to provide a final comparison.

For the micro case study areas, the walkability analysis included most of the redevelopment site. The macro case study areas of Twin Lakes and Blaine were physically large enough that two areas were analyzed for each case study. The same methodology was used for all case study sites.

Methodology

The Western Australian Planning Commission's *Liveable Neighbourhoods Community Design Code* served as the method for calculating walkable areas—often called "ped-sheds"—using its walkable catchment technique. That technique was adapted for standard measurements of feet and acres, and presented in a Congress for the New Urbanism (CNU) "tech sheet." The methodology generated walkable route length and percentage of walkable area (a minimum of 60% is the theoretical ideal). Steps of the methodology are summarized below:

1. Using the transit stop/center/station, draw two circles, one with a 1/4-mile radius the other with a 1/2 mile radius.
2. From the center point, measure out 1/4 mile along the center line of all street to the boundary of the inner circle and 1/2-mile for the boundary of the outer circle.
3. Identify and color blocks within a 1/4- and a 1/2-mile walk of the center point.
4. Approximate the walkable area (the area inside the block boundary) using a scaled grid; calculate the total walkable area and its percentage of the 1/4-mile radius circle (125 acres) and for the entire 1/2-mile radius circle (500 acres).

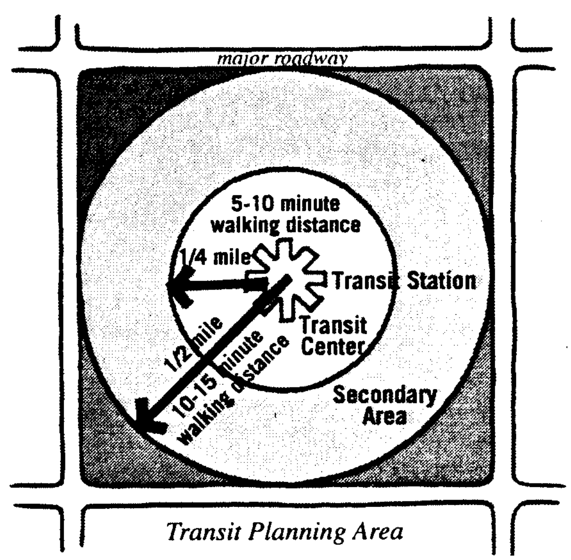


Figure 2.64. Area within walking distance of a transit stop. Source: *Creating Livable Communities.* Regional Transportation District, Denver, circa 1996.

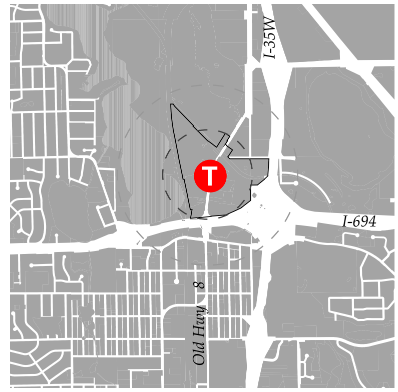
While it provided reasonable and comparable measures of walkability, the walkable catchment technique did have some flaws. Most notably, areas with land-use parcels that were exceptionally large generated deceptively high walkability percentages. This resulted from the fact that the technique required assigning all parcels of land adjacent to the walkable routes, without concern for their size, to the walkable area. Another factor that affected walkable area percentages was the density of the street grid. In an area with more streets, the increased land area needed for right-of-way reduced the land available for building. The result was a lower total walkability percentage than what might be expected. Also, common sense suggested that a 30-acre parcel of land that contains an asphalt plant, for example, is not "walkable," whether it was adjacent to a walkable route, or not. This fault in the method highlighted the need to examine and integrate other measures of walkability, such as block size, when creating a transit-supportive development.

Block size is commonly used for this purpose. The Met Council guidelines define seven acres as the maximum block size within a suburban transit-supportive development; maximum block length is limited to 500'. To compare the case study areas against those standards the longest and shortest blocks, and the largest parcel in each walkable area were identified. Those measures were represented in a percentage relationship to the allowable. In many walkable areas both the longest and shortest blocks were longer than 500', and the largest parcels were as much as 429%over the allowable block size of seven acres.

Another measure, related to walkability, calculates the connectivity of a neighborhood. The more through-streets and the fewer cul-de-sacs and dead-ends a neighborhood has, the more connected it is. Calthorpe and Associates provide a measure of connectivity that calculates the number of through-intersections in a neighborhood per quarter section of land. Measures of connectivity were compiled for each walkable area examined.

The walkability findings for each of the case study areas are summarized on the following pages. There is a brief summary of key findings followed by a numerical table of the results and a graphic chart of the design analyses.

Walkability Analysis:
Northwest Quadrant, New Brighton



The transit stop remained in the same location in all three design proposals. Within 1/4-mile of the transit stop, the percentage of walkable area remained approximately the same for existing conditions and the transit-supportive design; however, the calculation for the redevelopment proposal was higher. The walkable area in the transit-supportive design included a denser street network, which increased the amount of land required for right-of-way, therefore reducing the percentage of total walkable area. The transit-supportive design improved connectivity over the redevelopment proposal by keeping the longest block length to 800’ and the largest parcel size to 16 acres, in contrast to 1,900’ and 28 acres respectively. Within the 1/2-mile radius, the number of full intersections increased from 15 to 29 and the number of linear feet of street network from 19,250’ to 33,500’.

Table 2.1. Walkability Analysis: Northwest Quadrant, New Brighton

			Existing Land Use	Redevelopment Proposal	T-S.D. Proposal
Walkability	Routes and Areas	1/4-mile Walkable Area and Percentage of 1/4-mile Area	54 acres 43%	78 acres 62%	53 acres 42%
		1/4-mile Walkable Routes, Street Network Length	4,850 ft.	6,250 ft.	11,250 ft.
		1/2-mile Walkable Area and Percentage of 1/2-mile Area	114 acres 23%	94 acres 34%	101 acres 31%
		1/2-mile Walkable Routes, Street Network Length	8,850 ft.	19,250 ft.	33,500 ft.
	Blocks	Longest Block in Walkable Area	2,620 ft.	1,900 ft.	800 ft.
		Percentage Over Allowable (500')	424%	280%	60%
		Shortest Block in Walkable Area	900 ft.	200 ft.	250 ft.
		Percentage Over Allowable (500')	80%	——	——
		Largest Parcel in Walkable Area	30 acres	28 acres	16 acres
		Percentage Over Allowable (7 acres)	329%	300%	128%
Connectivity		Number of Intersections in Walkable Area	4	15	29
		Intersections/Quarter Section	5	13	30
		Number of Culs-de-Sac/Dead Ends in Walkable Area	1	2	0

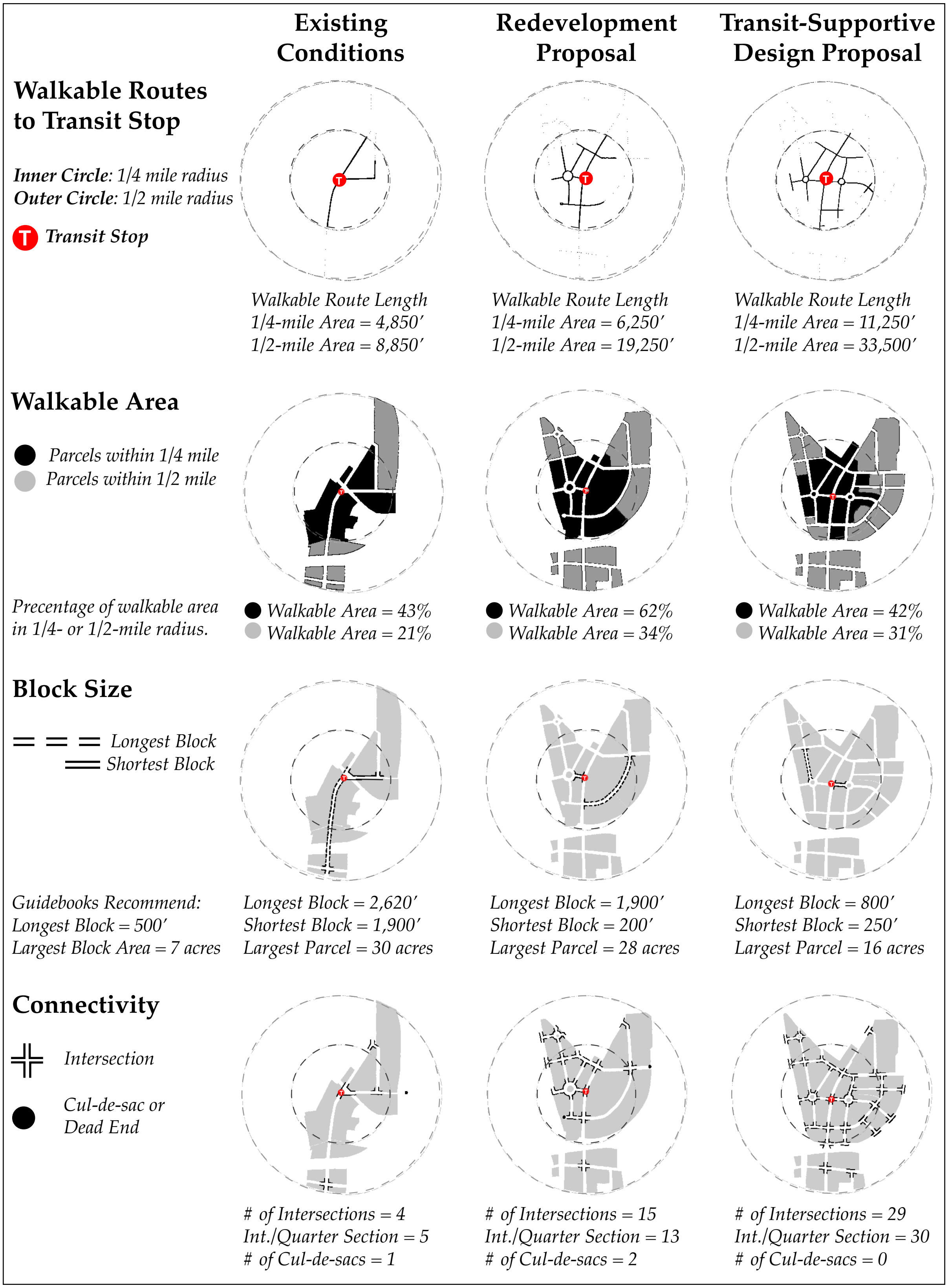


Figure 2.65. Walkability Analysis: Northwest Quadrant, New Brighton.

Walkability Analysis:
Town Center, Shoreview

In the Shoreview case study, the transit stop was moved from the intersection of Hwy. 96 and Lexington Avenue at the edge of the site to a location more central to higher intensity development. This shift reduced the number of existing net walkable acres within the 1/2 mile radius from 78 acres to 70 acres. Revisions to the street pattern and block size also affected acreage.

Both the redevelopment concept and transit-supportive design showed considerable improvements in connectivity measures over existing conditions. For example, the number of intersections in the 1/2-mile circle increased from the 13 existing to 25 in the transit-supportive design, the shortest block length was reduced from 800' to 250' and the largest area for a parcel was reduced from 12 acres to 10 acres.

Table 2.2. Walkability Analysis: Town Center, Shoreview

			Existing Land Use	Redevelopment Concept	T-S.D. Proposal
Walkability	Routes and Areas	1/4-mile Walkable Area and Percentage of 1/4-mile Area	49 acres 52%	44 acres 47%	33 acres 35%
		1/4-mile Walkable Routes, Street Network Length	8,250 ft.	10,500 ft.	9,750 ft.
		1/2-mile Walkable Area and Percentage of 1/2-mile Area	78 acres 34%	73 acres 31%	70 acres 27%
		1/2-mile Walkable Routes, Street Network Length	24,750 ft.	32,500 ft.	24,000 ft.
	Blocks	Longest Block in Walkable Area	1,900 ft.	1,900 ft.	1,800 ft.
		Percentage Over Allowable (500')	280%	280%	260%
		Shortest Block in Walkable Area	800 ft.	200 ft.	150 ft.
		Percentage Over Allowable (500')	60%	——	——
		Largest Parcel in Walkable Area	12 acres	10 acres	10 acres
		Percentage Over Allowable (7 acres)	71%	43%	43%
Connectivity		Number of Intersections in Walkable Area	13	28	25
		Intersections/Quarter Section	12	26	25
		Number of Culs-de-Sac/Dead Ends in Walkable Area	11	4	5

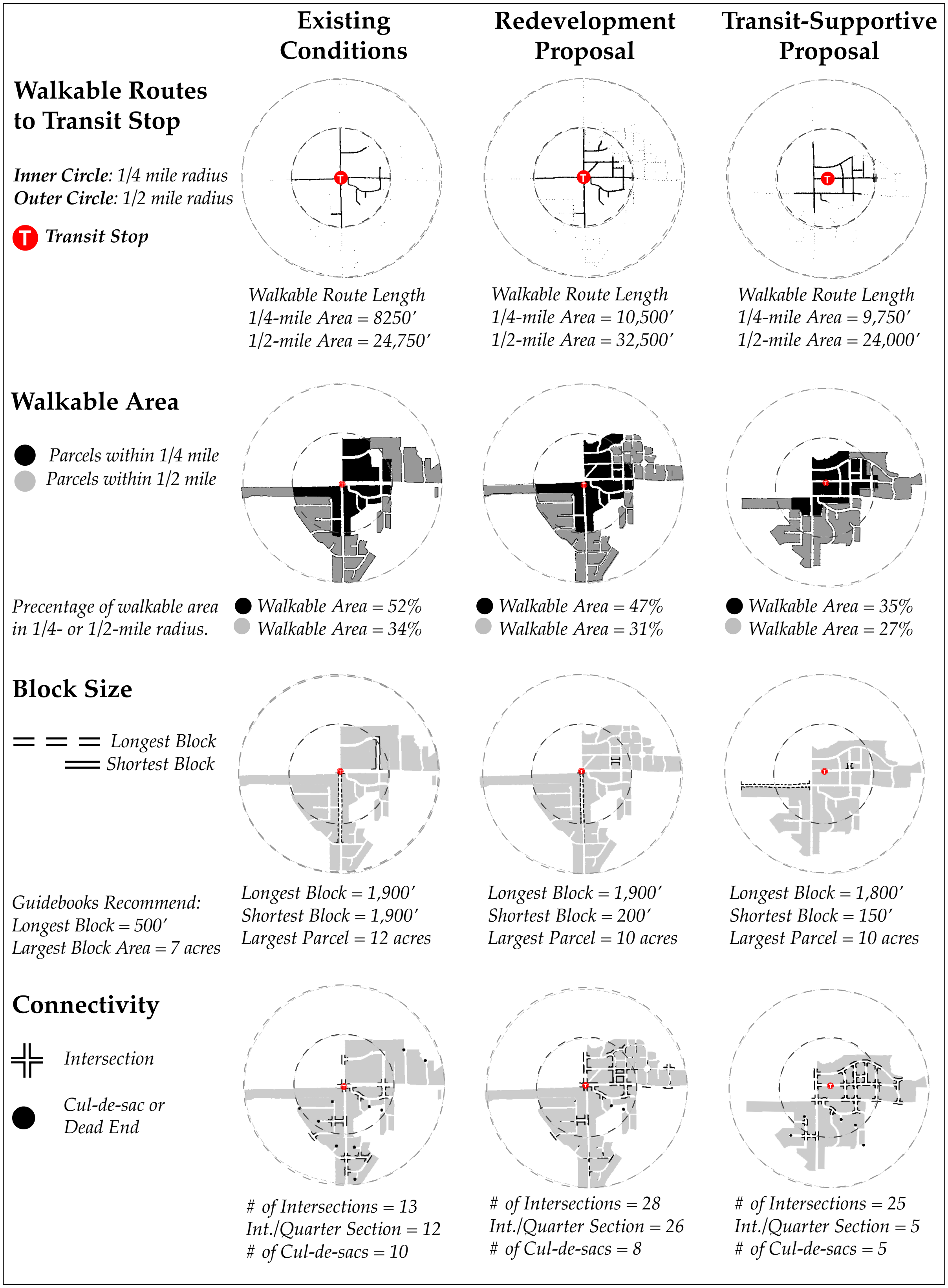
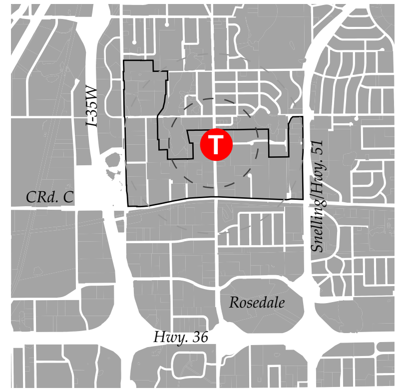


Figure 2.66. Walkability Analysis: Town Center, Shoreview.

Walkability Analysis:
Twin Lakes—East, Roseville



The transit stop location for this study area was the same in the AUAR concept and the transit-supportive design proposal. The transit-supportive design, however, intensified the street network over the AUAR concept. This additional network, while nearly doubling the total linear feet of walkable routes, actually reduced walkable area from 54% to 46%. (The was likely due to the increased area required for right-of-way.) The increased network doubled the number of full intersections and reduced the largest parcel size from 21 acres to 11 acres.

Table 2.3. Walkability Analysis: Twin Lakes—East, Roseville

			Existing Land Use	AUAR Concept	T-S.D. Proposal
Walkability	Routes and Areas	1/4-mile Walkable Area and Percentage of 1/4-mile Area	56 acres 45%	67 acres 54%	57 acres 46%
		1/4-mile Walkable Routes, Street Network Length	4,750 ft	7,500 ft	13,500 ft.
		1/2-mile Walkable Area and Percentage of 1/2-mile Area	74 acres 26%	148 acres 43%	138 acres 39%
		1/2-mile Walkable Routes, Street Network Length	13,250 ft.	27,750 ft.	47,000 ft.
	Blocks	Longest Block in Walkable Area	2,100 ft.	1,950 ft.	1,100 ft.
		Percentage Over Allowable (500')	320%	290%	120%
		Shortest Block in Walkable Area	200 ft.	250 ft.	150 ft.
		Percentage Over Allowable (500')	——	——	——
		Largest Parcel in Walkable Area	37 acres	21 acres	11 acres
		Percentage Over Allowable (7 acres)	429%	300%	57%
Connectivity		Number of Intersections in Walkable Area	6	22	55
		Intersections/Quarter Section	6	14	32
		Number of Culs-de-Sac/Dead Ends in Walkable Area	1	2	1

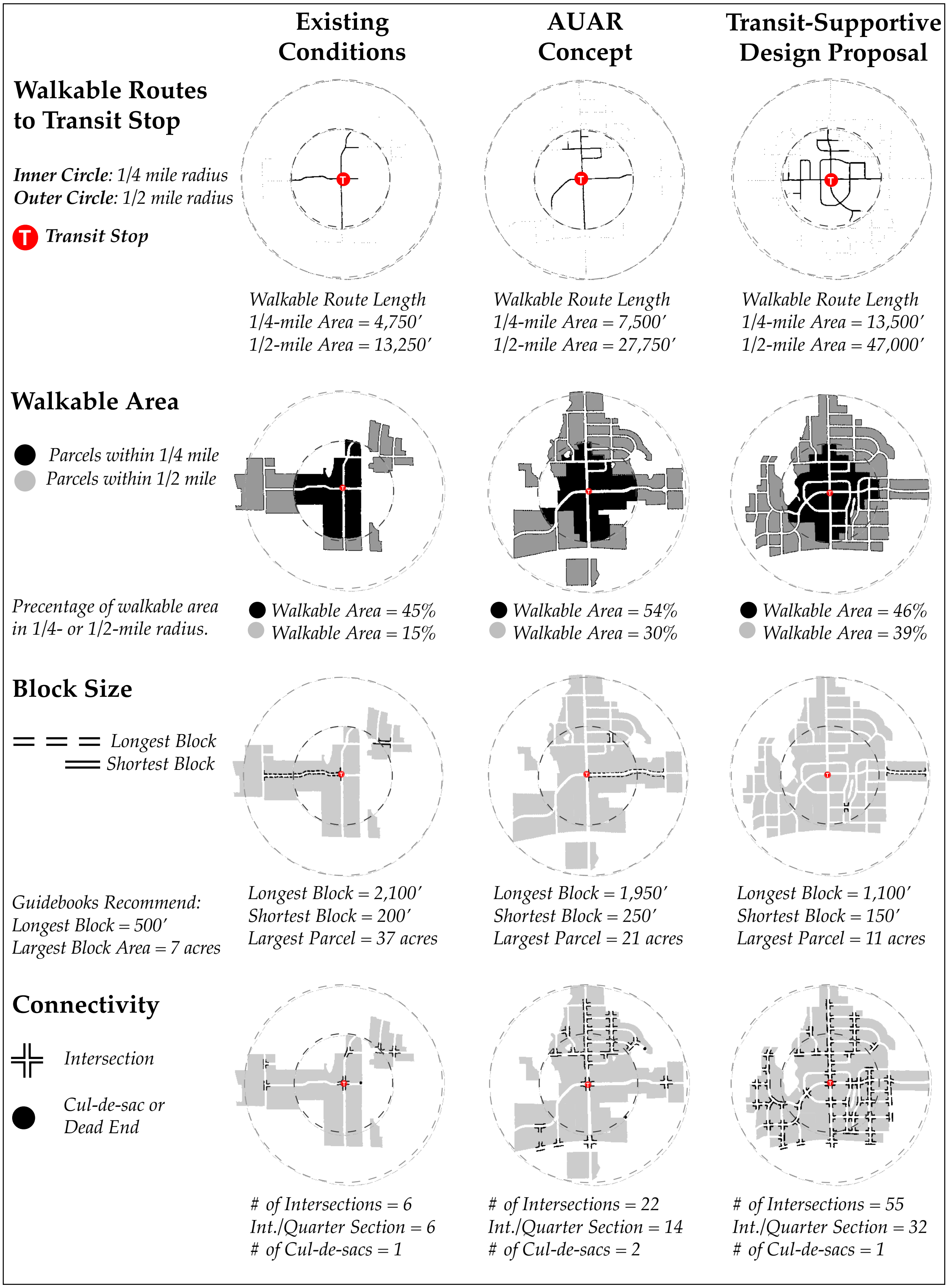
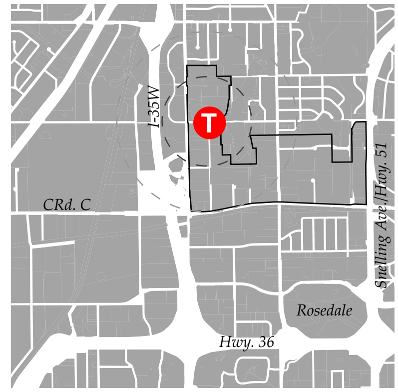


Figure 2.67. Walkability Analysis: Twin Lakes—East, Roseville.

Walkability Analysis:
Twin Lakes—West, Roseville



In the Twin Lakes West area, the transit stop in the transit-supportive design proposal was in the same location as it is in existing conditions. In the AUAR concept, the transit stop was located one block to the east. The street network changes in the transit-supportive design nearly doubled the linear feet of walkable routes within the 1/4-mile radius of the transit stop over the AUAR concept.

The walkable area peaks at 56% in the AUAR, while measures for existing conditions and the transit-supportive design were 47% and 43%, respectively. Connectivity, as measured by the number of full intersections, improved over existing conditions in both the AUAR concept and the transit-supportive design proposal.

Table 2.4. Walkability Analysis: Twin Lakes—West, Roseville

			Existing Land Use	AUAR Concept	T-S.D. Proposal
Walkability	Routes and Areas	1/4-mile Walkable Area and Percentage of 1/4-mile Area	59 acres 63%	70 acres 75%	40 acres 43%
		1/4-mile Walkable Routes, Street Network Length	4,000 ft.	5,500 ft.	10,500 ft.
		1/2-mile Walkable Area and Percentage of 1/2-mile Area	75 acres 35%	90 acres 43%	98 acres 37%
		1/2-mile Walkable Routes, Street Network Length	13,250 ft.	18,000 ft.	27,000 ft.
	Blocks	Longest Block in Walkable Area	2,640 ft.	2,600 ft.	1,400 ft.
		Percentage Over Allowable (500')	428%	420%	180%
		Shortest Block in Walkable Area	250 ft.	250 ft.	250 ft.
		Percentage Over Allowable (500')	——	——	——
		Largest Parcel in Walkable Area	28 acres	18 acres	12 acres
		Percentage Over Allowable (7 acres)	300%	64%	71%
Connectivity		Number of Intersections in Walkable Area	6	18	33
		Intersections/Quarter Section	6	14	27
		Number of Culs-de-Sac/Dead Ends in Walkable Area	1	0	1

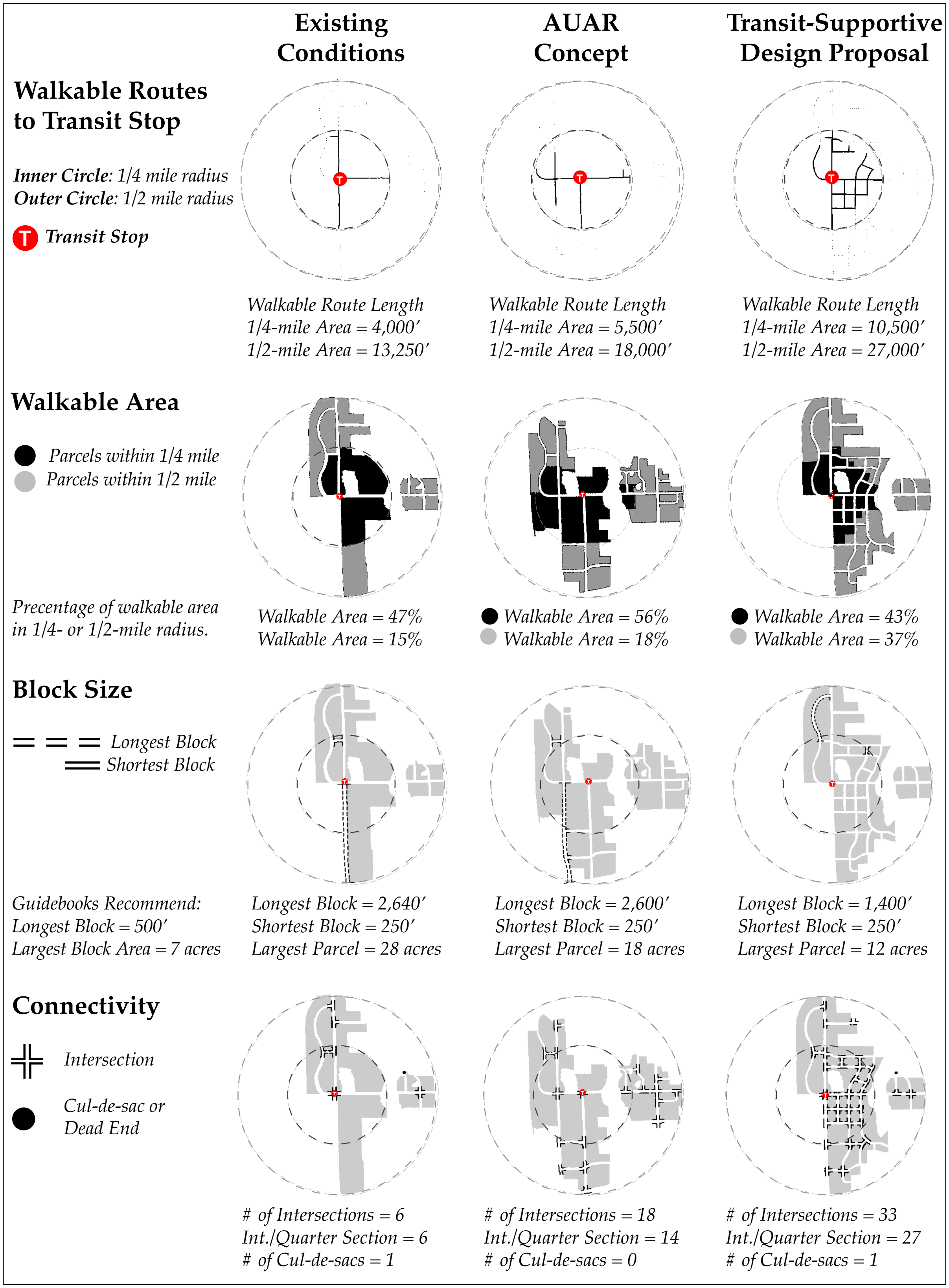
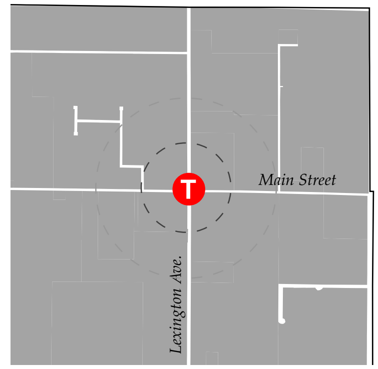


Figure 2.68. Walkability Analysis: Twin Lakes—West, Roseville.

Walkability Analysis:
Lochness Lake, Northeast Blaine



The transit-supportive design for the Lochness Lake study area spaced full intersections at the recommended 1/2 mile interval for minor arterials. The intersection of Lexington Avenue and Main Street—two minor arterials—was the point from which the 1/2-mile measure was taken. This transportation planning standard resulted in a street network pattern that was internally oriented. Since the transit stop was located at Lexington Avenue and Main Street and the methodology does not include off-street trails, the walkability measures were poor. In most instances, differences between the measures of existing conditions and the transit-supportive design were negligible. The one exception was the percentage of walkable area. The transit-supportive design measured 13%, while only 2% of the area was walkable under existing conditions.

Table 2.5. Walkability Analysis: Lochness Lake, Northeast Blaine

		Unit of Measurement	Existing Land Use	T-S.D. Proposal
Walkability	Routes and Areas	1/4-mile Walkable Area and Percentage of 1/4-mile Area	2 acres 2%	16 acres 13%
		1/4-mile Walkable Routes, Street Network Length	5,250 ft.	5,250 ft.
		1/2-mile Walkable Area and Percentage of 1/2-mile Area	2 acres 0.40%	29 acres 6%
		1/2-mile Walkable Routes, Street Network Length	12,000 ft.	12,000 ft.
	Blocks	Longest Block in Walkable Area	2,260 ft.	2,620 ft.
		Percentage Over Allowable (500')	424%	424%
		Shortest Block in Walkable Area	1,250 ft.	2,620 ft.
		Percentage Over Allowable (500')	150%	424%
		Largest Parcel in Walkable Area	1 acre	8 acres
		Percentage Over Allowable (7 acres)	—	14%
Connectivity		Number of Intersections in Walkable Area	2	1
		Intersections/Quarter Section	0.6	0.3
		Number of Culs-de-Sac/Dead Ends in Walkable Area	0	0

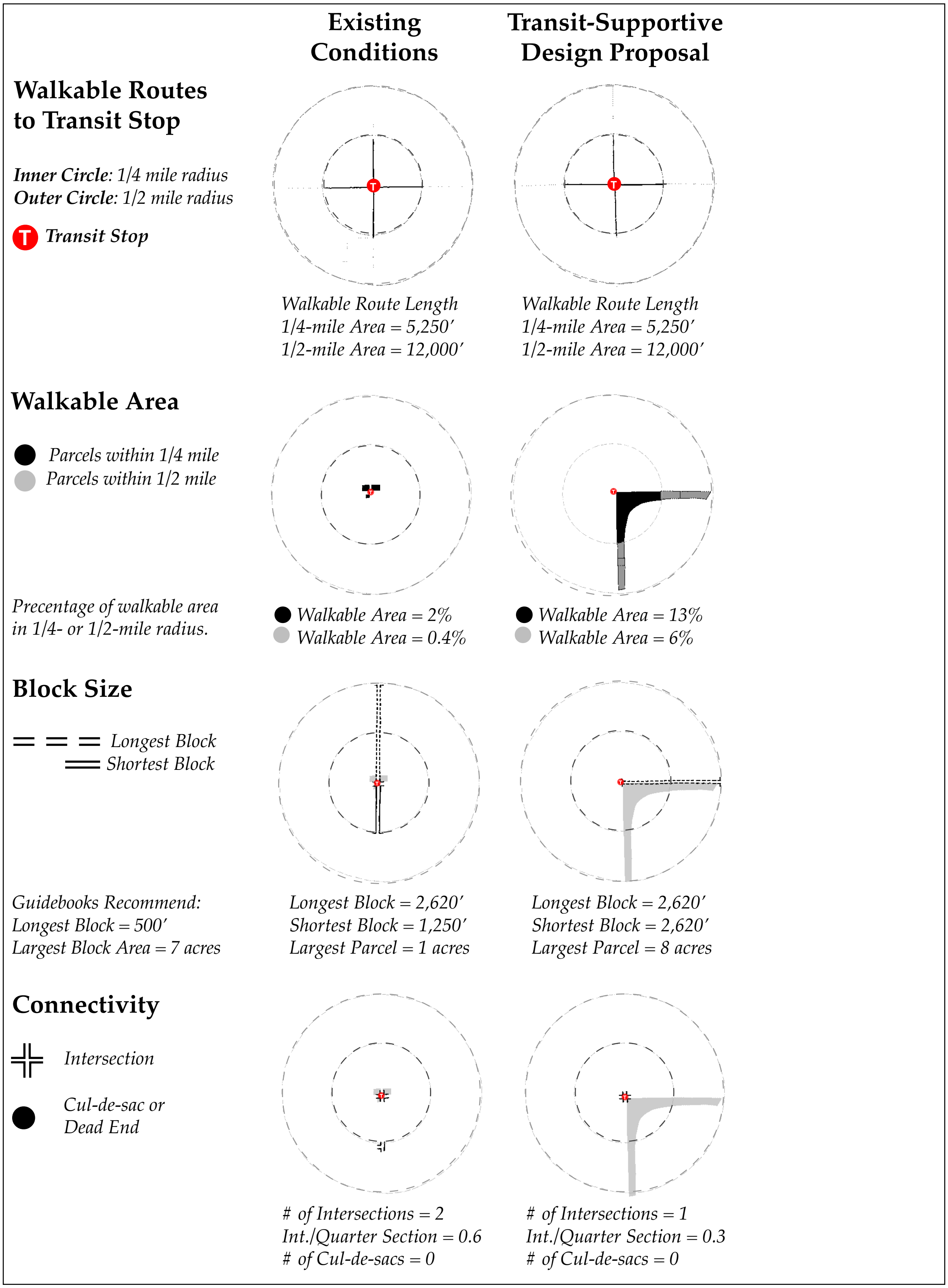
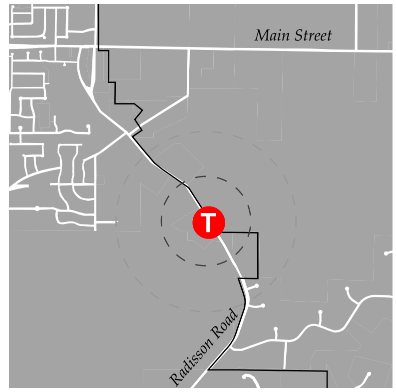


Figure 2.69. Walkability Analysis: Lochness Lake, Northeast Blaine.

Walkability Analysis:
West Meadows, Northeast Blaine



The West Meadow site is another greenfield condition. One minor arterial, Radisson Road, edges the study area and the transit stop was located along this road. The 1/2-mile spacing rule was not rigidly applied in the transit-supportive design. The road network was not as fine-grained as most other transit-supportive designs.

The conversion of the greenfield to development increased the walkable area within the 1/4-mile radius from 17% to 54% and added about 1/3 more linear feet of walkable routes to the same area. The largest block measure was reduced from 37 acres to 17 acres, but the longest block length increased from 1,900′ to 2,050′.

Table 2.6. Walkability Analysis: West Meadows, Northeast Blaine

		Unit of Measure	Existing Land Use	T-S.D. Proposal
Walkability	Routes and Areas	1/4-mile Walkable Area and Percentage of 1/4-mile Area	21 acres 17%	68 acres 54%
		1/4-mile Walkable Routes, Street Network Length	6,500 ft.	9,000 ft.
		1/2-mile Walkable Area and Percentage of 1/2-mile Area	177acres 35%	224 acres 45%
		1/2-mile Walkable Routes, Street Network Length	16,500 ft.	25,500 ft.
	Blocks	Street Network Length	1,900 ft.	2,050 ft.
		Percentage Over Allowable (500')	280%	310%
		Shortest Block in Walkable Area	200 ft.	200 ft.
		Percentage Over Allowable (500')	——	——
		Largest Parcel in Walkable Area	37 acres	17 acres
		Percentage Over Allowable (7 acres)	429%	143%
Connectivity		Number of Intersections in Walkable Area	5	9
		Intersections/Quarter Section	2	3
		Number of Culs-de-Sac/Dead Ends in Walkable Area	1	1

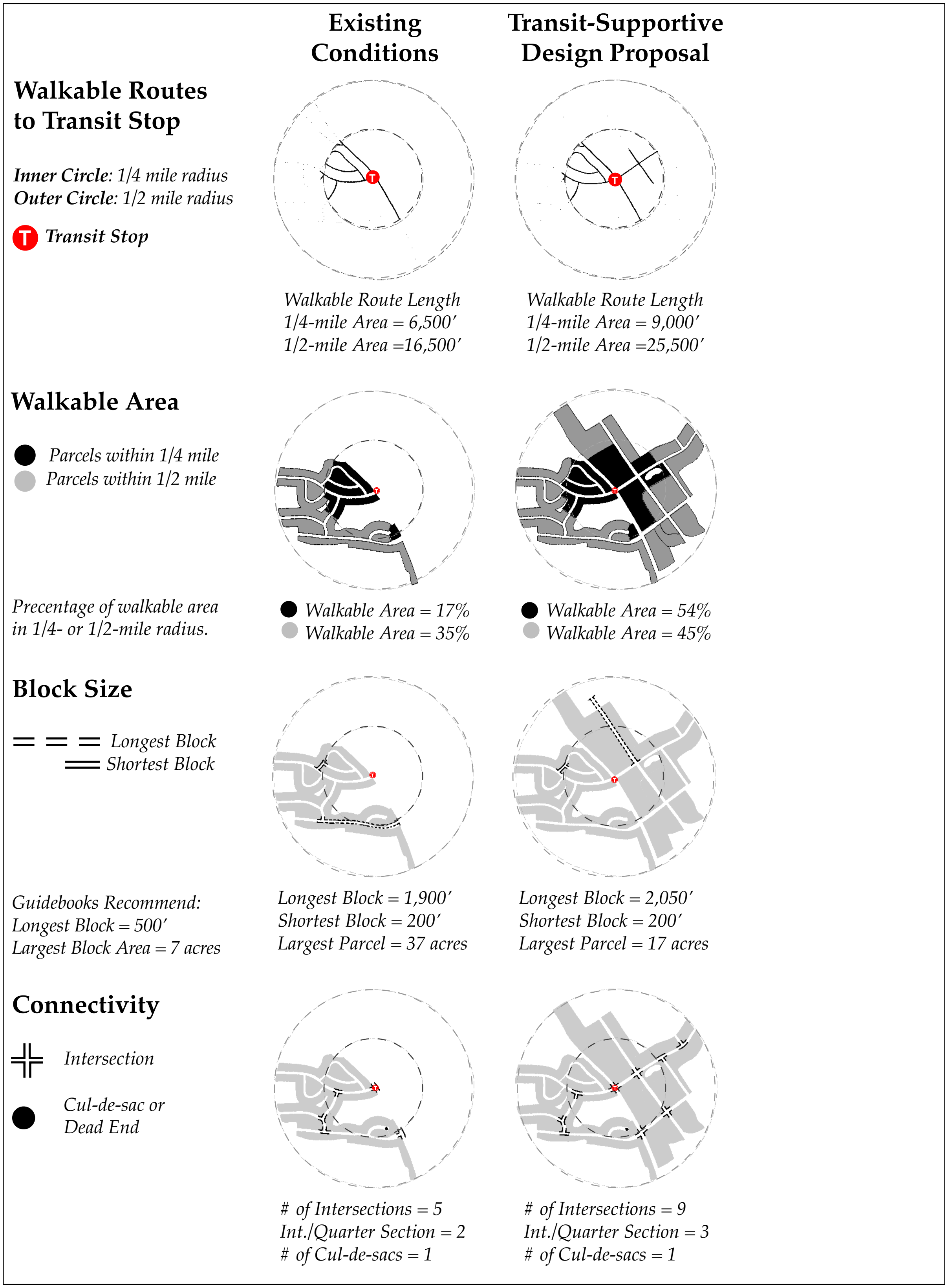


Figure 2.70. Walkability Analysis: West Meadows, Northeast Blaine.

2.4 Land Use and Density Analysis

The other major measurable category of transit-supportive design is land use. As a complement to the walkability analysis, the land use and density analysis examined population and employment numbers and densities in the four case study areas. Like the walkability analysis, the land use analyses for existing conditions and the proposed redevelopment or concept design were used to develop the transit-supportive design. Not only did these findings provide measures of comparison within and among sites, but they also suggested where road network changes were neede to reach transit-supportive design standards. Once the transit-supportive design was finalized, it was analyzed also. The tables and graphic charts that follow summarize land use and density findings for all case study sites and land use conditions.

Methodology

The area analyzed was defined by drawing a 1/2-mile radius from a common center point—in most cases a transit stop. The 1/2-mile radius corresponded to the area examined in the walkability analysis. Land area, population, and employment density numbers were calculated for the entire 1/2-mile circle and for the portion of the case study site that fell within the 1/2-mile circle. Population and employment yields for the redevelopment and transit-supportive proposals were calculated using the acreage of the assigned land uses and the residential and employment density targets outlined in the Metropolitan Council's handbook on transit-supportive design.

For each development, the following information was calculated:

Net Acres of General Land Use for the Following Categories

- Residential
- Commercial (included industrial land uses)
- Mixed-use
- Open space/Park

Residential Population and Density

- Residents
- Residents per the sum of the net residential and mixed-use acres

Commercial Employment and Density

- Employees
- Employees per the sum of the net commercial/industrial and mixed-use acre

Existing Conditions—Numbers of residents and employees for existing land use conditions in the four case study areas were calculated by Excensus, Inc. using the North Metro I-35W Coalition demographic data bases. These numbers were calculation for the area inside the case study site and the balance of the 1/2-mile circle. The numbers of residents and employees outside the case study site were held constant across all three situations.

Redevelopment and Transit-Supportive Designs—To calculate the total for the 1/2-mile radius circle, new net populations for the case study site were summed with existing populations outside the site, but inside the circle. The net resident and employee population numbers for the case study areas were the population and employee yields less existing residential and employee populations. These totals were subsequently converted into residents and employees per respective net acre.

Yields for the case study areas in New Brighton, Shoreview and Roseville (Twin Lakes) were calculated based on the Metropolitan Council's guidelines *for Inner Urban/Suburban* areas; numbers for Blaine were calculated based on the guidelines for *Outer Suburban* areas. The yields were then divided by the corresponding net acreage and reported out as residents per net residential acre rather than dwelling units per net residential acre. While less precise because total acres of mixed use is added to both the residential and employee calculations, it provides generalized consistency among the different design options.

The Met Council guidelines, which sets targets for the allowable mix of land uses in T.O.D.s, as well as residential and employment densities, were adapted as follows and used to calculate the gross residential and employee populations for the case study sites.

Residential Parcels: Dwelling Units per Acre (DU/acre) were used to translate acres into number of dwelling units and, further, into number of residents, with the following assumptions:

- 2.5 residents/housing unit (a regional average)
- 7 DU/acre for low-density residential land uses
- 13 DU/acre for low- to mid-density residential land uses
- 20 DU/acre for mid-density residential land uses

Commercial Parcels: Floor Area Ratio (FAR) was used to translate acres into square feet and, further, into number of employees, with the following assumptions:

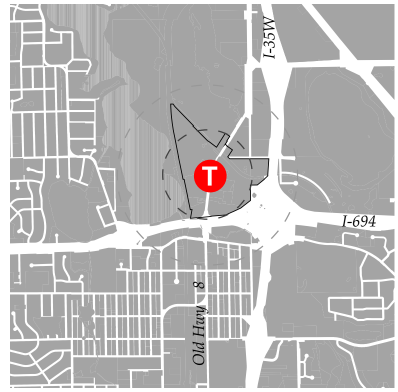
- 4 employees per 1,000 sq. ft. of office space (a regional average)
- 1 employee per 1,000 sq. ft. of retail space (a regional average)
- FAR of 1 for blocks adjacent to the transit stop (FAR of 0.5 for Blaine)
- FAR of 0.8 for blocks within 1/4 mile of the transit stop (FAR of 0.4 for Blaine)
- FAR of 0.4 for blocks between 1/4 mile and 1/2 mile of the transit stop (FAR of 0.3 for Blaine)

Mixed-Use Parcels: Numbers were calculated using the assumptions described above, with the following proportional land use divisions:

- Retail/Office = 1/3 retail and 2/3 office
- Retail/Residential = 1/3 retail and 2/3 residential
- Office/Residential = 1/3 office and 2/3 residential

Assignment of the above densities, FARs, and mixed-use proportions were made on a parcel-by-parcel basis for each case study site. These assignments also varied between the existing redevelopment proposal and the transit-supportive design proposal developed for this study. Professional judgement and knowledge of the site guided this decision-making process.

Land Use and Density Analysis: Northwest Quadrant, New Brighton



The transit-supportive design has two significant changes from the redevelopment proposal: a 6-acre mixed use core along Old Hwy. 8 and residential land uses on the eastern side of the site. These two strategies increased the residential population in the case study site from 1,263 to 1,745. Job-generating land uses in the case study site were intensified to compensate for a reduction in acreage resulting in an increase from 2,077 to 4,620 employees. In the case study site, densities for residents and employees are both high enough to support frequent local bus services. Fifteen acres of open space, which connects to Long Lake Regional Park, were added to the case study site design at the northern and southern edges if the site.

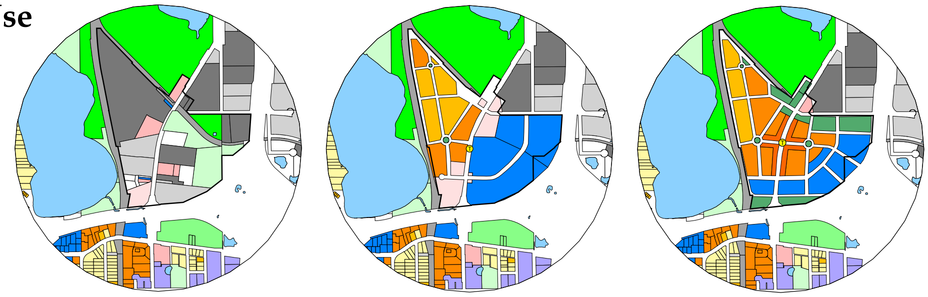
Table 2.7. Land Use and Density Analysis: Northwest Quadrant, New Brighton

			Existing Land Use	Redevelopment Proposal	T-S.D. Proposal
General Land Use	1/2-mile Area	Residential	31 acres	61 acres	67 acres
General Land Use	1/2-mile Area	Commercial and Industrial	121 acres	103 acres	70 acres
General Land Use	1/2-mile Area	Mixed Use	0 acres	0 acres	6 acres
General Land Use	1/2-mile Area	Open Space / Park	176 acres	156 acres	171 acres
General Land Use	Case Study Area	Residential	0 acres	30 acres	36 acres
General Land Use	Case Study Area	Commercial and Industrial	72 acres	55 acres	22 acres
General Land Use	Case Study Area	Mixed Use	0 acres	0 acres	6 acres
General Land Use	Case Study Area	Open Space / Park	20 acres	0 acres	15 acres
Residential Density	1/2-mile Area	Residents	542	1,805	2,287
Residential Density	1/2-mile Area	Residents/acre	17 res/acre	30 res/acre	31 res/acres
Residential Density	Case Study Area	Residents	0	1,263	1,745
Residential Density	Case Study Area	Residents/acre	——	42 res/acre	42 res/acre
Employment Density	1/2-mile Area	Employees	1,671	3,431	5,974
Employment Density	1/2-mile Area	Employees/acre	14 emp/acre	33 emp/acre	79 emp/acre
Employment Density	Case Study Area	Employees	317	2,077	4,620
Employment Density	Case Study Area	Employees/acre	4 emp/acre	30 emp/acre	165 emp/acre

	Existing Conditions	Redevelopment Proposal	Transit-Supportive Design Proposal

General Land Use

- **Residential**
  - Detached
  - Attached
  - Multi-family
  - Rural
- **Commercial**
  - Neighborhood
  - Community
  - Regional
  - Office
  - Light Industry
  - Heavy Industry
- **Mixed Use**
- **Open/Park**



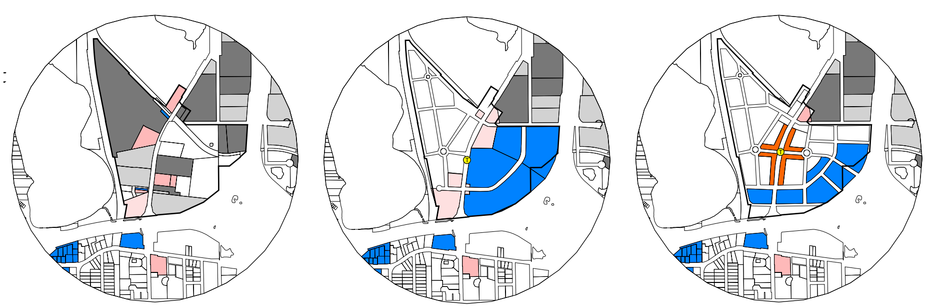
	Existing Conditions	Redevelopment Proposal	Transit-Supportive Design Proposal
Residential	*31 acres*	*61 acres*	*67 acres*
Commercial	*121 acres*	*103 acres*	*70 acres*
Mixed Use	*0 acres*	*0 acres*	*6 acres*
Open/Park	*176 acres*	*156 acres*	*171 acres*

Residential Population and Net Density for 1/2-mile Area

Density per sum of net residential and mixed-use acres

	Existing Conditions	Redevelopment Proposal	Transit-Supportive Design Proposal
Residents	542	1,805	2,287
Residents/acre	17	30	31

Employee Population and Net Density for 1/2-mile Area

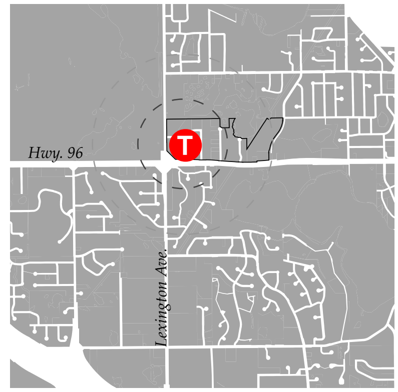


Density per sum of net commercial, industrial and mixed-use acres

	Existing Conditions	Redevelopment Proposal	Transit-Supportive Design Proposal
Employees	1,671	3,431	5,974
Emp/acre	14	33	79

Figure 2.71. Summary Land Use and Transportation Analysis: Northwest Quadrant, New Brighton.

Land Use and Density Analysis: Town Center, Shoreview



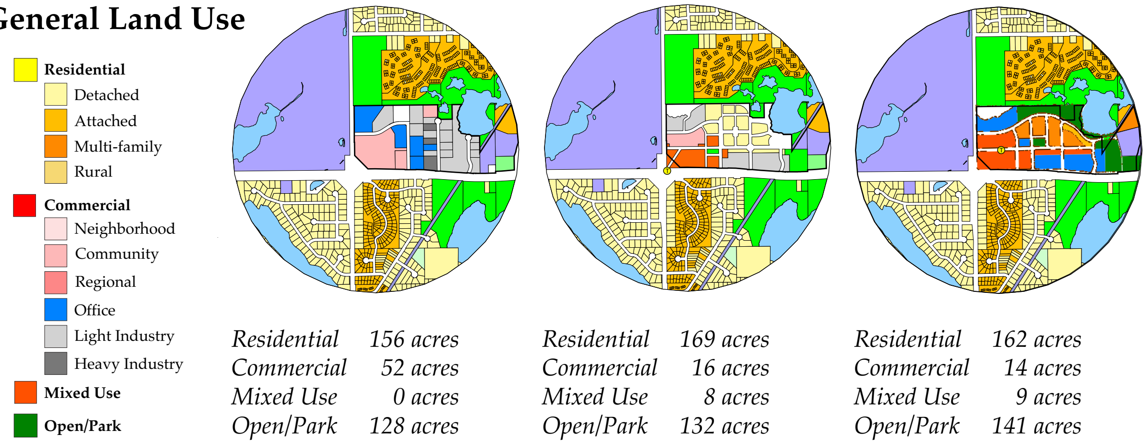
The revised design from the town center site added 9 acres of open space for a total of 13 acres and reduced the residential and commercia/industrial acreage from 16 each to 9 and 14, respectively. To compensate for the loss in area, residential and job intensity was increased. The result was an increase of 125 residents and loss of 34 employees in the case study site. Overall densities for residents and employees remains high enough to support frequent local bus service. The mixed use core was increased by one acre; land use was divided into 1/3 commercial/industrial and 2/3 residential.

Table 2.8. Land Use and Density Analysis: Town Center, Shoreview

			Existing Land Use	Redevelopment Concept	T-S.D. Proposal
General Land Use	1/2-mile Area	Residential	156 acres	169 acres	162 acres
		Commercial and Industrial	52 acres	16 acres	14 acres
		Mixed Use	0 acres	8 acres	9 acres
		Open Space / Park	128 acres	133 acres	141 acres
	Case Study Area	Residential	3 acres	16 acres	9 acres
		Commercial and Industrial	52 acres	16 acres	14 acres
		Mixed Use	0 acres	8 acres	9 acres
		Open Space / Park	0 acres	4 acres	13 acres
Residential Density	1/2-mile Area	Residents	1,631	2,224	2,349
		Residents/acre	10 res/acre	13 res/acre	14 res/acre
	Case Study Area	Residents	0	593	718
		Residents/acre	—	25 res/acre	40 res/acre
Employment Density	1/2-mile Area	Employees	797	2,163	2,129
		Employees/acre	15 emp/acre	90 emp/acre	93 emp/acre
	Case Study Area	Employees	706	2,072	2,038
		Employees/acre	14 emp/acre	86 emp/acre	89 emp/acre

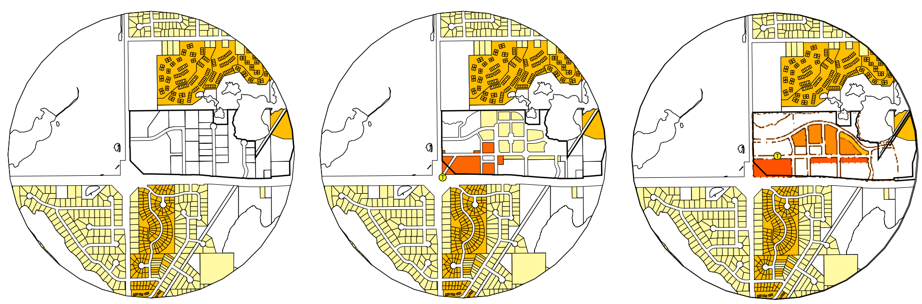
	Existing Conditions	Redevelopment Concept	Transit-Supportive Design Proposal

General Land Use



	Existing Conditions	Redevelopment Concept	Transit-Supportive Design Proposal
Residential	*156 acres*	*169 acres*	*162 acres*
Commercial	*52 acres*	*16 acres*	*14 acres*
Mixed Use	*0 acres*	*8 acres*	*9 acres*
Open/Park	*128 acres*	*132 acres*	*141 acres*

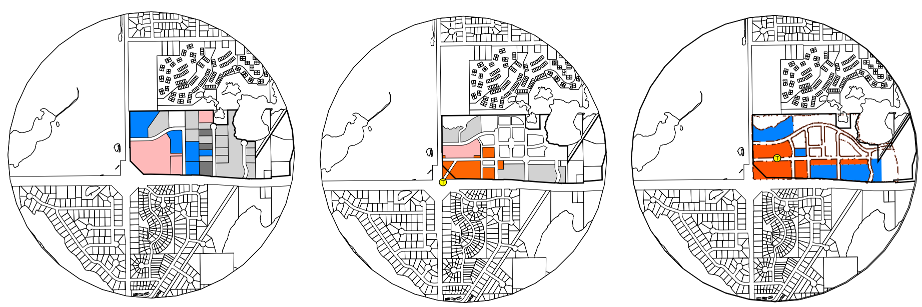
Residential Population and Net Density for 1/2-mile Area



Density per sum of net residential and mixed-use acres

	Existing Conditions	Redevelopment Concept	Transit-Supportive Design Proposal
Residents	*1,631*	*2,224*	*2,349*
Residents/acre	*10*	*13*	*14*

Employee Population and Net Densityfor 1/2-mile Area



Density per sum of net commercial, industrial and mixed-use acres

	Existing Conditions	Redevelopment Concept	Transit-Supportive Design Proposal
Employees	*797*	*2,165*	*2,131*
Emp/acre	*15*	*86*	*89*

Figure 2.72. Summary Land Use and Transportation Analysis: Town Center, Shoreview.

Land Use and Density Analysis: Twin Lakes—East, Roseville

Several land use changes were made for the transit-supportive design. Residential was increased from 18 acres to 39 acres; commercial/industrial was reduced from 124 acres to 80 acres; and open space/parks was decreased from 34 acres to 29 acres. Mixed use was kept constant at 17 acres in the case study site. Residential density for the case study site was increased from 28 to 31 residents per net residential acre and employee density was increased from 36 to 64 employees per employment acres.

Table 2.9. Land Use and Density Analysis: Twin Lakes—East, Roseville

			Existing Land Use	AUAR Concept	T-S.D. Proposal
General Land Use	1/2-mile Area	Residential	101 acres	101 acres	140 acres
		Commercial and Industrial	236 acres	214 acres	117 acres
		Mixed Use	0 acres	41 acres	17 acres
		Open Space / Park	35 acres	36 acres	60 acres
	Case Study Area	Residential	0 acres	18 acres	39 acres
		Commercial and Industrial	199 acres	124 acres	80 acres
		Mixed Use	0 acres	17 acres	17 acres
		Open Space / Park	4 acres	34 acres	29 acres
Residential Density	1/2-mile Area	Residents/acre	1,133	2,264	2,863
		Residents	11 res/acre	16 res/acre	18 res/acre
	Case Study Area	Residents	0	1,131	1,730
		Residents/acre	——	28 res/acre	31 res/acre
Employment Density	1/2-mile Area	Employees	5,428	8,516	6,833
		Employees/acre	23 emp/acre	33 emp/acre	51 emp/acre
	Case Study Area	Employees	4,808	7,896	6,213
		Employees/acre	24 emp/acre	36 emp/acre	64 emp/acre

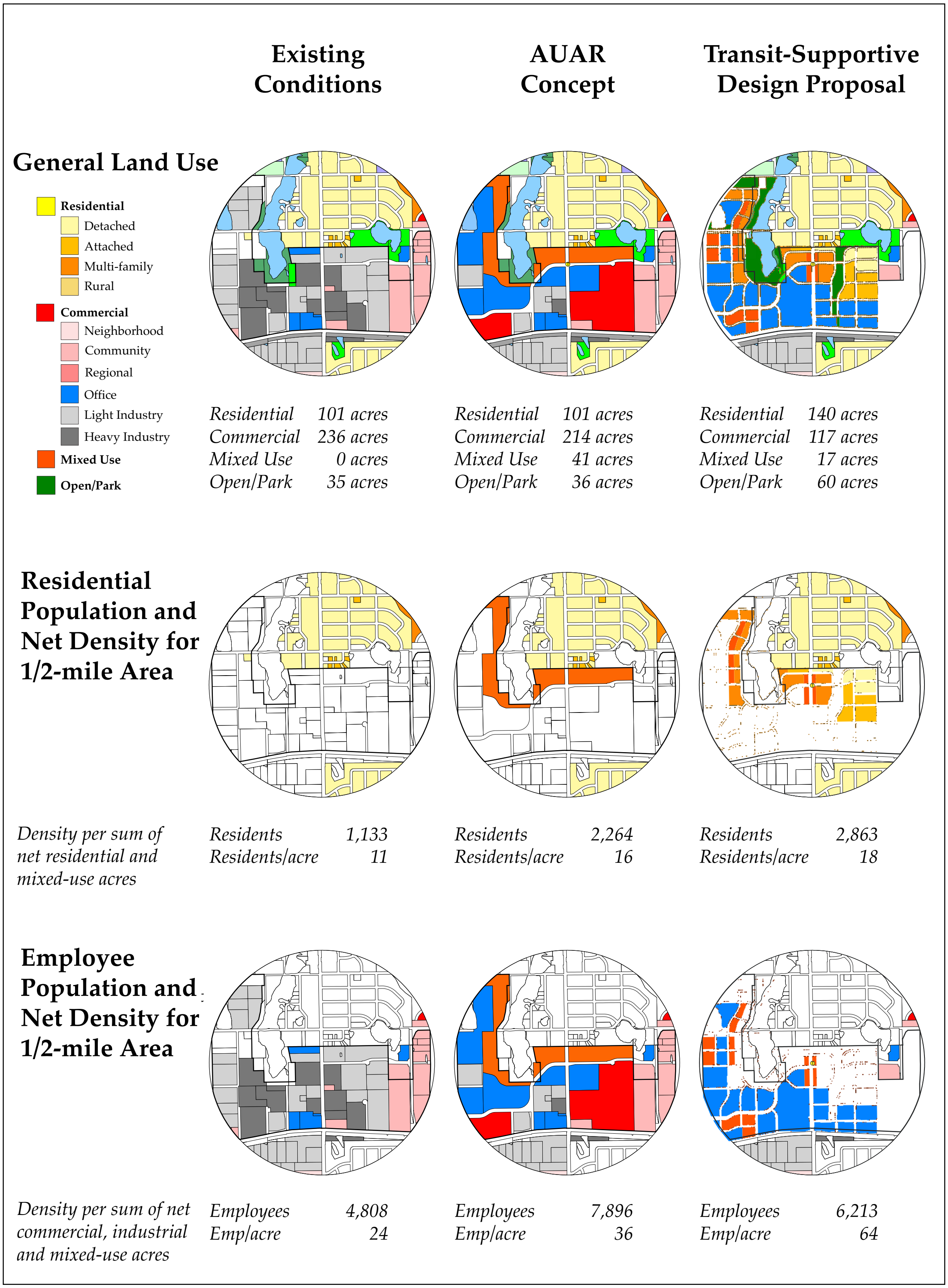
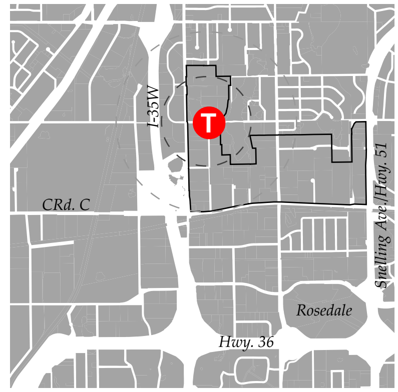


Figure 2.73. Summary Land Use and Transportation Analysis: Twin Lakes—East, Roseville.

Land Use and Density Analysis: Twin Lakes—West, Roseville



Land use allocation in the transit-supportive design changes from the AUAR proposal for this case study site. Residential acreage increase from 0 to 24; commercial/industrial acreage decreased from 105 to 66; mixed use acreage decreased from 45 to 17; and open space/parks increased from 5 to 29. The residential population decreased slightly from 1,438 to 1,375 for a drop from 32 to 34 residents per residential acre. The employee population decreased despite an increase from 40 to 64 employees per employment acre in the transit-supportive design. These changes are largely attributable to a revised design strategy for the area adjacent to Langton Lake.

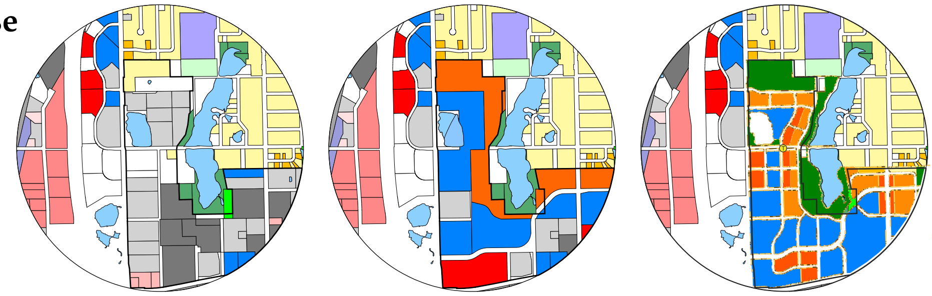
Table 2.10. Land Use and Density Analysis: Twin Lakes—West, Roseville

			Existing Land Use	AUAR Concept	T-S.D. Proposal
General Land Use	1/2-mile Area	Residential	74 acres	66 acres	90 acres
		Commercial and Industrial	192 acres	178 acres	139 acres
		Mixed Use	0 acres	45 acres	17 acres
		Open Space / Park	61 acres	60 acres	84 acres
	Case Study Area	Residential	8 acres	0 acres	24 acres
		Commercial and Industrial	119 acres	105 acres	66 acres
		Mixed Use	0 acres	45 acres	17 acres
		Open Space / Park	6 acres	5 acres	29 acres
Residential Density	1/2-mile Area	Residents	611	2,041	1,978
		Residents/acre	8 res/acre	18 res/acre	18 res/acre
	Case Study Area	Residents	8	1,438	1,375
		Residents/acre	1 res/acre	32 res/acre	34 res/acre
Employment Density	1/2-mile Area	Employees	4,850	7,928	7,160
		Employees/acre	25 emp/acre	36 emp/acre	46 emp/acre
	Case Study Area	Employees	2,967	6,045	5,277
		Employees/acre	25 emp/acre	40 emp/acre	64 emp/acre

	Existing Conditions	AUAR Concept	Transit-Supportive Design Proposal

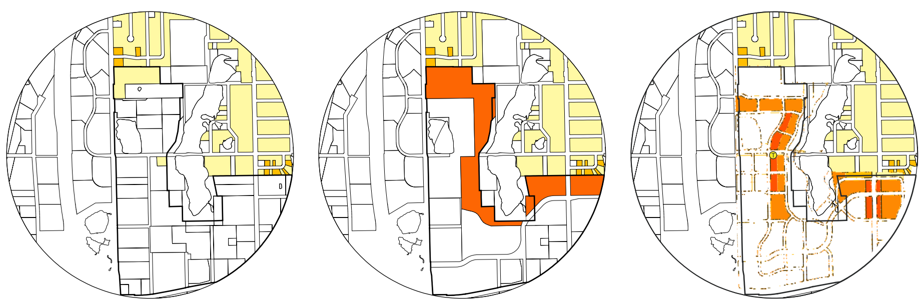
General Land Use

- **Residential**
  - Detached
  - Attached
  - Multi-family
  - Rural
- **Commercial**
  - Neighborhood
  - Community
  - Regional
  - Office
  - Light Industry
  - Heavy Industry
- **Mixed Use**
- **Open/Park**



	Existing Conditions		AUAR Concept		Transit-Supportive Design Proposal	
Residential	*74 acres*		*66 acres*		*90 acres*	
Commercial	*192 acres*		*178 acres*		*139 acres*	
Mixed Use	*0 acres*		*45 acres*		*17 acres*	
Open/Park	*61 acres*		*60 acres*		*84 acres*	

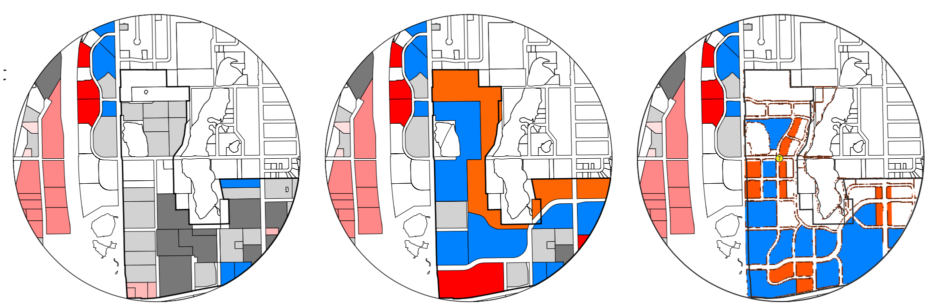
Residential Population and Net Density for 1/2-mile Area



Density per sum of net residential and mixed-use acres

	Existing Conditions	AUAR Concept	Transit-Supportive Design Proposal
Residents	611	2,041	1,978
Residents/acre	3	18	18

Employee Population and Net Density for 1/2-mile Area

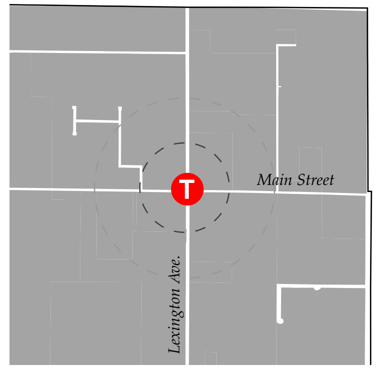


Density per sum of net commercial, industrial and mixed-use acres

	Existing Conditions	AUAR Concept	Transit-Supportive Design Proposal
Employees	2,967	6,045	5,277
Emp/acre	25	40	64

Figure 2.74. Summary Land Use and Transportation Analysis: Twin Lakes—West, Roseville.

Land Use and Density Analysis: Lochness Lake, Northeast Blaine



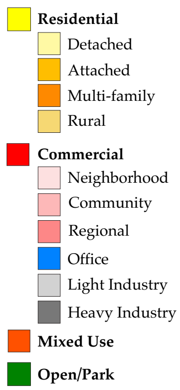
The Lochness Lake case study site focused on the southeast quadrant of the intersection of Lexington Avenue and Main Street. There was no previously proposed site design for the area. The prospective developer and city indicate that site would be appropriate for mixed-use commercial with a mix of low and moderate residential densities. The transit-supportive design analyzed in this case study proposes 6 acres of mixed use, 65 acres of residential, and 13 acres of open space/parks. The total population yield at 31 residents per net residential acre is 1,998 new residents. The employee yield is 131 at 22 employees per net employee acre.

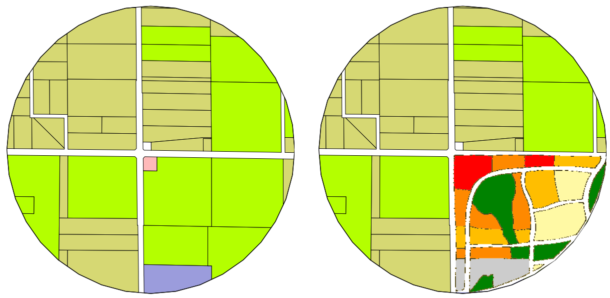
Table 2.11. Land Use and Density Analysis: Lochness Lake, Northeast Blaine

			Existing Land Use	T-S.D. Proposal
General Land Use	1/2-mile Area	Residential	209 acres	272 acres
		Commercial and Industrial	2 acres	6 acres
		Mixed Use	0 acres	0 acres
		Open Space / Park	0 ares	13 acres
	Case Study Area	Residential	2 acres	65 acres
		Commercial and Industrial	2 acres	6 acres
		Mixed Use	0 acres	0 acres
		Open Space / Park	0 acres	13 acres
Residential Density	1/2-mile Area	Residents	84	2,072
		Residents/acre	0.4 res/acre	8 res/acre
	Case Study Area	Residents	0	1,998
		Residents/acre	—	31 res/acre
Employment Density	1/2-mile Area	Employees	17	131
		Employees/acre	9 emp/acre	22 emp/acre
	Case Study Area	Employees	17	131
		Employees/acre	9 emp/acre	22 emp/acre

	Existing Conditions	Transit-Supportive Design Proposal

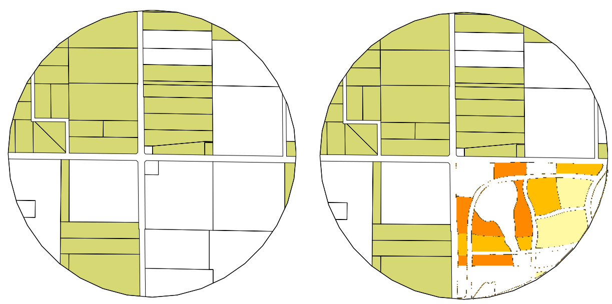
General Land Use





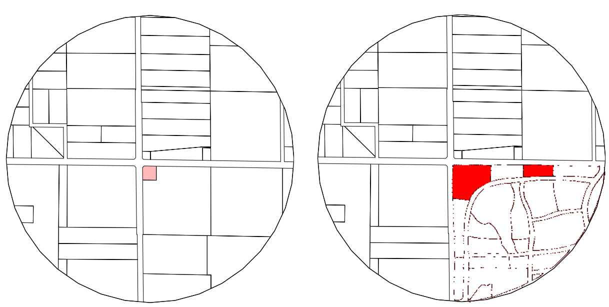
	Existing Conditions		Transit-Supportive Design Proposal	
	Residential	*209 acres*	*Residential*	*272 acres*
	Commercial	*2 acres*	*Commercial*	*6 acres*
	Mixed Use	*0 acres*	*Mixed Use*	*0 acres*
	Open/Park	*0 acres*	*Open/Park*	*13 acres*

Residential Population and Net Density for 1/2-mile Area



	Existing Conditions		Transit-Supportive Design Proposal	
Density per sum of net residential and mixed-use acres	*Residents*	*84*	*Residents*	*2,072*
	Residents/acre	*0.4*	*Residents/acre*	*8*

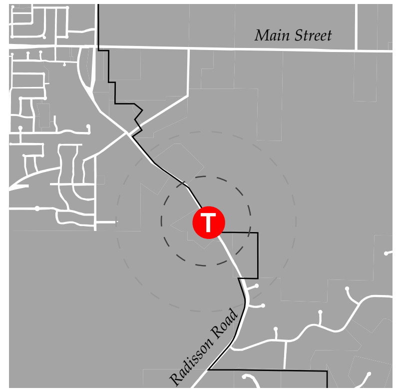
Employee Population and Net Density for 1/2-mile Area



	Existing Conditions		Transit-Supportive Design Proposal	
Density per sum of net commercial, industrial and mixed-use acres	*Employees*	*17*	*Employees*	*131*
	Emp/acre	*9*	*Emp/acre*	*22*

Figure 2.75. Summary Land Use and Transportation Analysis: Lochness Lake, Northeast Blaine.

Land Use and Density Analysis: West Meadows, Northeast Blaine



The West Meadows case study site is currently in agricultural land use. The proposed transit-supportive design oriented activity to Radisson Road. The design included 190 acres of residential land use, 8 acres of commercial, and 46 acres of park and open space. A total of 4,151 new residents were added to the site at a density of 22 residents per residential acre. The number of new employees on the site was 163 or 20 employees per employment acre. (Note, that at the time of the analysis, there were only 37 residents in the entire 1/2-mile radius. Apparently housing had not been built and occupied when the data were gathered. Also the 47 employees were most likely associated with the golf course, a part of which lies in the 1/2-mile radius.)

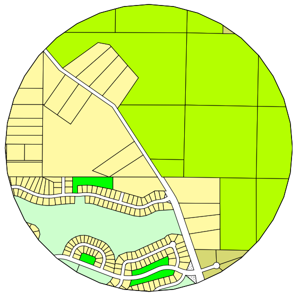
Table 2.12. Land Use and Density Analysis: West Meadows, Northeast Blaine

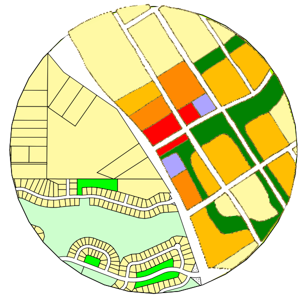
			Existing Land Use	T-S.D. Proposal
General Land Use	1/2-mile Area	Residential	189 acres	338 acres
		Commercial and Industrial	0 acres	8 acres
		Mixed Use	0 acres	0 acres
		Open Space / Park	55 acres	101 acres
	Case Study Area	Residential	41 acres	190 acres
		Commercial and Industrial	0 acres	8 acres
		Mixed Use	0 acres	0 acres
		Open Space / Park	0 acres	46 acres
Residential Density	1/2-mile Area	Residents	37	4,188
		Residents/acre	0.2 res/acre	12 res/acre
	Case Study Area	Residents	0	4,151
		Residents	—	22 res/acre
Employment Density	1/2-mile Area	Employees	47	163
		Employees/acre	—	22 emp/acre
	Case Study Area	Employees	—	163
		Employees/acre	—	20 emp/acre

	Existing Conditions	Transit-Supportive Design Proposal

General Land Use

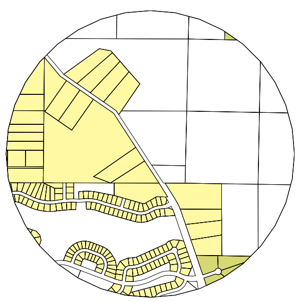
- **Residential**
  - Detached
  - Attached
  - Multi-family
  - Rural
- **Commercial**
  - Neighborhood
  - Community
  - Regional
  - Office
  - Light Industry
  - Heavy Industry
- **Mixed Use**
- **Open/Park**

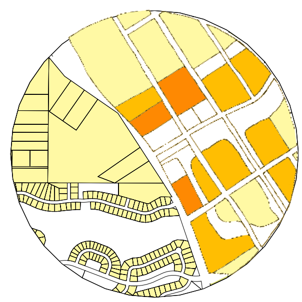




Existing Conditions		Transit-Supportive Design Proposal	
Residential	*189 acres*	*Residential*	*338 acres*
Com/Ind	*0 acres*	*Commercial*	*8 acres*
Mixed Use	*0 acres*	*Mixed Use*	*0 acres*
Open/Park	*55 acres*	*Open/Park*	*101 acres*

Residential Population and Net Density for 1/2-mile Area

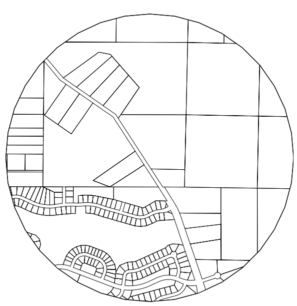


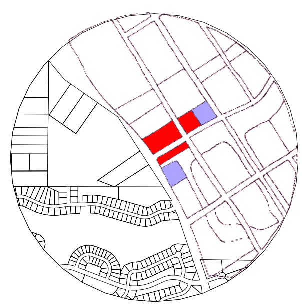


Density per sum of net residential and mixed-use acres

Existing Conditions		Transit-Supportive Design Proposal	
Residents	*37*	*Residents*	*4,188*
Residents/acre	*0.2*	*Residents/acre*	*12*

Employee Population and Net Density for 1/2-mile Area





Density per sum of net commercial, industrial and mixed-use acres

Existing Conditions		Transit-Supportive Design Proposal	
Employees	*47*	*Employees*	*163*
Emp/acre	*—*	*Emp/acre*	*20*

Figure 2.76. Summary Land Use and Transportation Analysis: West Meadows, Northeast Blaine.

Section 2. Notes

1. Transit-supportive and transit-oriented are commonly used adjectives to refer to development that is designed to support mass transit. Although the term was originally associated with light or heavy rail, it is also being adapted for rapid bus transit.

2. Peter Calthorpe, *The Next American Metropolis* (New York: Princeton Architectural Press, 1993), 43.

3. Connectivity is a term that describes a circulation system—auto, pedestrian, or bicycle—with many opportunities to take different routes or to go in different directions. It is considered advantageous in transit-supportive design because it offers the traveler many options to get to the same destination.

4. These statistics were abstracted from the following sources: Reid Ewing, *Best Development Practices* (Chicago: American Planning Association, 1996); Peter Calthorpe, *The Next American Metropolis* (New York: Princeton Architectural Press, 1993); Josep DeChiara, Julius Panero, Martin Zelnik, *Time-Saver Standards for Housing and Residential Development* (New York: McGraw-Hill, 1995).

5. In transit-supportive design, mobility refers to the option to take many different transportation modes to make the same trip. If the traveler can walk, ride transit or a bicycle, or drive a car to the same destination, that individual has a high degree of mobility.

6. Metropolitan Council, *Planning More Livable Communities with Transit-Oriented Development* (St. Paul: Metropolitan Council, July 2000; updated March 2001), 45.

7. Transit center refers to a wide variety of facility types. The basic transit center would have a building with amenities, such as telephones, benches, information kiosks, and, possibly, vending machines. The level of transit service would include coordinated timing of transfers between intersecting routes, especially local circulators. At the other end of the spectrum, a transit center might include multi-modal public transit, e.g. light rail and buses. Transit centers are different from park-n-ride facilities, in that service is provided throughout the day and targets a broad market range beyond the commuter.

8. Douglas Porter, *Making Smart Growth Work* (Washington, D.C.: Urban Land Institute, 2002), 56.

9. Ibid., 56.

10. Human-scale refers to designs that are approximately two to four stories high with frequently spaced windows to create visual interest for the pedestsrian and several entries into the building.

11. Porter, *Making Smart Growth Work*, 56.

12. Transparency is an architectural term used to refer to windows, glass doors, etc.

13. Until recently, transportation planning was oriented primarily to the automobile. New concepts in transportation planning are based on moving people, not just cars.

Section 3. Subarea Model Development

3.1 Overview

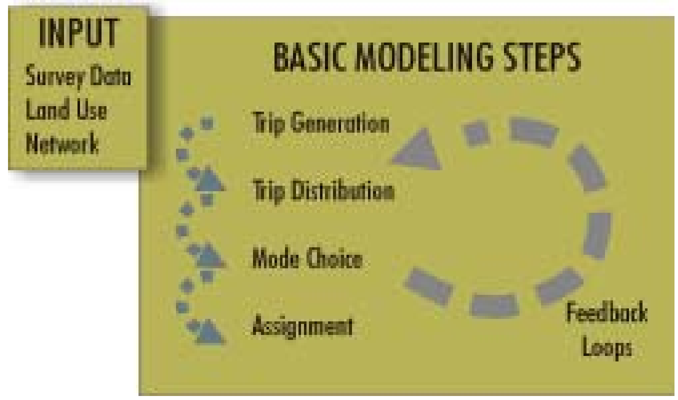


Figure 3.1 Basic Modeling Steps.

An outcome of this research is to identify regional travel demand forecasting model techniques to measure the individual and accumulative impacts of transit supportive urban design strategies on transportation demand at various scales of analysis that range from the site to the subregion.

The current regional forecasting model for the Twin Cities was developed in 1993 and has been updated periodically over the intervening years. The model follows a core four-step process that is shared by most regional forecasting models. The process includes a step for trip generation, one for trip distribution, a process to allocate trips to different travel modes and one to assign trips to the transit and highway networks.

The model is used to forecast regional travel demand, which is in turn used to plan the regional road and transit system. The model represents the region's transportation system as a pair of networks of links[1] and nodes[2] —one for highways and one for transit. The region is divided into a series of traffic analysis zones[3] (TAZs) that tend to be smaller in the more intensely developed core areas of the Twin Cities and larger near the outer edge of the metropolitan area where development is less intense.

The model's representation of the region is consistent with the current conventional urban and suburban development patterns present in the region. Development patterns currently being explored at the regional level[4] would introduce a greater degree of transit supportive urban design strategies (mixed-use walkable centers) into the existing mix. As suburban development patterns change to include more mixed-use walkable centers, travel behavior also changes at the neighborhood and subregional levels.

The characteristics that make the model efficient at the regional level reduce its sensitivity to changes in travel behavior at the neighborhood level, particularly in suburban and exurban parts of the region where the model's zones are large and the model's highway and transit networks are sparse. Accordingly, enhancements to the existing model are needed to be able to estimate the travel behavior associated with an increase in transit supportive urban design strategies. The types of enhancements that are needed depend upon the types of travel behavior to be addressed.

The literature review suggests that transit supportive urban design strategies generally cause two types of effects on travel demand—trips are diverted from further away destinations as a result of the closer proximity of land uses in transit-supportive developments and some trip types are increasingly made by non-auto modes in the mixed-use areas. These effects intuitively derive from the compact, mixed-use development pattern inherent with transit supportive urban design.

At the neighborhood level, transit supportive urban design strategies provide for compact mixed-use and transit-oriented (TOD) patterns of development that have the following effects on travel behavior:

- A larger proportion of trips remains internal to the mixed-use center, which has the effect of shortening average trip length.
- Walking between land uses is facilitated in the mixed-use center, which has the effect of reducing the number of auto trips that would otherwise be made.

As transit-supportive urban design strategies are applied at the subregional level, the result is a pattern of multiple mixed-use nodes, each with similar localized travel characteristics as just noted. In the aggregate, this pattern of development has the following effects on subregional travel:

- Multiple mixed-use nodes affect both the proximity of jobs to housing and the balance of jobs and housing in the subregion, which can increase the number of work trips that remain in the subregion rather than out-commuting to other parts of the region. The net effect of trip capture within the subregion is to shorten overall trip length.
- Multiple mixed-use nodes create a pattern of development that can support transit ridership along corridors, which supports the provision of higher capacity transit service in those corridors.

These travel characteristics indicate that the effects to be addressed are recognition of (1) a higher proportion of shorter distance trips and (2) the potential for some shorter distance trips to be made by non-auto modes. To quantify such effects, the travel demand forecasting model needs to be enhanced to better track short trips (both auto and transit) in the subregion and it needs to include a method to estimate primary walk (or non-motorized) trips at the neighborhood level.

Development and testing of the identified enhancements is the subject of the following sections of this report.

3.2 Research Approach

The approach used in this research has been to pursue a series of model enhancements, but to do so in the framework of a subarea model.[5] The enhancements are designed to enable better evaluation of transit supportive urban design and to address the relationship between land use density and type, vehicle trip-reduction and transit usage, shorter-distance trip making, pedestrian activity, and proximity to transit.

This approach was selected to take advantage of the way in which a subarea model is designed to add detail to a portion of the regional model. The added detail in a subarea model provides a finer-grained system of zone and networks, which allows for a finer-grained assignment of trips in the subarea. The finer-grained assignment directly addresses the ability of the model to track shorter distance trips.

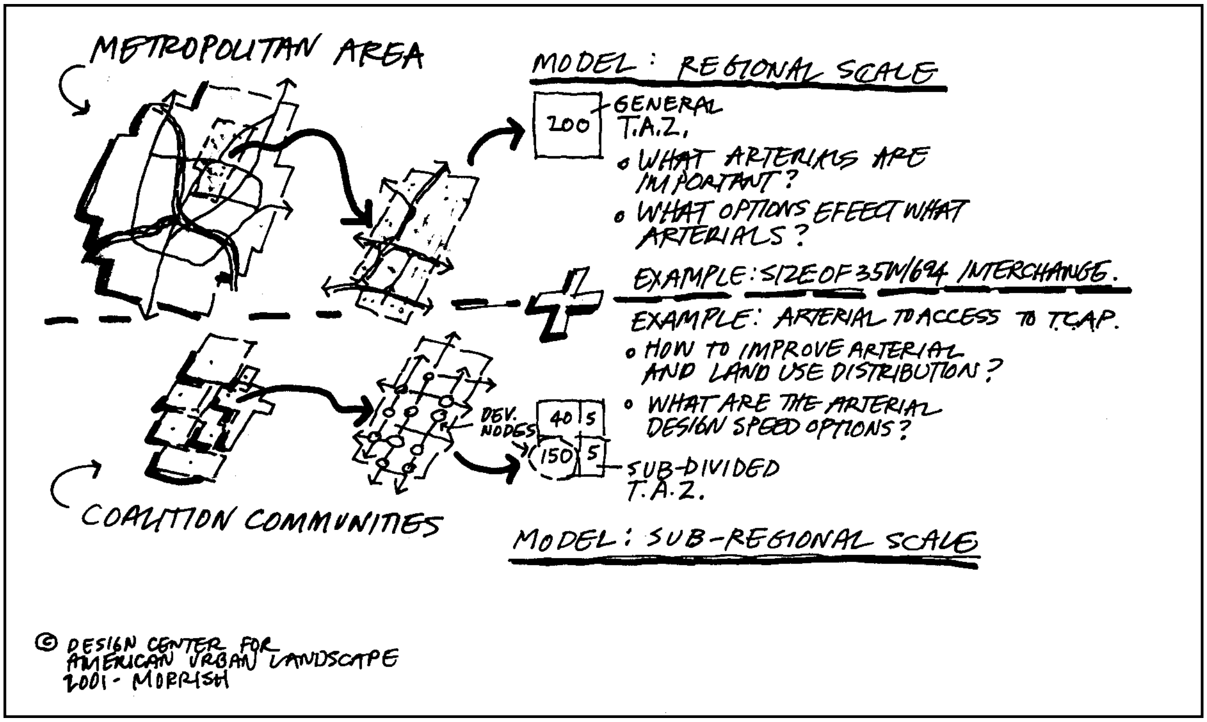


Figure 3.2. Subarea Model Concept Illustration.

Two basic approaches to the subarea model development are available. One is to ***window*** the subarea out of the regional model and then to add detail to the network and zones such that more detailed (fine-grained) traffic assignment occurs. The other is to ***focus*** the subregional area inside of the regional model by adding detail to the subarea within the regional model framework. While both of these techniques add detail by adding more network links and using smaller size zones, they differ in how each maintains consistency with the underlying regional model.

The windowing technique essentially extracts the subarea and sets it up as a separate model that maintains consistency by establishing equivalency with the regional model's forecasts for trips that enter and leave the subarea. Regional trips that pass through the subarea (that do not have origin or destination within the subarea) are extracted from the regional model and added to the windowed model. The windowed model uses a process parallel to the regional model to forecast trips from within the subarea. This technique allows for more flexibility for adding detail, but limits the interaction between the subarea and rest of the region.

The focusing technique adds detail in the subarea, but does not remove it from the regional model. The software platforms for forecasting models generally contain some limitations on the numbers of zones, links, and nodes that can be in use at one time, which limits how much detail can be added in the subarea. However, the focusing technique allows for the subarea model to operate within the regional model, which permits various elements of the regional modeling process to be used within the subarea and it permits strong interaction between the subarea and the rest of the region.

If the goal of a subarea model is merely a more refined assignment of auto trips to the highway network, then either technique can provide similar results. Alternately, where the goal of the subarea model is to forecast effects on trip distribution at various scales and effects on mode choice, then the focused techniques is superior to the windowing technique, since it allows for interaction between the subarea and the rest of the region. The choice of technique also needs to consider the level of detail provided by various elements of the regional model and what level of regional interaction is necessary. The focused technique was chosen for this study.

3.3 Subarea Model Development

The regional model uses two networks to represent the region's transportation system, one for highways that includes freeways, arterials, and some collector streets and one for transit that includes most of the public transit routes in the region. Transit is coded by type of service and mode (bus, express bus, transitway, etc.) As noted above, the networks are made up of links and nodes that represent the street segments and intersections in the roadway system and transit routes and stops in the transit network.

Trip generation is based on demographic data about jobs and population. The major determinants for trip generation are retail employment, non-retail employment, population and households in each TAZ. Trip generation is based on survey data, both from locally collected travel behavior inventories and from Census Journey-to-Work files.

Trip distribution occurs at two different levels within the model. A gravity model[6] is used to distribute trips by purpose (home based work and other, non-home based) for trips that have both ends inside the metro area. Intrazonal trips (or trips that do not leave the zone of origin) are identified at this stage and drop out of subsequent calculations. The factors used to calculate intrazonal trips are derived from travel behavior surveys and reflect local conditions. For trips that have one or both ends outside the metro area (external trips), a Fratar[7] model is used.

Trips are assigned to travel modes (autos, shared rides, car/van pools, and transit) in the mode choice model[8] using a process that considers the relative value for each mode for travel time (including time to access the mode) and operating cost (e.g., transit fares, parking).

At this stage of the modeling process, transit trips are segregated from other trips and are assigned to the transit network. All non-transit person trips in vehicles are assigned as vehicle trips to the highway network on the basis of vehicle occupancy (drive alone, shared rides, carpool, and vanpool). Shared rides, carpools, and vanpools are kept as separate "modes" and identified as types of high occupancy vehicles (HOVs). This level of detail provides for HOV trips to be tracked within the assignment process and to allow assignment of trips to HOV-only roadways (e.g., ramp meter bypasses, diamond lanes).

The assignment process is similar for both networks and uses an equilibrium process that balances travel times over parallel routes between the same destinations. The transit assignment uses the travel time attributes of links in the transit network to determine zone to zone travel time for assignment purposes. The vehicle or highway assignment uses a more com-

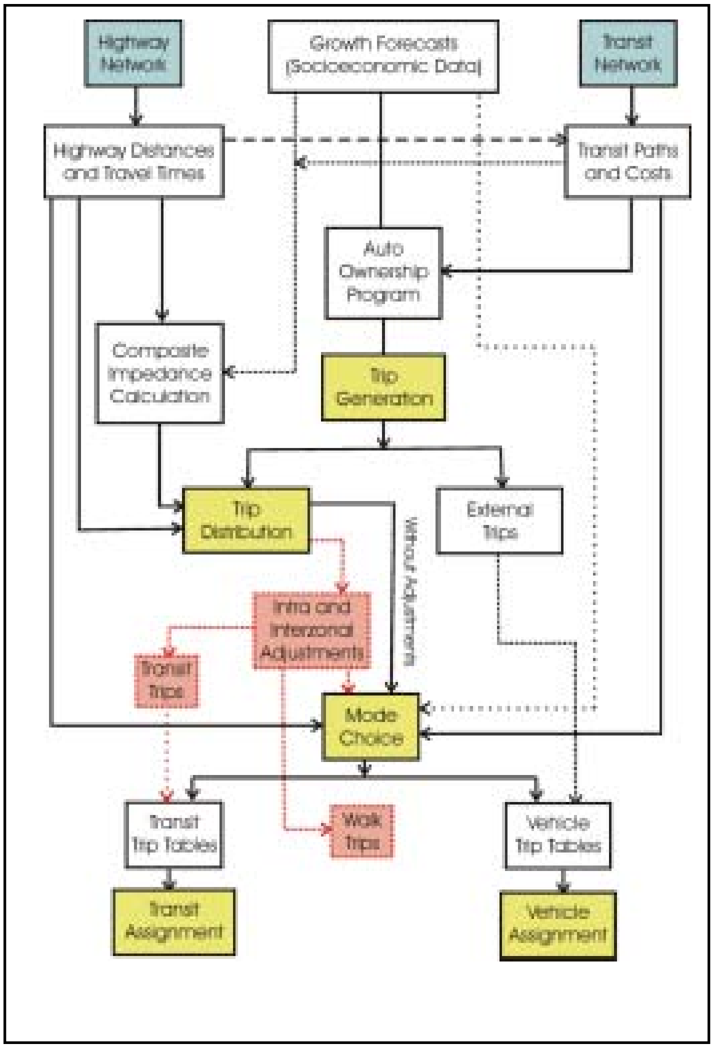


Figure 3.3. Forecasting Model Framework.

plex process that takes delay on congested links in the network into consideration, which requires several iterations of the highway assignment process to reach equilibrium.

Subarea Model Enhancements

To construct the focused model, various elements of the regional model are refined or modified for the subregion within the focused model. The refinements fall into ***spatial*** and ***relational*** types of activities.

Spatial activities involve subdividing regional model analysis zones into smaller pieces and adding more roads and transit routes to the model network. Both of these activities add detail to the model results without significantly altering the sensitivity of the model to land use patterns.

Relational activities are designed to increase the sensitivity of the model to the interaction between land use mix, density, and short distance trip making. The relational activities draw from two primary data sources. One is the availability of more finely grained socioeconomic data for the subregion that has allowed for exploration of the sensitivity of the trip generation and distribution components of the regional model. A brief explanation of this enhanced data is provided below. The other is the information developed through the Urban Design Analysis described in the preceding section, which provides relative measures of the effects of density, walkability and connectivity within the subarea model. These measures have been used to identify the areas of influence to be addressed within the modeling enhancements.

Demographic Data Enhancements

An enhanced demographic data set was constructed by Excensus, LLC for the I-35W Coalition. The Excensus process used employment data from both the Minnesota Department of Economic Security and from Dun & Bradstreet and filtered both data sets through a cross-checking and linking process that allowed each employer to be linked to a specific TAZ.

The population and household data set was built by Excensus using household-specific data tied to individual residential parcels that was current as of 1999. A number of public data sources (including school census data, county property tax records, vehicle registration and driver license data, and city utility billing data) were merged to produce household-level profiles that match (within one to three percent) Metropolitan Council and Census estimates.

Detailed parcel data from the I-35W Coalition's consolidated GIS database was used to establish area measurements that were used to calculate various measures of employment and population density in the study area. The disaggregated data set developed for this project is shown in comparison to 1990 TAZ data in Appendix B.

Spatial Elements – TAZ Separation

The subregion contains all or part of 84 TAZs as defined in the regional model. Zone boundaries often lie along major highways or on arterial streets. Zone boundaries also follow significant physical elements that shape and direct traffic movements such as rivers and larger lakes. County and other political boundaries form TAZ boundaries as well. As noted previously, the primary elements that make up zones are census tracts and block groups.

Subdividing TAZ boundaries in the subarea is a necessary step to focus the model. The process by which TAZs are subdivided used a layered approach to add the necessary amount of detail and was accomplished through five rounds of analysis of different criteria as follows (each of which is described in the following section):

- Cropping of zones at the edges of the subarea to fit the zones to the subarea political boundaries
- Community and planning area boundaries
- Highways, transit, and natural features
- School District boundaries
- Generalized land uses

The first round of TAZ separation adjusted boundaries for model TAZs that do not lie entirely within the subregion boundaries to be consistent with the subregional boundary. Fourteen TAZs lie only partially within the subregion. Six of these TAZs lie within the City of Roseville. Four of these TAZs also contain most of Falcon Heights, and all of Lauderdale, neither of which lie within the subregion. One TAZ is mostly within Little Canada with part of it laying on the eastern boundary of Roseville on Rice St between County Road B2 and County RoadC. This TAZ is 0.273 acres in Roseville, and lies entirely within the Rice St right of way. No structures lie in this portion of the TAZ. The last shared TAZ in Roseville is also shared with St. Anthony to the west. In the subregion, there is a narrow strip of land from New Brighton Boulevard to I-35W totaling 2.75 acres adjacent to two TAZs in Roseville. This segment of land contains mostly light industrial land uses. Two of the remaining TAZs lie within New Brighton. These TAZs also contain part of St. Anthony. There is one TAZ in Mounds View that is also partly shared with Spring Lake Park. There is one TAZ in Shoreview that is also shared with White Bear Township. Blaine contains the remaining four TAZs, all centered on the Northtown Mall. Three of these TAZs extend into Coon Rapids, of which two extend only to Trunk Highway (TH) 47. The third TAZ is mostly in Coon Rapids, containing the portion of Blaine north of 85th Avenue and west of TH 47. This is a small TAZ, which has a size of 8.2 acres. The fourth TAZ that lies partially in Blaine is mostly in Fridley, containing the portion of Blaine south of 85th Avenue and west of TH 47. This TAZ is only 1.2 acres in size. Most of the last TAZ is the right of way for 85th Avenue.

The second round of separation divided TAZs based on community boundaries and planning areas within communities. The goal was to allow TAZs to be contiguous with planning district and city boundaries and represent only one community. Several TAZs are part of two communities within the subregion. Part of this step entailed the combination of the smaller TAZs cut in the first round of TAZ separation. In particular, the two small TAZs in Blaine were combined to join the Northtown Mall TAZ. The TAZ in eastern Roseville joined the one to its west and the TAZs in western Roseville were split and joined to their neighboring TAZs to the east.

The third round of TAZ separation is based on the highway and transit networks and natural features such as bodies of water. The original TAZ network was based on divisions by major roads and bodies of water. Other roads in the highway network affect circulation patterns and were also considered. Utility corridors such as railroad tracks and power lines were also considered as they sometimes restrict development of road networks. The density of streets was also considered, since more connected streets give traffic more options and usually mean more development opportunities in the area. The rural areas in the subregion are not divided much using this criterion. Consideration of future development patterns and movement network entered into this decision.

The fourth round of TAZ separation followed school district boundary lines. Many short distance trips are affected by location of schools during the A.M. peak period in particular.

The fifth round of separation followed general land uses. Land uses provide different levels and types of trip generation and distribution patterns. Land uses are usually divided by streets or alleys, major bodies of water, and utility corridors. Certain utility corridors and major streets attract particular land uses. For example, rail corridors tend to attract industry. Commercial zones tend to line major streets near city centers and other shopping areas. Separating each land use in a TAZ would create a large number of TAZs, which may make the model analysis too complex. Additionally, a corner store surrounded by low density residential would not generate enough trips to justify a model analysis. Also, there are several places in the subregion where certain land use areas are on only one parcel of land.

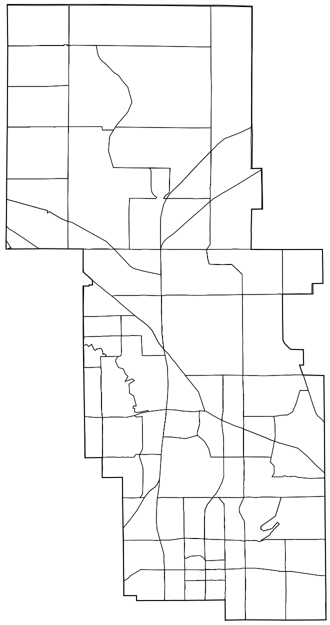


Figure 3.4. 84 Traffic Analysis Zones, 1990; North Metro I-35W Corridor Coalition Subregion.

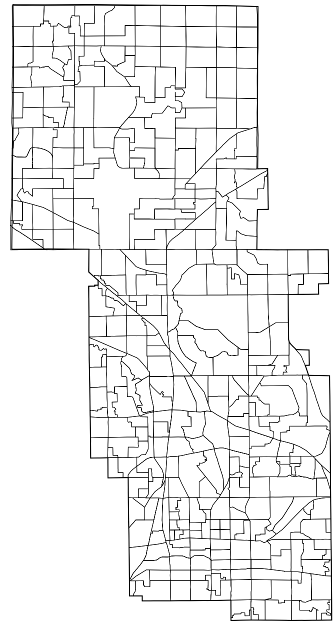
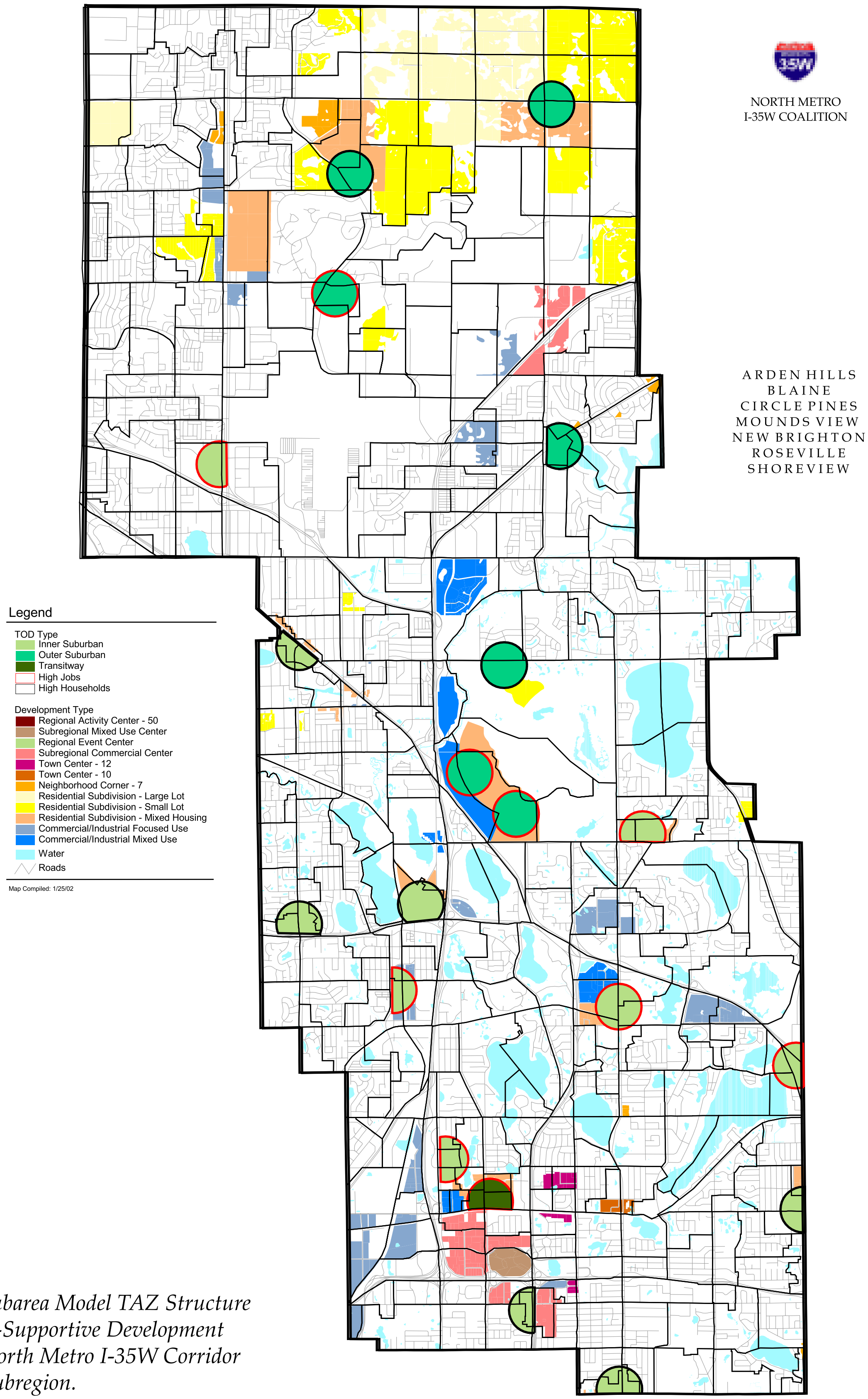


Figure 3.5. 371 Subdivided Traffic Analysis Zones of the Subarea Model, 2000; North Metro I-35W Corridor Coalition Subregion.

Density of population and employment was also used to divide TAZs in addition to land use. Higher density areas should generate more trips than lower density areas, and therefore can be subdivided into smaller zones. Higher density zones also tend to attract trips more easily than lower density zones for industrial and commercial areas in particular.

The TAZ structure for the focused model had to be adjusted to fit within the maximum number of zones permitted in the executable files for the travel demand model. Meeting these limitations required some re-aggregation of zones in areas where limited development is projected to occur. The following graphics show the resulting zone structure in comparison with the baseline and with the proposed development pattern in the Coalition area so as to maintain a consistent basis for comparison with the regional model for validation purposes. The access links[9] in the transit network and the centroid connectors[10] in the highway network for the subdivided zones were reconnected to the same locations as for the parent zones from the regional model. This step allowed for travel times to be calculated from the same basis and for trips to load onto the networks at the same locations as in the regional model.

In a subsequent step, once subarea model validation was achieved, additional network was added to the subarea model to take advantage of the smaller zone structure. Collector streets were added to the network. This necessitated breaking arterial links, which added nodes to the model networks. Access links in the transit network were revised to reflect the smaller zone structure in relation to stop patterns on transit routes serving the study area. As part of the Coalition Buildout Study, a series of modifications and additions to the arterial and collector network and to the transit network were also coded into the subarea model. These elements and the resulting highway and transit networks are discussed in the Buildout Study Results section of this report.



Map 3.1. Subarea Model TAZ Structure and Transit-Supportive Development Scenario, North Metro I-35W Corridor Coalition Subregion.

Relational Elements—Short-Distance Trips

One of the goals for this research is to allow for better quantification of short-distance trips. The current model shows short-distance trips as intrazonal[11] trips, giving each trip an average distance instead of a distance traveled on the network. With smaller TAZs, more sensitivity to short-distance trips was considered to make sure that these short-distance trips are reflected accurately on the highway network. This included sensitivities in the trip generation, trip distribution, and mode choice models.

The ***trip generation*** models are extremely sensitive to change and changing these factors will affect the number of trips generated, both in the subarea and throughout the entire regional network. It is not possible to isolate changes to the trip generation model to specific zones.

The ***trip distribution*** model is calibrated to have a gravity model equation represent each of the trip purposes. The impedance factor between zones from the gravity model is called a friction factor, or an F factor, which is directly proportional to the average travel time between zones as calculated by the model.

Additionally, the regional model also uses a socioeconomic factor, called the K factor, which accounts for movement between zones. The K factor is estimated using a formula from the Federal Highway Administration, which is based on ratios of observed trips between zones.

F factors are determined in the model between TAZs, while K factors are determined for districts.[12] Adjusting these factors in the trip distribution model provides a means of affecting the sensitivity of the subarea model only in the selected zones as opposed to the entire network (as would be the case with the trip generation model). The focused subarea model has many small TAZs that are closely spaced, which means that the interchange between zones will be much more sensitive. The F factors in the subarea were re-generated to reflect the change in zone structure in the subarea. To make adjustments to the K factors and to more easily report trips from the subarea, the existing district structure was modified to create a district that conforms to the subarea boundaries and the factors were calculated for the smaller zones in the subarea model. Changing these factors affects the sensitivity of the model and allows the model to reflect existing conditions more accurately.

The ***mode choice*** model uses a utility function to assign trips to modes. As with trip generation, changes or adjustments to the mode choice model affect the entire network for those trip purposes affected. Accordingly, no changes were made to the modal bias constants for the focused model.

A ***transit accessibility factor*** is used within the mode choice model to account for short walks (one-third mile or less) and long walks (one mile) to transit from within a zone that is served by transit. The walkability analysis contained in the Urban Design Analysis is based on a two-tiered system for walk distance in mixed-use areas that uses one-quarter mile and one-half mile distances to classify walkable areas. The one-third mile short walk to transit in the regional model is representative of an average of the factors used in the walkability analysis and was used without changes in the focused model. Similarly, the one-mile long walk is consistent with the measures used in the walkability analysis and was likewise used without changes.

The mode choice and transit accessibility features of the regional model are both well-suited to use in the subarea model and reinforce the choice of a focusing methodology for this analysis. Constraints that need to be addressed with respect to using these features to address transit demand is the level and type of transit service coded in the transit network. If an adequate amount and type of transit service is available within the short walk to transit, the regional model's mode choice and transit accessibility factors will adequately assign trips from transit-supportive developments to transit.

The walk trips that are reported in the regional model can be misleading. The mode choice report for each trip type (home to work, non-work, etc.) shows the number of *walk* trips that are forecast by the model. However, these walk trips are specifically only to and from transit modes (and are essentially transit trips, not primary walk trips). As a result, the mode choice routine in the model assumes that all person trips made are either made by auto, transit or both auto and transit. While the number of exclusive walk trips is expected to be relatively small, no such walk trips from origin to destination are reported. These would include trips to the corner market, trips to school, or even trips to work if the destination was within a certain distance. The model also makes no assumptions about bicycle trips, although they may be included in walk to transit numbers.

The main problem with this methodology when TODs and other mixed-use areas are incorporated into the model is that the model algorithms will code all person trips as auto or transit trips. The model has no way of coding *short trips* as walk or bike trips or additional transit trips even if origins and destinations are adjacent to one another. Resolution of this issue is addressed in the Estimating Travel Demand Effects of Transit Supportive Urban Design Strategies section of this report.

3.4 Validation of Focused Subarea Model

The focused model was run with 1990 data for the subdivided TAZs using the original model's highway network and compared with a run from the original (unsubdivided) model. Bandwidth plots of assigned P.M. peak hour volumes by roadway link are shown on the following pages for the whole subarea. "Original" model refers to the 1990 model and "modified" refers to the subdivided model. Volumes were extracted for 19 screenlines[13] at various locations within the subarea and compared between the two runs to test the variation in model assignments. The following chart shows that the variation between total volumes crossing the screenlines is in the range of less than 3%.

Within each screenline, there are variations by direction (north-east vs. south-west) that differ from the variation by total volume. The following chart shows one screenline and illustrates the variation by direction. Overall, the screenline comparison shows good correspondence between the subdivided model and the original model for assigned vehicle trips. The tabular data for the screenlines is included in Appendix C.

At the focus area level, a series of select link plots were prepared from both models for comparison to ascertain how the subarea model was performing on a localized basis for specific streets in the study area.

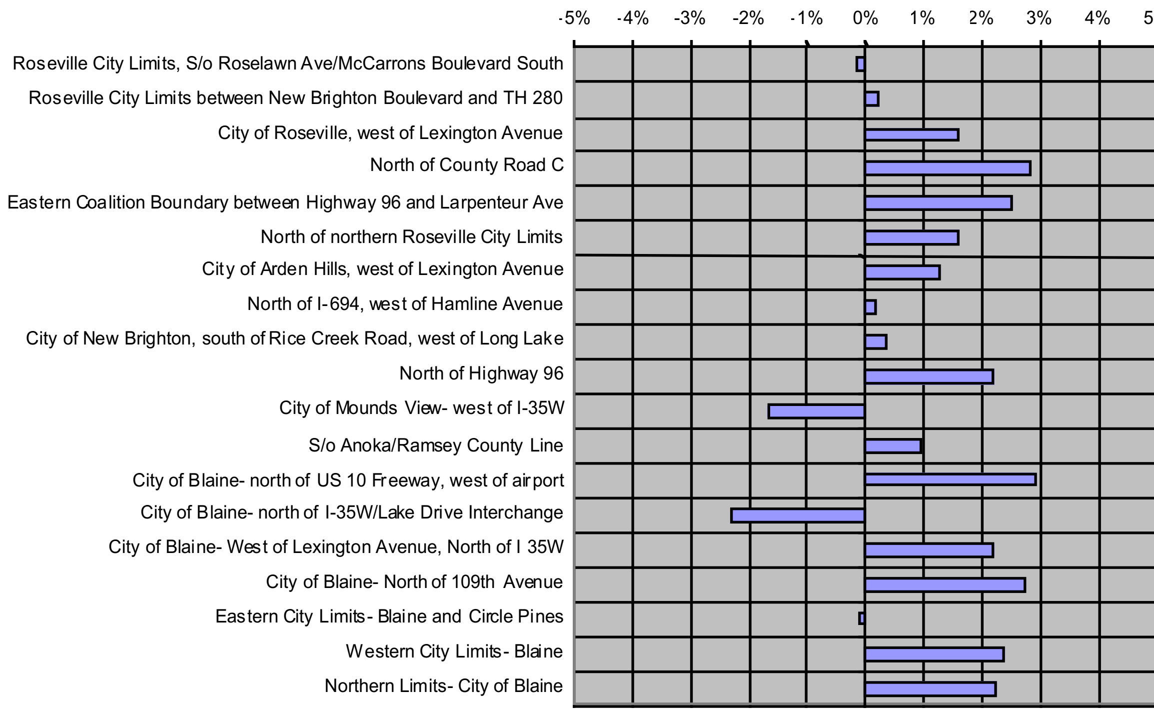


Figure 3.6. Change in Screenline Volume Between the Subdivided Model and the Original Model.

A select link analysis tracks the origins and destinations of trips that use a "selected" link in the forecasting model. The data is directional in that it only shows one direction of travel at a time. The data is also specific to only the selected link in that for a trip to be counted, it has to travel on the selected link in the selected direction of travel.

Four sets of plots of the graphical output from the select link analyses with both directions of travel combined are on the following pages. In each set, one plot is from the original model and the other is from the subdivided model. In each set, the select link was chosen to represent a point in the highway network where trips from the focus area would be loaded onto the network. The assignment of trips near each focus area also shows good correspondence between the two models.

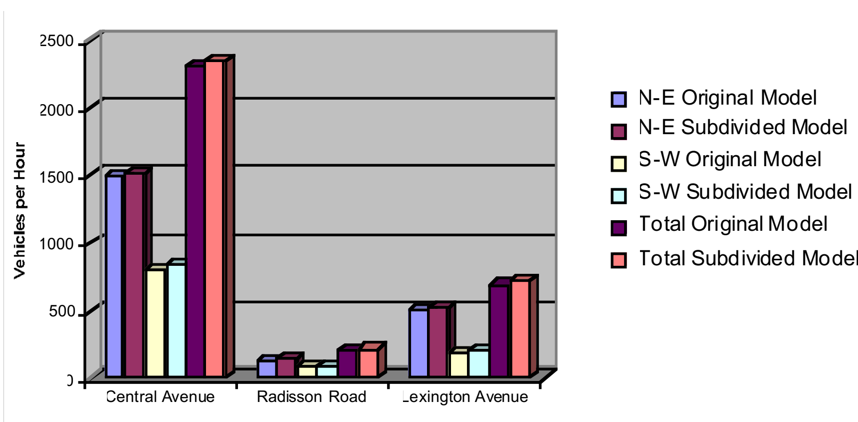


Figure 3.7. Screenline Volumes—Variation by Direction (Northern limits: Blaine).

Validation of Subarea Model—Subregional Level

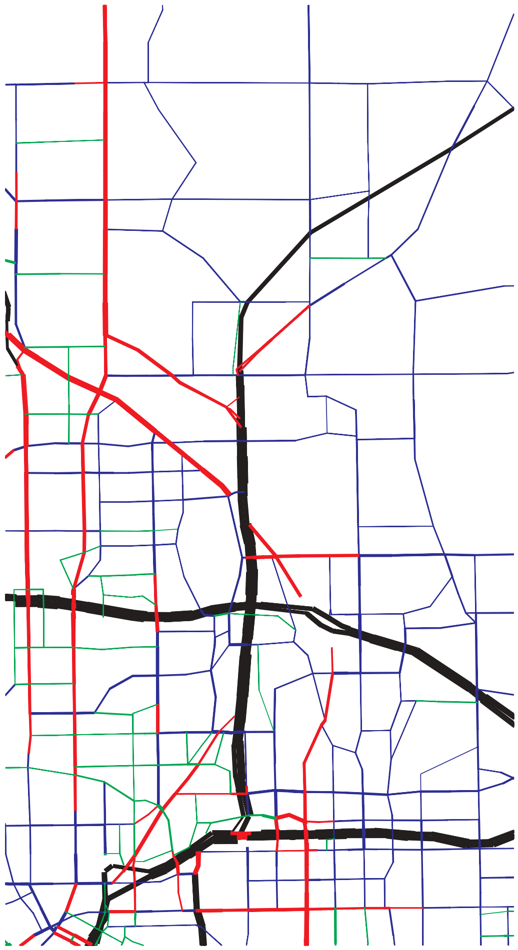


Figure 3.8. Original Traffic Data, Volume Bandwidth Plot; North Metro I-35W Corridor Coalition Subregion.

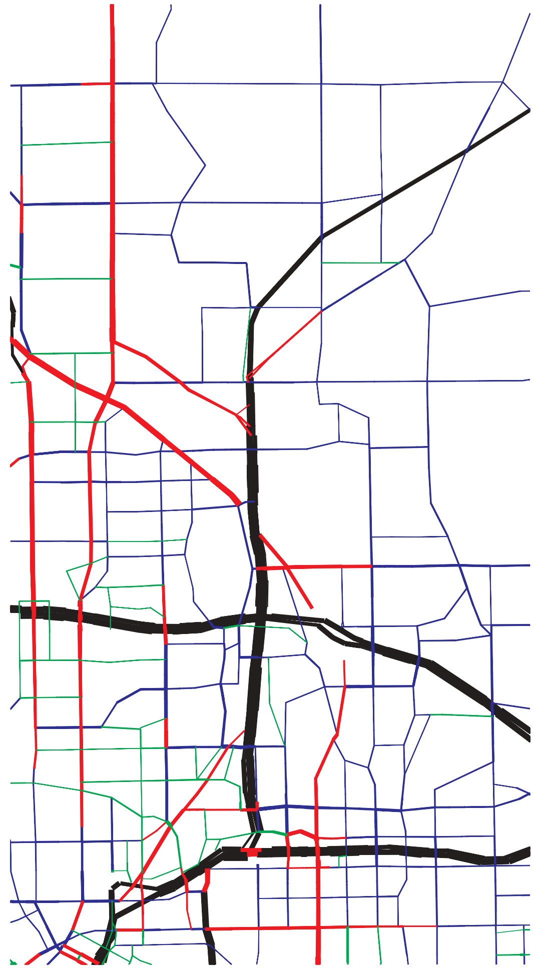


Figure 3.9. Modified Traffic Data, Volume Bandwidth Plot; North Metro I-35W Corridor Coalition Subregion.

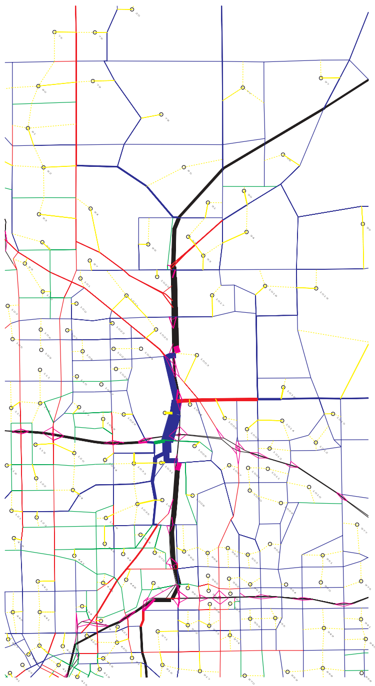


Figure 3.10. Original Traffic Data, Volume Bandwidth Plot; Northwest Quadrant, New Brighton.

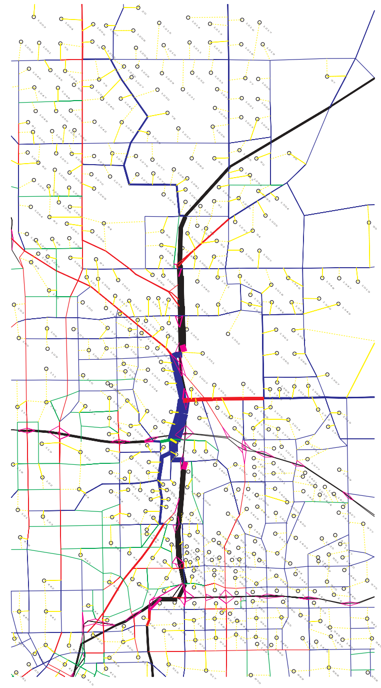


Figure 3.11. Modified Traffic Data, Volume Bandwidth Plot; Northwest Quadrant, New Brighton.

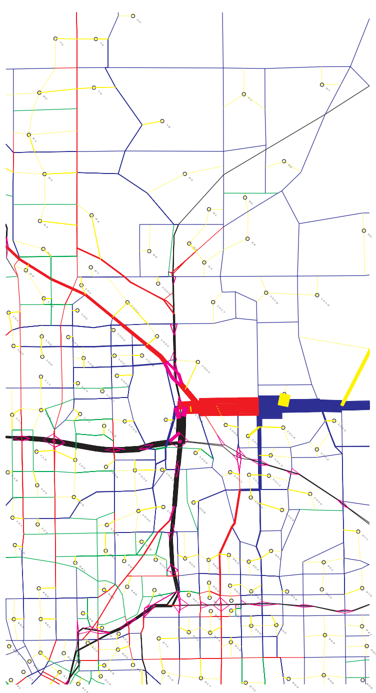


Figure 3.12. Original Traffic Data, Volume Bandwidth Plot; Town Center, Shoreview.

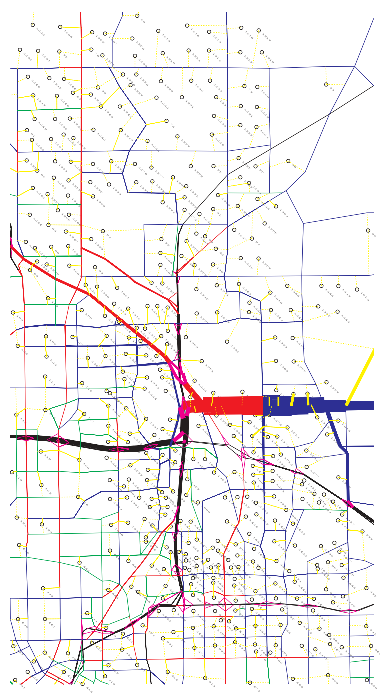


Figure 3.13. Modified Traffic Data, Volume Bandwidth Plot; Town Center, Shoreview.

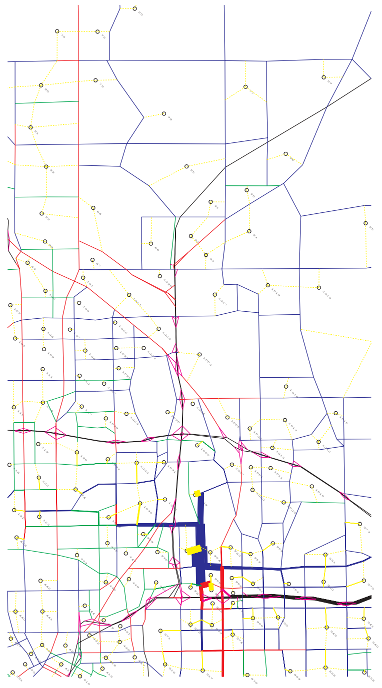


Figure 3.14. Original Traffic Data, Volume Bandwidth Plot; Twin Lakes, Roseville.

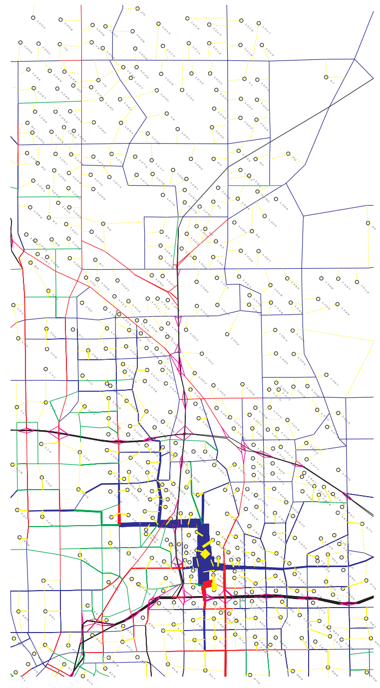


Figure 3.15. Modified Traffic Data, Volume Bandwidth Plot; Twin Lakes Roseville.

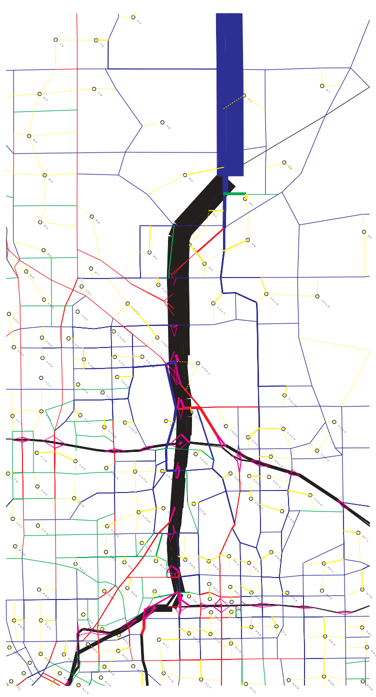


Figure 3.16. Original Traffic Data, Volume Bandwidth Plot; Northeast Blaine.

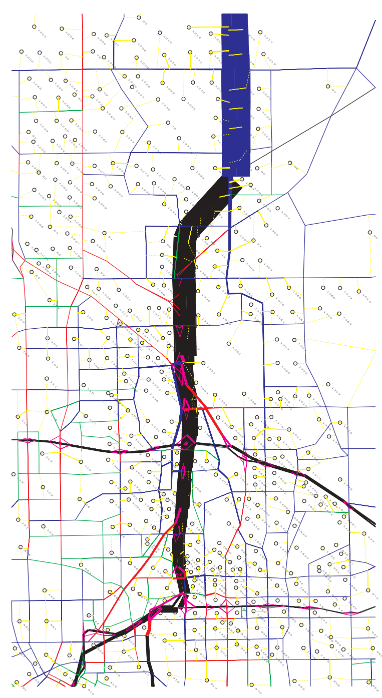


Figure 3.17. Modified Traffic Data, Volume Bandwidth Plot; Northeast Blaine.

3.5 Estimating Travel Demand Effects of Transit-Supportive Urban Design Strategies

As mentioned earlier, the regional forecasting model process does not account for primary walk or bicycle trips. It is likely that increases in primary walk and bicycle trips from future transit supportive urban design land use strategies (transit-supportive developments) would be inappropriately assigned as auto trips by the forecasting model under its current structure. Accordingly, adjustments to the model are needed to assign trip making from land uses in transit-supportive developments to appropriate modes of travel.

Since the trip-making mode is determined in the mode choice component of the travel demand model, the mode choice process appears to be the appropriate place to investigate for modifications that reflect walk trips. However, this is not the case. The mode choice model is segregated by trip type, where each trip type has a multinomial or nested logit model with several coefficients. These coefficients are validated for the entire Twin Cities network and therefore cannot be altered in a simple manner. Additionally, since there is no formula that produces a primary walk mode, a new series of equations would have to be created with a new set of coefficients for all modes, if walk trips were to be generated as a primary travel mode. The model would then have to be re-calibrated to incorporate the new equations. Lack of data about walk trips consistent with the 1990 calibration of the model precludes integration of primary walk trips into the mode choice model for the current version of the regional model.

In the absence of adjustments to the mode choice model, two other modeling steps were considered for modification. One is the trip distribution matrix. The trip distribution matrix contains the total person trips interchanged between all zone pair,[14] by each trip purpose. At this stage, these trips are not yet allocated to mode of travel. Here, it is possible to construct a constraint matrix that adjusts the number of trips by mode between specific zone pairs based on characteristics determined by the Urban Design Analysis that include land use density, distance between zones, trip purpose, transit access, street density, walkability and connectivity.

The other component for implementing a trip adjustment methodology is the output of the trip generation model. The trip generation process determines the number of trip productions and attractions from a TAZ. As with the trip distribution process, these productions and attractions can be modified at the zone level on the basis of factors that represent different characteristics of land use density, transit access, proximity to other zones, and other factors.

Accordingly, the most readily accessible components to adjust for a trip adjustment method to report primary walk/bicycle trips are the production and attractions by zone from the trip generation model and the outputs from the trip distribution model. The methodology is based on the premise that land use development patterns that have certain favorable intensity and urban design characteristics have a propensity for generating less automobile travel (but not less total travel) than conventional land use patterns. The method and applications are generally based on recent national research materials and practices on the relationship between land use and travel behavior. In the methodology, a series of factors are used to reduce auto trips generated between each of the travel demand model's TAZs based on key independent variables, such as:

- Population Density of the production TAZ
- Employment Density of the attraction TAZ
- Jobs/Housing Balance of each TAZ, reflected by the ratio of both TAZs' employment to population for both productions and attractions
- Distance between each TAZ, measured by distance between the center of each TAZ
- Transit Accessibility for each TAZ, reflected by the percentage of TAZ population that is within a reasonable walking distance of a transit stop for both productions and attractions.

Review of the literature showed two types of studies related to the effects of transit-supportive development patterns on tripmaking.[15] In one type of study, comparative surveys were conducted in traditional neighborhoods and in suburban neighborhoods to determine travel behavior differences including trip generation and mode choice. The other type of study evaluated national and regional travel survey data to explore the correlation of travel behavior and urban structure. Results were focused on vehicle trips and vehicle miles traveled (VMT). Most of the studies that have been researched produced a high level of consistency in the overall results. These results included the following typical conclusions:

- Vehicle trip generation is over 20% higher in conventional suburban neighborhoods compared to more dense traditional neighborhoods
- Transit mode share tends to be higher in more traditional neighborhoods
- Doubling land use density can reduce VMT by about 20%.

The methodology developed for this research uses two similar off-line adjustments individually to address design relationships within a zone and/or concurrently to address design relationships with adjacent zones. These two methods are labeled ***intrazonal adjustments*** and ***interzonal adjustments.***

Intrazonal Adjustment

The *intrazonal adjustment* factors the trip generation results for a zone to adjust the number of intrazonal trips. The factoring is based on a comparison of the land use of the zone with a typical suburban TAZ. For example, an average suburban neighborhood has a certain density. Auto trip reduction could be expected to occur when the density and diversity of uses reaches a certain percentage over that threshold. For the purpose of this research, the numbers are compared for a predefined baseline for the specific TAZs that will be analyzed.

The factor is applied in the form of elasticity numbers. Elasticity numbers are percentage adjustment factors representing the propensity for trip reduction resulting from a change in density or mix of uses. An elasticity of -0.04 for density means for a density that is 1% greater than a typical suburban density in the region, a 0.04% decrease in trips can be expected. An equal proportion of trips for each trip length will be reduced using the elasticity method. The trips that are reduced using this method will all become intrazonal trips in the TAZ. On the basis of the way that TAZs are structured in the four focus areas from the Urban Design Analysis, it has been assumed that all these new intrazonal trips are walk or bicycle trips.

Zone attractiveness is a function of density, land use diversity, and accessibility. For each TAZ, the population density, employment density, the corresponding density ratios, and the jobs/housing balance is calculated. Data from the Urban Design Analysis were used for these calculations. The number of transit stops within the TAZ is also determined.

The intrazonal adjustment is applied as follows.

- Socioeconomic data with the focus area improvements is input into a spreadsheet. Only the TAZs representing the focus areas are included in the spreadsheet calculations.
- A new model run is performed through trip generation with the new socioeconomic data. Then the TPA Conversion executable is run. The end result of the executable are two trip generation tables with productions and attractions for home-based work trips and non-work trips.
- These trip generation tables are then imported into the spreadsheet. The spreadsheet is designed to take these inputs and run calculations to develop the outputs automatically.
- The final output contains two complete trip tables with the adjusted trip generation numbers. One table contains the adjusted trips for all four combined home-based work trip types, and the other table contains a combined output for all non work trip purposes. The sheets that have the adjusted numbers are saved as space-delimited text files. These tables are the input for trip distribution in the subarea model.
- A second output is a table that shows how many trips by TAZ have been reduced. These trips are the walk/bicycle trips generated by this method.

A parallel study[16] being conducted for the Metropolitan Council is addressing how to estimate trip reductions from Smart Growth within the existing regional model and has evaluated data from the 2000 Travel Behavior Inventory (TBI) and compared it to both the 1990 TBI and to national data. The findings from the 2000 TBI data are the most complete local data set and have been the primary data source for determining trip adjustment factors in this research.

An additional reference used in the determination of adjustment factors is the *ITE Trip Generation Handbook*. This book contains comprehensive data for several mixed-use developments. In spite of the limited data points, it does give a comprehensive analysis of trip interaction between different land uses within a mixed-use center. It analyzes several aspects of trip making within nine different transit-supportive developments within the state of Florida. The most relevant section in this source is the comparison of vehicle trip generation rates. ITE daily trip generation rates are applied for each of the land uses within the development and are summed. This number is then compared to the actual driveway counts taken at the sites. The actual counts are about 10% lower than the ITE counts for the smaller mixed-use developments (<500,000 total square feet) and about 20% lower for the larger mixed use developments.

The *ITE Trip Generation Handbook*[17] does caution against using it as the source for determining trip rates due to the few data points available, and due to the fact that they are all located in the same state. The handbook clearly mentions that if local data can be used or collected, then that should govern if there are any discrepancies. The TBI survey data is a reasonable indicator of trip making characteristics in the Twin Cities area, and as a result, is the primary source of input for the development of factors. As the Fehr and Peers Associates report indicates, most of the data in the TBI survey indicates that the trip making characteristics are almost identical to those done by other studies and those listed in the *ITE Trip Generation Handbook*. The adjustment factors used in the intrazonal adjustment are based primarily on the results of the TBI survey data from the Fehr and Peers report. A brief description of the development of the adjustment factors follows.

As mentioned earlier, the adjustment factors are based on a percentage change over an existing baseline. A set of 68 TAZs within the study area were selected that best represented typical suburban neighborhoods. Typical characteristics of these TAZs included low-density land use (less than 8 persons per acre), low jobs/housing ratios (typically jobs/person less than 0.20), and poor transit accessibility (50% or less within 1/3 mile of transit). Data for the zones included in the analysis and the calculated averages are shown in Appendix D.

The population and employment density factors compare the population and employment densities for the subject TAZ to the regional suburban averages. The resulting ratio is used to determine the density factor. A ratio for population density of 1.20 means that the residential density in a TAZ is 20% greater than the average suburban population density for the region. These numbers are obtained by taking population or employment and dividing it by land area of the entire TAZ. The average calculated for the typical suburban TAZ is 6.62 persons per acre. A typical mixed-use center TAZ will have between 20-50 persons per acre. As the Fehr and Peers report shows, the Twin Cities model does account for density changes in its trip-making module. However, several of the TAZs, which are used to represent focus areas, contain some land uses outside the focus area, so an additional density factor needs to be assumed to account for higher densities within the focus areas. The adjustment rate is constant for density ratios greater than three to account for the fact that most of the high density TAZs are almost entirely within a focus area.

The jobs/housing balance ratio is a measure of the extent of diversity (mixtures) of land uses available in a TAZ. The jobs/housing balance is determined by dividing the total employment of the attraction zone by the total population of the attraction zone. For the smaller TAZs created for the submodel, it is a good reflection of how mixed the land uses may be in a zone. For example, a certain percentage of trips can be reduced if the ratio falls within a certain threshold, because a good balance of residential and employment (office and retail) land uses allows for residents to walk to work or for retail shopping instead of driving. The average calculated for the typical TAZ is 0.14. It is important to note that low jobs/person ratios are not the only poor jobs/housing balance indicators. High jobs/person ratios are also indicators of poor jobs/housing balance. A value 3 jobs/person is the threshold above which the jobs/housing balance is presume to be poor in the calculations for diversity.

Transit accessibility is also an important measure. The more residents in a TAZ living within walking distance of a transit stop, the more likely that they will be willing to take transit to travel to their intended destination. Given the level of coverage for transit trips in the regional model, this adjustment for transit accessibility is suggested as a surrogate measure for times when it is not feasible to run the transit components of the regional model to test transit accessibility. The average suburban TAZ will have approximately 54% of the population within 1/3 mile of a transit stop. Most of these are express bus stops serving the Minneapolis or Saint Paul CBDs.

Table 3.1 lists the trip adjustment factors applied to the trip generation tables. The lookup table references a ratio between the transit-supportive developments' numbers and the suburban average numbers. A value of 3 for the density ratio indicates that the density at this location is 3 times 6.62, or 19.86 persons per acre. For the diversity ratio, a value of 9-11 is most ideal. This translates to 0.14 times 9 or 11, or a range of 1.24-1.54 for the diversity or employment/population ratio. This is an effort to account for office and retail employment. The *ITE Trip Generation Handbook* indicates that retail employment and access to retail tends to have a higher internal capture rate than office employment.

Table 3.1. Intrazonal Trip Adjustment Factor Lookup Tables

TAZ Density/SA	Factor
0 - 1	1
> 1 - 1.5	0.99
> 1.5 - 2	0.98
> 2 - 2.5	0.97
> 2.5 - 3	0.96
> 3	0.95
TAZ Diversity/SA	Factor
0 - 1	1
> 1 - 3	0.99
> 3 - 5	0.98
> 5 - 7	0.97
> 7 - 9	0.96
> 9 - 11	0.95
> 11- 13	0.96
> 13 - 15	0.97
> 15 - 17	0.98
> 17 - 19	0.99
> 19	1
TAZ Transit Accessibility/SA	Factor for Prod. & Attr.
0 - 1.2	1
> 1.2 - 1.4	0.99
> 1.4 - 1.6	0.98
> 1.6 - 1.8	0.96
> 1.8 - 2	0.94
> 2	0.92

SA = Suburban TAZ Average
Prod. = Production trip ends
Attr. = Attraction trip-ends

Table 3.2. shows a part of the spreadsheet that calculates the trip reduction factors. All calculations are listed by TAZ. Some demographic information is shown and is used for calculation of the ratios. Three factors are calculated, and are then combined by multiplication into a comprehensive factor. A zone with a density factor of 0.95, a diversity factor of 0.98, and an accessibility factor of 0.99 will yield a comprehensive factor of 0.9219. This comprehensive factor is applied to the unadjusted counts to get the adjusted counts. The unadjusted and adjusted counts are subtracted to obtain the total trips reduced. The reduced trip numbers are then summed. Since this summed number is both the sum of productions and the sum of attractions, the final result must be halved to get the actual trip reduction for the intrazonal trips.

Table 3.2. Trip Generation Reduction Spreadsheet Sample

																TRIPS					
TAZ	POP	EMPL	Area	Pop Dens	Emp. Dens	Density	Density	Factor	EMP/POP	EMP/POP	Factor	% Pop w/in	% Pop w/in	Factor	Comp.	UNADJUSTED		ADJUSTED		REDUCED	
#			(acres)	pers/acre	empl/acre		Ratio			Ratio		1/4 mile	1/4 mile Ratio		Factor	Prod.	Attr.	Prod.	Attr.	Prod.	Attr.
77	3364	288	159.16	21.14	1.81	22.95	3.47	0.95	0.09	0.62	1.00	0%	0.00	1.00	0.95	9578	4898	9099	4654	479	245
1212	1097	0	241.89	4.54	0.00	4.54	0.68	1.00	0.00	0.00	1.00	0%	0.00	1.00	1.00	2798	977	2798	977	0	0
1218	1725	60	159.52	10.81	0.38	11.19	1.69	0.98	0.03	0.25	1.00	0%	0.00	1.00	0.98	4566	1923	4475	1885	91	38
1227	3242	40	121.24	26.74	0.33	27.07	4.09	0.95	0.01	0.09	1.00	0%	0.00	1.00	0.95	8281	3085	7867	2931	414	154
1233	2967	0	242.98	12.21	0.00	12.21	1.84	0.98	0.00	0.00	1.00	0%	0.00	1.00	0.98	7494	2639	7344	2586	150	53
1276	1264	1141	71.40	17.70	15.98	33.68	5.09	0.95	0.90	6.51	0.97	0%	0.00	1.00	0.92	5019	6029	4625	5556	394	473
1336	1125	4244	138.38	8.13	30.67	38.80	5.86	0.95	3.77	27.20	1.00	19%	0.36	1.00	0.95	4747	13559	4510	12881	237	678
1370	261	1275	31.45	8.30	40.54	48.84	7.38	0.95	4.89	35.22	1.00	100%	1.86	0.94	0.89	1781	4742	1590	4235	191	507
1371	464	2237	65.28	7.11	34.27	41.38	6.25	0.95	4.82	34.76	1.00	98%	1.82	0.94	0.89	4765	9877	4255	8820	510	1057
1462	0	898	58.48	0.00	15.36	15.36	2.32	0.97	898.00	6474.60	1.00	100%	1.86	0.94	0.91	4277	11081	3900	10104	377	977
1463	850	1930	35.07	24.24	55.03	79.27	11.97	0.95	2.27	16.37	0.98	95%	1.77	0.95	0.89	7349	14055	6568	12562	781	1493
1464	312	2007	37.58	8.30	53.41	61.71	9.32	0.95	6.43	46.30	1.00	47%	0.88	1.00	0.95	5082	10808	4828	10192	254	547

Two trip generation sheets serve as output to the spreadsheet. Figure 55 shows a part of a sample output for the non-work trip generation table from the Trip Generation spreadsheet.

Table 3.3. Trip Generation Reduction Output Sample

	A	B	C	D	E	F	G	H	I
1	GF	1	1	546	969	2384	6215	1079	2304
2	GF	2	1	277	428	1140	2484	1587	2530
3	GF	3	1	319	408	1301	2792	450	746
4	GF	4	1	83	103	339	714	25	26
5	GF	5	1	127	222	560	1214	40	37
6	GF	6	1	313	506	1334	2933	128	154
7	GF	7	1	155	246	669	1439	166	250
8	GF	8	1	152	231	622	1373	331	796
9	GF	9	1	526	833	2186	4801	198	427
10	GF	10	1	350	549	1602	3268	827	1173
11	GF	11	1	260	421	1120	2420	45	46
12	GF	12	1	292	505	1276	2791	97	174
13	GF	13	1	284	500	1249	2755	435	863
14	GF	14	1	461	575	1877	4043	271	543
15	GF	15	1	612	882	2582	5560	160	194
16	GF	16	1	181	286	758	1655	142	141
17	GF	17	1	315	463	1301	2817	390	584
18	GF	18	1	56	71	223	480	689	1256
19	GF	19	1	51	81	215	479	121	197
20	GF	20	1	183	321	776	1752	148	187

Interzonal Adjustment

The *interzonal adjustment* removes trips based on the relationship of certain TAZ variables to the subregional average. An adjustment methodology similar to the intrazonal adjustments is used. In addition, this method includes a factor to analyze the interaction between the target TAZ and other TAZs based on distance.

Interzonal adjustments serve two purposes. First, three of the focus areas consist of multiple TAZs, some of which are separated by land use. The intrazonal adjustments do not account for this. Second, interaction with TAZs within walking distance of the focus areas needs to be accounted for. For this project, the walking distance is assumed to be one mile, which is consistent with the long walk to transit used in the regional model.

Zone attractiveness is a function of density, land use diversity, distance between zones, and accessibility. For each TAZ, the population density, employment density, and the corresponding density ratios are calculated. The jobs/housing balance from the elasticity method is also used. The number of transit stops within the TAZ is calculated. The distance between the subject TAZ and the surrounding TAZs is noted. Walkability and connectivity data from the Urban Design Analysis were used for these calculations.

The interzonal adjustment is applied as follows.

- Socioeconomic data with the focus area improvements is input to a spreadsheet that calculates adjustment factors based on various characteristics.
- Two sheets are saved out of this spreadsheet as space-delimited text files. These sheets are set up as TRANPLAN control files, and automatically carry factors based on the socioeconomic data. Only those zones that lie within a one-mile radius of a focus area are adjusted by this method.
- A new model run is performed through the first step of the mode choice module. The end results of this step are six trip tables separated by trip purpose with productions and attractions.
- The two TRANPLAN control files are run. The resulting output files are the adjusted trip tables to be used in the remaining mode choice steps.
- A third TRANPLAN control file is run. This is a matrix comparison program which compares the original trip tables and the adjusted trip tables. The output contains the change in total interzonal trips for all trip purposes. These trips are the walk/bicycle trips generated by this method.

The ratios used to determine the adjustment factors for both adjustment methods are very similar. The same sources of data were used to calculate the trip adjustment factors. A brief description of the development of the adjustment factors follows.

The population and employment density factors sum the population density of the production TAZ and employment density for the attraction TAZ, and compare this summed density to the regional suburban average. The resulting ratio is used to determine the density factor. The determination of the density ratio for the interzonal adjustments mixes productions and attractions, since typically, the home end of all home-based trips is considered the production side and attractiveness is calculated at the destination end. The density ratios are obtained by taking population or employment and dividing it by the land area. The adjustment factors for the density ratios are significantly higher since the majority of the zones that are being analyzed are outside the focus area boundaries. The adjustment rate is constant for density ratios greater than 3 to account for the fact that most of the high density TAZ interactions are the zone pairs that are entirely within a focus area, and the interaction should be similarly accounted for as in the intrazonal adjustment phase.

The jobs/housing balance ratio is a measure of the extent of mixtures (or diversity) of land uses available in a TAZ. For the interzonal trips, the jobs/housing balance is determined by dividing the total employment of the attraction zone by the total population of the attraction zone. This is a reflection of the interaction between zones based on the diversity of the land uses between the two TAZs. In this way, two zones that are both mostly residential will not have much interaction. But if one zone is high density residential and its neighbor zone has high density office and/or retail employment, a very high level of interaction between the two zones could be expected. Since the interaction between two zones is the biggest measure, and since the model does not effectively account for diversity, this ratio has the heaviest weight for the interzonal adjustment.

Transit accessibility is determined in the same manner as it is in the intrazonal adjustment stage. Due to the interaction between zones, the factors are slightly different. Given the level of coverage for transit trips in the regional model, this adjustment for transit accessibility is suggested as a surrogate measure for times when it is not feasible to run the transit components of the regional model to test transit accessibility.

In order to accurately reflect walking trips, a distance factor must also be introduced that is independent of land use types. Most walk trips would be confined within a small distance. Bicycle trips, weather permitting, would be able to travel farther, but in general also have a shorter distance due to the perception of the automobile or transit being quicker for longer distances. This factor would negate longer distance trip adjustments, and would factor shorter trips based on their distances.

Table 3.4. lists the trip adjustment factors applied to the trip tables for the interzonal adjustment. The lookup table references a ratio between the transit-supportive developments' numbers and the suburban average numbers. The table is very similar to that of the intrazonal adjustments with the exception of the different factors and the additional adjustment for distance. A value of 3 for the density ratio indicates that the density at this location is 3 times 6.62, or 19.86 persons per acre. For the diversity ratio, a value of 9-11 is most ideal. This translates to 0.14 times 9 or 11, or a range of 1.24-1.54 for the diversity or employment/population ratio. This is an effort to account for office and retail employment. The *ITE Trip Generation Handbook* indicates that retail employment and access to retail tends to have a higher internal capture rate than office employment. Also, no adjustments for transit access are assumed for any zone with transit access that is less than the average suburban area. The spreadsheet is set up to penalize any trips greater than 0.6 mile, significantly penalizing trips greater than 1 mile. This is due to the model's definition of short walk trips vs. long walk trips. Short walk trip (trips less than 1/3 mile) should be expected to attract more trips, and this is reflected in the adjustments.

Table 3.4. Interzonal Trip Adjustment Factor Lookup Tables

TAZ Density/SA	Factor
0 - 1	1.00
> 1 - 1.5	0.95
> 1.5 - 2	0.90
> 2 - 2.5	0.85
> 2.5 - 3	0.80
> 3	0.75
TAZ Diversity/SA	Factor
0 - 1	1.00
> 1 - 1.5	0.95
> 1.5 - 2	0.85
> 2 - 3	0.75
> 3 - 5	0.65
> 5 - 20	0.60
> 20 - 40	0.65
> 40 - 60	0.75
> 60 - 80	0.85
> 80 - 100	0.95
> 100	1
TAZ Transit Accessibility/SA	Factor
0 - 1.2	1
> 1.2 - 1.4	0.95
> 1.4 - 1.6	0.9
> 1.6 - 1.8	0.85
> 1.8 - 2	0.8
> 2	0.75
Distance between TAZs/SA	Factor
0 - 0.2	0.9
> 0.2 - 0.4	0.95
> 0.4 - 0.6	1
> 0.6 - 0.8	1.05
> 0.8	1.1

SA = Suburban TAZ Average
Prod. = Production trip ends
Attr. = Attraction trip ends

Table 3.4. reports the regional model trip distribution matrix for all trip types. This is due to the differences in the mode choice model. This also allows for different trip adjustment factors based on trip type. In combination, all the matrices report every auto and transit trip in the region. The adjustment factors are based primarily on the socioeconomic data.

Table 3.5. shows a part of the spreadsheet that calculates the trip adjustment factors. All calculations are listed by TAZ pair. Some demographic information is shown and is used for calculation of the ratios. Three ratios are calculated, and then they are combined by multiplication into a comprehensive factor. A zone with a density factor of 0.85, a diversity factor of 0.70, an accessibility factor of 0.95, and a distance factor of 0.95 will yield a comprehensive factor of 0.537. It is possible to get a comprehensive adjustment factor greater than 1.00, which will add trips. The spreadsheet is set up so that no adjustment greater than 1.00 will be reported.

Table 3.5. Trip Distribution Reduction Spreadsheet Sample

TAZ		Density	Density	Factor	EMP/POP	EMP/POP	Factor	% Pop w/in	% Pop w/in	Factor	Distance	Factor	Comp.
#			Ratio			Ratio		1/4 mile	1/4 mile				Factor
									Ratio				
78	1276	17.10	2.58	0.80	3.08	22.23	0.65	0%	0.00	1.00	1.15	1.10	0.55
79	1227	6.12	0.92	1.00	0.05	0.35	1.00	0%	0.00	1.00	0.83	1.10	1.00
959	1462	15.36	2.32	0.85	898.00	6474.60	1.00	100%	1.91	0.80	0.84	1.10	0.75
959	1463	55.03	8.31	0.75	1930.00	13915.34	1.00	95%	1.82	0.80	0.71	1.05	0.60
959	1470	47.21	7.13	0.75	1269.00	9149.52	1.00	66%	1.26	0.95	0.80	1.10	0.80
962	1462	21.05	3.18	0.75	2.03	14.62	0.60	100%	1.91	0.80	0.73	1.05	0.20
963	1462	21.79	3.29	0.75	0.95	6.84	0.60	100%	1.91	0.80	0.62	1.05	0.20
963	1464	59.84	9.04	0.75	2.12	15.30	0.60	47%	0.90	1.00	0.75	1.05	0.40
964	1462	20.83	3.15	0.75	1.32	9.54	0.60	100%	1.91	0.80	0.51	1.00	0.15
964	1463	60.51	9.14	0.75	2.84	20.49	0.65	95%	1.82	0.80	0.60	1.05	0.25
964	1464	58.88	8.89	0.75	2.96	21.31	0.65	47%	0.90	1.00	0.41	1.00	0.40
964	1466	34.53	5.21	0.75	1.34	9.68	0.60	97%	1.85	0.80	0.59	1.00	0.15
964	1467	56.22	8.49	0.75	2.40	17.30	0.60	100%	1.91	0.80	0.68	1.05	0.20
964	1469	24.12	3.64	0.75	0.70	5.08	0.60	58%	1.10	1.00	0.76	1.05	0.40
964	1470	52.68	7.96	0.75	1.87	13.47	0.60	66%	1.26	0.95	0.68	1.05	0.35
964	1471	35.03	5.29	0.75	2.06	14.88	0.60	12%	0.24	1.00	0.50	1.00	0.35
965	1462	15.36	2.32	0.85	898.00	6474.60	1.00	100%	1.91	0.80	0.64	1.05	0.70

This comprehensive factor is automatically appended into two TRANPLAN control files. One of these files is for home-based work trips, and the other is for all non-work trips. Table 3.6. shows a sample output file from the spreadsheet based on Table 3.5. The resulting outputs of the TRANPLAN control files are the modified trip tables to be used in the remaining mode choice steps.

Table 3.6. Trip Distribution Reduction Control File Sample

	A	B	C	D	E
1	$MATRIX UPDATE				
2	$FILES				
3	INPUT FILE =	UPDIN, USER ID = $HBWMCIN.TRP$			
4	OUTPUT FILE =	UPDOUT,USER ID = $HBWMCIN1.TRP$			
5	$HEADERS				
6	TRIP REDUCTION:	INTERZONAL TRIPS			
7	HOME BASED WORK	TRIPS			
8	$OPTIONS				
9	$PARAMETERS				
10	$DATA				
11	T1, 78,1276,*	0.55			
12	T1, 79,1227,*	1.00			
13	T1, 959,1462,*	0.75			
14	T1, 959,1463,*	0.60			
15	T1, 959,1470,*	0.80			
16	T1, 962,1462,*	0.20			
17	T1, 963,1462,*	0.20			
18	T1, 963,1464,*	0.40			

A matrix compression utility is run to calculate the total reduced trips. The output of this file summarizes the number of reduced trips, and can be traced by origin or destination. Table 3.5. shows part a sample output of this utility. Note that the total reduced trips must be halved since both productions and attractions are summed.

Data for existing walk or bicycle trips is available from the TBI surveys and has been used as the basis for these calculations. Regression equations have been developed based on the TBI survey data to determine the percent mode split of walk/bike trips based on the origin zone information. This percentage is used to determine the number of walk/bike trips from a zone and is used to verify the numbers calculated from the two methods used.

Table 3.7. Trip Distribution Reduction Output Sample

	ZONE/DIST	ORIG/PROD	DEST/ATTR	TOTAL	INTRATRIPS
FILE 1	1461	986	1024	2010	16
FILE 2		891	993	1884	16
DIFF		95	31	126	0
RATIO		.90	.97	.94	1.00
FILE 1	1462	3608	8775	12383	494
FILE 2		3315	7728	11043	494
DIFF		293	1047	1340	0
RATIO		.92	.88	.89	1.00
FILE 1	1463	6306	11185	17491	379
FILE 2		5246	10200	15446	379
DIFF		1060	985	2045	0
RATIO		.83	.91	.88	1.00
FILE 1	1464	4531	9460	13991	272
FILE 2		3689	8796	12485	272
DIFF		842	664	1506	0
RATIO		.81	.93	.89	1.00
FILE 1	1465	1646	3847	5493	33
FILE 2		1582	3731	5313	33
DIFF		64	116	180	0
RATIO		.96	.97	.97	1.00

The process was developed using the TAZs for the four focus areas from the Urban Design Analysis, and, as such, it is applied only to specific TAZs rather than being applied generally to the subregion. Incrementally within the framework of the 1990 model, the trip reductions from intrazonal and interzonal adjustments are relatively minor. This is a result of the relatively small land area contained in two of the focus areas (New Brighton, Shoreview) and the relatively small scale of the transit-supportive developments to be included in relation to the predominant land use in the larger focus areas (Blaine, Twin Lakes). The effects of the trip reduction estimation methodology is more apparent in the analysis of the I-35W Coalition Buildout Study,[18] where multiple transit-supportive developments are introduced into the area contained in the subarea model.

Section 3. Notes

1. Links are used in the model's highway network to represent roadway segments between intersections or terminals. In the transit network, links represent transit routes between stops. Attributes are assigned to links that are used to calculate the impedance of flow on the link. Typical attributes include number of lanes, capacity, travel time, speed, jurisdiction, assignment group (which modes can use the link), one- or two-way designation, distance, facility type, and intersection control, among others.

2. Nodes are used to represent intersections or terminals in the highway network and transit stops in the transit network.

3. TAZs represent the smallest unit of travel demand in the model. All demand in a zone is generally represented as originating from a point (known as a zone centroid). Zones are generally equal in size on the basis of population and share boundaries with census tracts or block groups.

4. See also *Smart Growth Twin Cities Regional Study*, Metropolitan Council, 2002.

5. A subarea model adds detail in a portion of the area included in a regional model and generally uses the regional model framework for trip generation, mode choice, and trip distribution.

6. A gravity model works on the principal that the number of trips between two zones is directly proportional to the number of trip attractions at the destination zone and inversely proportional to the travel time between zones.

7. The Fratar model is a type of growth factor model that proportions future trip generation to each zone as a function of the product of the current trips between the zones and the growth factor of the attracting zone.

8. The mode choice model uses a multinomial logit utility function to allocate trips to modes.

9. Access links in the transit network are used to represent walk or drive/park and ride access to transit stops. Each zone has one or more access links that connect the zone centroid to transit stops in and near the zone.

10. Centroid connectors are specialized links that connect the zone centroid to the highway network. The attributes of these connectors reflect access time internal to the zone.

11. Intrazonal trips are trips that are assumed to not leave the zone in which they are produced.

12. The regional model aggregates zones into districts that correspond to subregional areas with similar characteristics—both core city CBDs, core cities outside the CBD—and several suburban and exurban groupings of zones from the districts for which K Factors are developed.

13. A screenline is a cordon or cut line drawn across a series of streets (or transit lines). The volumes on all of the selected streets at the point where the cordon crosses the streets are added together. This approach to validation allows for the general tendencies of the model to assign trips to corridors to be assessed.

14. Each trip starts in an origin zone and ends in a destination zone, the two of which are a zone pair.

15. Primary references include the following publications:

Cervero, Robert and Kara Kockelman. "Travel Demand and the Three Ds: Density, Diversity, and Design" (Berkeley: Institute of Urban and Regional Development, University of California, Working Paper 674, 1996).

Dunphey, Robert and Kimberly Fisher. "Transportation, Congestions, and Density: New Insights." *(Transportation Research Record* 1552, 1996).

Ewing, Reid, Padma Haliyur, and G. William Page. "Getting Around a Traditional City, a Suburban Planned Unit Development, and Everything in Between" *(Transportation Research Record*, 1466, 1994).

Frank, Lawrence D. and Gary Pivo. "Impacts of Mixed Use and Density on Utilization of Three Modes of Travel: Single-Occupant Vehicle, Transit, and Walking" *(Transportation Research Record,* 1456, 1994).

Handy, Susan. "Methodologies for Exploring the Link Between Urban Form and Travel Behavior" (*Transportation Research D,* Vol. 1, No.2, 1996).

Krizek, Kevin J. "A Pre-test/Post-test Strategy for Researching Neighborhood-scale Urban Form and Travel Behavior" *(Transportation Research Board Record*, 2000).

McNally, Michael G. and Sherry Ryan. "Comparative Assessment of Travel Characteristics for Neotraditional Designs" (*Transportation Research Record* 1400, 1997).

Rutherford, G. Scott, Edward McCormack, and Martina Wilkinson. "Travel Impacts of Urban Form: Implications from an Analysis of Two Seattle Area Travel Diaries" (presented at the Urban Design, Telecommunication and Travel Forecasting Conference, August 1997). Internet: www.bts.gov/tmip/papers/tmip/udes/mccormack.html.

Steiner, Ruth. "Residential Density and Travel Patterns: Review of the Literature." (*Transportation Research Record* 1466, 1994).

16. *Travel Forecasting Approach for Smart Growth Twin Cities*, Fehr & Peers Associates, Inc. for Calthorpe Associates and the Metropolitan Council, 2002.

17. Institute of Transportation Engineers, Principal Editor: Kevin G. Hooper, P.E., 1998.

18. *North Metro I-35W Coalition Subregional Growth Study 2000-2020: Land Use and Transportation Analysis Summary Report* (Minneapolis: Design Center for American Urban Landscape, University of Minnesota, 2002).

Section 4. Subregional Land Use and Transportation Analysis of Transit-Supportive Design

Research conducted under the Transportation and Regional Growth (TRG) Study sought to develop a subarea transportation model that can detect the impacts of transit-supportive design. The I-35W Coalition's study[1] sought to compare the subregional transportation impacts of a conventional suburban development scenario and a transit-supportive development scenario. The Coalition used the subarea model created through the TRG research to conduct this analysis. Findings from both studies offer insights for the conclusions presented in this paper. This section describes development of a subregional growth scenario based on transit-supportive principles and findings from use of the subarea model to compare the impacts of a conventional growth scenario with the transit-supportive growth scenario.

4.1 Development of Subregional Transit-Supportive Growth Scenario

In preparation for developing the scenario, Coalition cities identified 7, 860 gross acres of land likely to develop or redevelop in the next 20 years (fig. 59). Cities also indicated when they thought site buildout would be achieved, using 2005, 2010 and 2020 as target completion intervals. This palette of sites was the starting point for developing the scenario.

There is no definitive urban design method for identifying and aggregating individual transit-supportive opportunity sites into a subregional system. The Coalition study developed a methodology that blended city planning goals with regional transit-supportive development guidelines and regional transportation policies and plans. This methodology began with a series of "framing questions" that evaluated and classified potential transit-supportive opportunity sites and then used a density table to calculate job and household projections.

Framing Question 1. What are the existing environmental conditions on and around the site? Two aspects of environmental concerns were addressed at this point: natural resources and brownfields. Preservation and restoration of natural resources is a major goal of the smart growth movement. The Minnesota Department of Natural Resources, in cooperation with the Metropolitan Council, Minnesota Department of Transportation and other agencies, is conducting a Natural Resources Inventory (NRI) of the region. One goal of the NRI is to create a detailed data base to inform policy, planning, and development decisions. The Coalition study used NRI data available at the time and other environmental data to remove land that has environmental constraints and to identify areas that border designated open space or greenway corridors. If developed, such border sites would demand design strategies that are environmentally sensitive.

Contamination is the second environmental filter and impacts the economic feasibility of developing the site. Brownfields are promising locations for transit-supportive development because they are generally large enough, have good connections to the transportation infrastructure, and are not immediately adjacent to residential neighborhoods. The challenge of these sites, however, is the type of contamination, the cost of and time frame for cleanup, and the public resources—staff time and money—needed to subsidize development.

Framing Question 2. Given current and future land uses as proposed in the city comprehensive plan, are these opportunity sites appropriate locations for a transit-supportive development and should the land use mix emphasize jobs or housing? Comprehensive plans are key documents for the city and the region. In addition to guiding future land use, these plans sometimes identify areas that the community is targeting for developed or redeveloped. Parcels falling under either category are acceptable locations for transit-supportive development because the changes they would bring are consistent with current city planning.

Framing Question 3. Given regional transit policies and priorities and existing infrastructure, what type and level of transit service might be viable in the prospective location? From a transit service perspective, not all opportunity sites are equal. If located on a proposed transitway or LRT line, development at higher densities is essential. If not, moderate densities are appropriate. Regional transit policies have established several types of service areas. Most of the Coalition lies within areas characterized as inner or outer suburban. Since the study planning horizon is 2020, opportunity sites were evaluated according to the criteria associated with the service area definition rather than where service area boundaries are drawn on current policy maps. For example, the Shoreview town center site now lies in an area designated as outer suburban. However, if the development projected is the scenario occurs, it is not unreasonable to plan as though it is in an inner suburban transit service area.

Framing Question 4. Is there sufficient land area for transit-supportive development? These developments have minimum land requirements for the core and the surrounding area. Requirements vary relative to location within the region, the transit mode, and the level of potential transit service. For example, a transit-supportive development in the central city or on a transitway must be at least 60 acres, while an outer suburban location requires a minimum of 125 acres.

Of particular importance is a prerequisite acres to form the mixed use core of a transit-supportive development. This critical criterion was used as the final screen for decided if the site had potential for transit-supportive development. If the area identified for development or redevelopment did not meet the minimum acreage required for that type of transit-supporive development, the site was removed from the opportunities list. However, if the redevelopment area did reach the minimum, then existing development was included as part of the 60 -acre minimum requirement.

Using this set of framing questions, a total of 20 transit-supportive development sites were identified. Of these, there were seven outer suburban sites, twelve inner suburban sites, and one transitway site. According to city comprehensive plans, ten of the sites should be oriented toward land uses that generate jobs, while the other ten should dominated by residential development. (The final run of the model included only 19 sites. City review of the opportunities list resulted in one city requesting removal of a site because, in their judgement, it was unlikely that such a development would occur in that location.)

Coalition cities identified approximately 7,900 acres of land that will redevelop or develop by 2020. The dark colored areas, 75% of the identified parcels, are likely to reach buildout by 2010. These are mostly “greenfield” sites near the outer edge of the metropolitan region. The lighter colored areas are likely to reach buildout by 2020. Nearly all of these sites fit into the redevelopment category and many will require land assembly before significant development can occur.

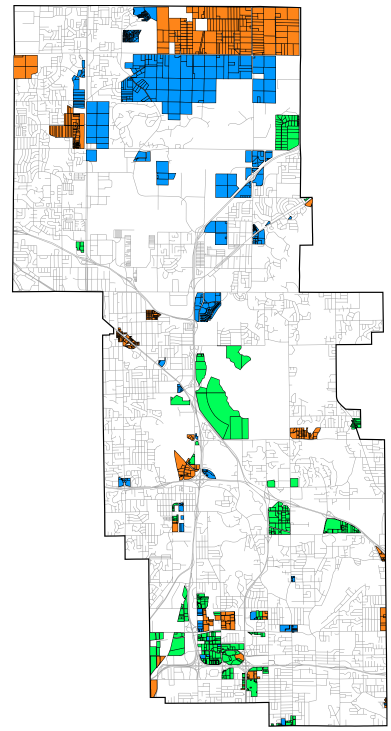


Figure 4.1. Parcels Likely to Develop or Redevelop by 2020.

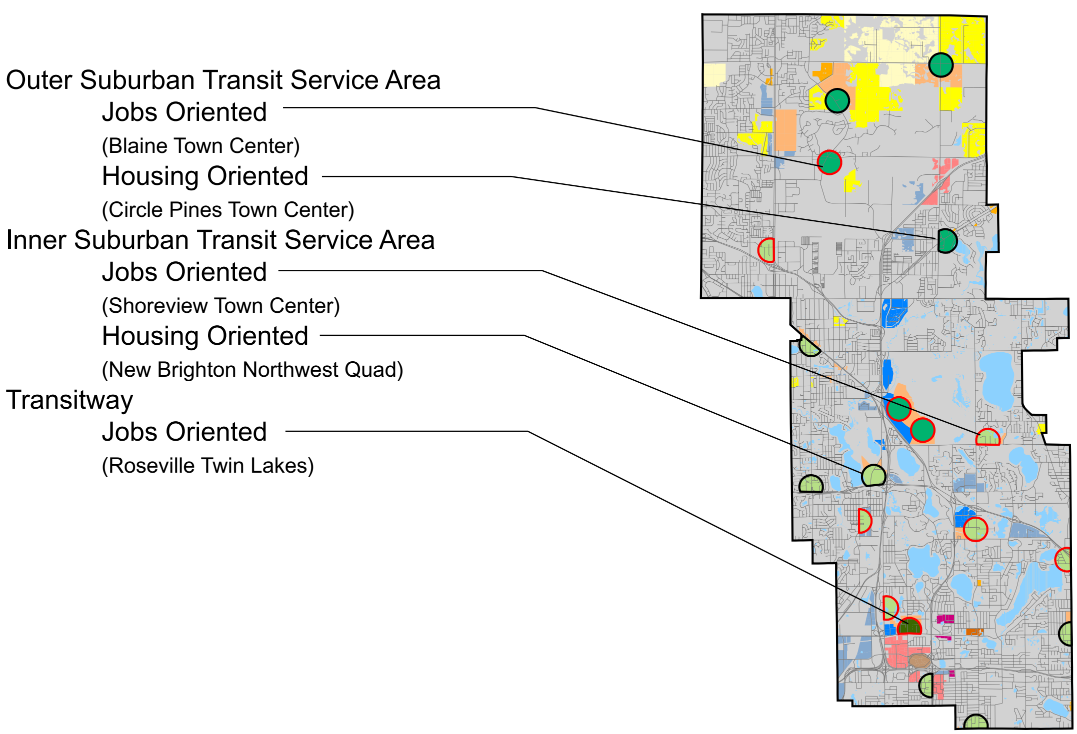


Figure 4.2. Transit-Supportive Development Types.

Once the transit-supportive development sites were identified, a development type consistent with the city comprehensive plan was assigned to remaining land projected for development or redevelopment. Once this process was completed, the final steps were to create job, household, and population projections for 2020 and to prepare subTAZ input tables for modeling purposes.

The Coalition's fine-grained database (the same one used to develop the subarea transportation model and to complete the urban design analysis) was use to calculate growth projections. Extra effort was made to remove unbuildable land, land required for public uses, land needed for stormwater management, etc. The intent was to use the data and computer software available to generate growth numbers that achieved a level of refinement on par with the subarea transportation model. Key steps in deriving growth projections are described below.

Determination of Net Acres
Electronic data bases compatible with Geographic Information System (GIS) software were the main information sources for determining buildability. They were used to remove protected wetlands and slopes of 20 percent or more from the gross acreage of each parcel. Also, parcels with soil conditions similar to recent development projects that required at least 30 percent of the site for preparation building pads were identified and 30% of the acreage was removed as unbuildable. This exercise generated a total net buildable acreage for each site. From this figure, acreage was removed for ROW, parking, civic use, and stormwater management (fig. 61). This yielded the net acres for the site. The development type determined how much of the remaining acreage was allocated for job-generating land use versus household-generating land uses.

Development of Job and Household Density Factors for Development Types
There are no universally-used tables for calculating job and household densities. Research for scenario development found that many studies suggest a range of density minimums to support transit and that transportation planning tables are keyed to auto-dependent development conditions. The Coalition study generated draft tables based on numbers used in the Metropolitan Council's transit-supportive guidelines. Draft tables were checked against conventional transportation forecasting tables, estimated densities at existing workplaces in the Twin Cities region, and densities used in current development proposals with a 20-year buildout period. The revised draft tables were reviewed by Coalition members and regional planning staff and final revisions were made as seemed appropriate.

City reviewers noted that in their experience, job and household densities for redevelopment sites should be higher than those for greenfield sites. The rationale is that the higher cost of redevelopment requires more intense land use. To account for this important variable, a redevelopment factor was determined and applied to all commercial/industrial redevelopment parcels. These densities and the redevelopment factor were inserted into a common formula used to calculate future growth for each (re)development area.

Table 4.1. Tables Used to Calculate Growth Projections for the Conventional Scenario (1.5) and Transit-Supportive Scenario 2.5a/b/c. Source: *Land Use and Transportation Analysis*. North Metro I-35W Corridor Coalition, 2002.

(Scenario 1.5a)

Table 1: Conventional Development -- Net Density Guidelines

Development Type	Gross Acre to Net Acre Conversion Formula						Density Multiplier	
	ROW	Parks	Civic	Water Manage	Total		HHs/ net acre	Jobs/net acre
Regional Activity Center – 50	24%	4%	5%	10%	**43%**	**57%**	50	101
Subregional Mixed Use Center	24%	2%	3%	10%	**39%**	**61%**	25	29
Regional Event Center	10%	1%	0%	10%	**21%**	**79%**	0	NA
Subregional Commercial Center	1%	0%	0%	10%	**11%**	**89%**	0	13
Town Center – 12	24%	4%	5%	10%	**43%**	**57%**	12	47
Town Center - 10	24%	4%	5%	10%	**43%**	**57%**	10	39
Neighborhood Corner – 7	21%	3%	5%	10%	**39%**	**61%**	7	39
Residential Subdivision Large Lot	6%	1%	0%	10%	**17%**	**83%**	1	0
Residential Subdivision Small Lot	6%	2%	0%	10%	**18%**	**82%**	4	0
Residential Subdivision Mixed Housing	6%	6%	0%	10%	**22%**	**78%**	12	0
Commercial/Industrial Focused Use	1%	0%	0%	10%	**11%**	**89%**	0	20
Commercial/Industrial Park Mixed Use	1%	0%	0%	10%	**11%**	**89%**	7	23

* parks based on national standards for parks

(Scenario 2.5a)

Table 2: Livable Community Development -- Net Density Guidelines

Development Type	Gross Acre to Net Acre Conversion Formula						Density Multiplier	
	ROW	Parks	Civic	Water Manage	Total		HHs/ net acre	Jobs/net acre
Regional Activity Center – 50	24%	4%	5%	10%	**43%**	**57%**	50	101
Subregional Mixed Use Center	24%	4%	5%	10%	**43%**	**57%**	25	29
Regional Event Center	15%	3%	4%	10%	**32%**	**68%**	0	NA
Subregional Commercial Center	5%	3%	4%	10%	**22%**	**78%**	0	13
Town Center – 12	24%	4%	5%	10%	**43%**	**57%**	12	47
Town Center - 10	24%	4%	5%	10%	**43%**	**57%**	10	39
Neighborhood Corner – 7	21%	3%	5%	10%	**39%**	**61%**	7	39
Residential Subdivision Large Lot	10%	1%	1%	10%	**22%**	**78%**	1	0
Residential Subdivision Small Lot	10%	4%	2%	10%	**26%**	**74%**	4	0
Residential Subdivision Mixed Housing	10%	6%	4%	10%	**30%**	**70%**	12	0
Commercial/Industrial Focused Use	5%	3%	4%	10%	**22%**	**78%**	0	20
Commercial/Industrial Park Mixed Use	5%	3%	4%	10%	**22%**	**78%**	7	23

Calculation of Job, Household, and Population Yields

The density tables were then used to calculate job and household yields for each site. Both growth scenarios assumed a no net increase in areas not identified for change. This assumption reflects the relatively small number of parcels in these areas that have potential for redevelopment. If developed, these parcels would not have a significant impact on subregional numbers. Population calculations were tailored to the location of the development and the prevailing trends in household size in those locations. For example, household sizes in inner suburban communities tend to be smaller that households in outer suburban areas.

Preparation of SubTAZ Input Tables

The final step in this portion of the Coalition study was assignment of projected growth to subdivided traffic assignment zones (subTAZs). This was accomplished by looking at each subTAZ individually, estimating what portion of the development type fell within the subTAZ, and extrapolating the number of jobs, households, and people. Data were then entered into the model.

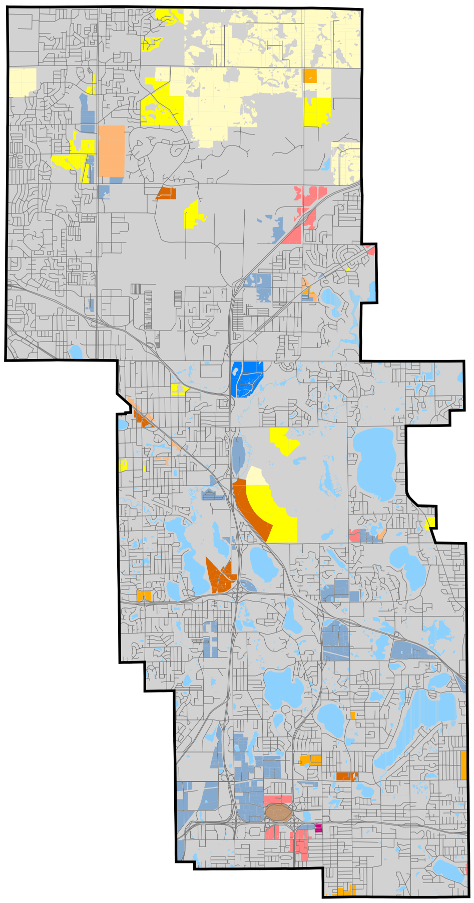


Figure 4.3. Conventional Growth Scenario for Coalition Subregion.
Growth projections for 2020 have a net increase in 12,208 households and 41,305 jobs. Roughly 7,900 acreas of land are developed or redevelopment and only 350 acres are designated for mixed-use development. Source: *Land Use and Transportation Analysis*. North Metro I-35W Corridor Coalition, 2002.

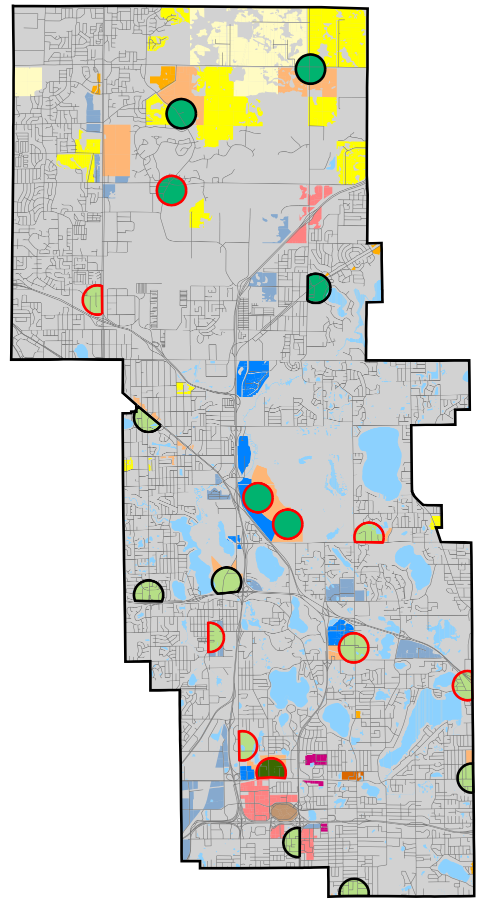


Figure 4.4. Transit-Supportive Growth Scenario for Coalition Subregion.
Growth projections for 2020 have a net increase of 27,717 households and 59,330 jobs. Approximately 7,900 acres of land are developmed or redeveloped, and over 1,000 acres are in some form of mixed-use development. Source*: Land Use and Transportation Analysis.* North Metro I-35W Corridor Coalition, 2002.

4.2 Comparative Analysis Using Subarea Transportation Model

There were two sets of subarea model runs for the Coalition's subregional growth study. The first set held transportation assumptions constant to compare the impacts of the conventional development scenario with the transit-supportive growth scenario. (Identified in the Coalition study as Scenario 1.5 and Scenario 2.5a.) The second set of runs held a revised transit-supportive scenario constant and varied the transportation assumptions. (Identified in the Coalition study as Scenario 2.5b and 2.5c.)

Transportation Assumptions for the first set of runs:

Conventional Scenario 1.5 and Transit-supportive Scenario 2.5a

- *Transit Network*—Assumes the Regional Transportation Plan: North Star Commuter Rail, Northeast Diagonal, new transit service in the subregion to reflect development areas.

- *Regional Roadway Network*—Assumes the Regional Transportation Plan: I-694 will have one additional lane from I-35E to I-35W and no weave at I-35E; I-35E improvements between I-94 to I-694; I-35W will have one additional lane from Washington Ave. to TH 36; TH 36 will have an additional lane from I-35W to Stillwater.

- *County/Local Roadway Network*—New roads that have been built, but are not part of the regional model will be added; new internal roadways will be added to development areas in Blaine and at the TCAAP site.

Transportation assumptions for the second set of runs (additions to above assumptions):

Transit-supportive Scenario 2.5b.

- *New County/Local Network*—changes to the network were developed with input from the study's transportation work group. Among the changes are new bridges over I-35W to improve county/local network connectivity and changes in functional class designations for a few roadway segments.

Transit-supportive Scenario 2.5c.

- *Transit Network*—an additional $7 million in express and local services were added in areas where development intensity increases; new routes were added,

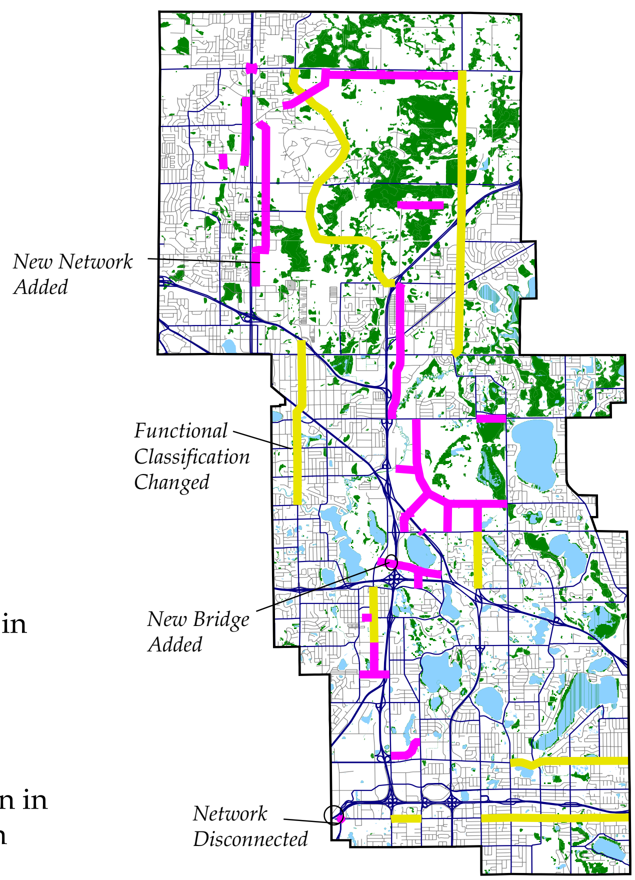


Figure 4.5. Model Changes to Roadway Network.
Source*: Land Use and Transportation Analysis.* North Metro I-35W Corridor Coalition, 2002.

Coalition Study Findings

Findings from the two sets of subarea model runs indicate that, although both growth scenarios place additional stress on transportation systems as planned for 2020, the transit-supportive development scenario shows changes in tripmaking that offer subregional and regional advantages. An efficiency in tripmaking is shown by the decrease in trips per capita for all trip types. Specifically, more trips stay within the subregion, trips within the subregion are shorter, and there is increased use of transit. The sensitivity of the subarea model also report out walking trips, which the regional model does not detect. The overall conclusion drawn from the findings was that transit-supportive development generated desired benefits and that the Coalition should encourage cities to adopt this growth strategy and work to secure the transportation/transit infrastructure and service levels that would support these development patterns. Summary findings that further support this conclusion are included below. (These findings are excerpted from Subregional Growth Study 2000-2020: Land Use and Transportation Analysis, June 2002.)

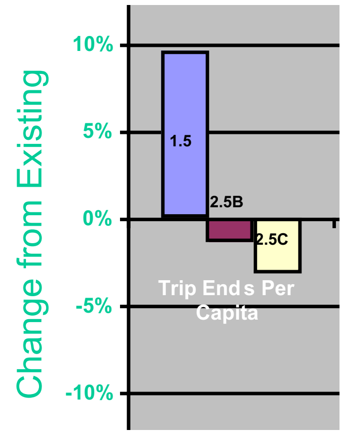


Figure 4.6. Trip Ends Per Capita by Scenario.
Source*: Land Use and Transportation Analysis.*
North Metro I-35W Corridor Coalition, 2002.

Trip Generation Findings

- In the Coalition growth scenario, trips made within the subregion grow at roughly twice the rate of total trip growth. This finding indicates that mixed-use centers have a positive impact on trip capture and may form the basis for new and enhanced transit service strategies within the Coalition.
- While the Coalition growth scenario generates more trips because of higher household densities, new trip production is occurring at a slower overall rate of growth than under the conventional scenario.

Mode Choice Finding

- There is a 23 percent to 33 percent increase in transit trips over the conventional scenario in both 2.5b and 2.5c. This increase is likely due to a 10 percent increase in the number of dwelling units within a short walk (1/3 mile) to transit and the enhanced transit service of Coalition Growth Scenario 2.5c. Mixed-use centers contribute to the increase in dwelling units near roadway networks.

Vehicle Miles Traveled and Average Trip Length Findings

- The Coalition growth scenario shows increased use of arterials and collectors over the conventional scenario. This increased use is consistent with the increase in trips internal to the subregion and with increased connectivity provided by links added to the minor arterial network.
- Using standard travel demand calculations, the Coalition growth scenario generates a 25 percent increase in automobile ownership over the conventional scenario, yet only an 11.5 percent increase in VMT per capita. The average trip length within the subregion is 3.5 miles, while in/out average commute length is 11 miles.
- It is likely that the reduced rate of growth is attributable to "trip capture" within the subregion. This is accomplished by increasing mixed-use developments, which offer subregional residents close proximity to work, shopping, and leisure activities.

Table 4.2. Study Area Trip Ends by O/D
Source: *Land Use and Transportation Analysis.* North Metro I-35W Corridor Coalition, 2002.

Trip Type	Existing	Scenario 1.5	Scenario 2.5B	Scenario 2.5C
Internal to Internal	465,086	661,456	793,952	797,078
Internal to External	321,003	372,411	411,422	410,503
External to Internal	302,223	437,185	432,433	431,966
Total Subarea	*1,088,312*	*1,471,052*	*1,637,807*	*1,639,547*

Table 4.3. Subarea Trips by Mode
Source: *Land Use and Transportation Analysis.* North Metro I-35W Corridor Coalition, 2002.

Mode	Existing	Scenario 1.5	Scenario 2.5b	Scenario 2.5c
Auto	844,416	1,120,380	1,192,564	1,190,760
Transit	11,353	19,944	24,532	26,613
Walk	-	-	23,735	23,635
Total	*855,769*	*1,140,324*	*1,240,831*	*1,241,008*

Table 4.4. VMT in Subarea Generated by Subarea
Source: *Land Use and Transportation Analysis.* North Metro I-35W Corridor Coalition, 2002.

Facility Type	Existing	Scenario 1.5	Scenario 2.5b	Scenario 2.5c
Freeways	55.2%	48.7%	51.7%	50.9%
Arterials	80.1%	75.8%	77.3%	76.7%
Collectors	83.9%	96.2%	93.6%	93.8%

Table 4.5. Vehicle Trip End Statistics
Source: *Land Use and Transportation Analysis.* North Metro I-35W Corridor Coalition, 2002.

Trip Type	Existing	Scenario 1.5	Scenario 2.5b	Scenario 2.5c
Trip Ends Per Capita	5.81	6.37	5.73	5.63
HB Trip Ends Per Capita	1.90	1.81	1.79	1.77
NHB Trip Ends Per Capita	3.91	4.56	3.94	3.87
NHB Trip Ends Per Employee	6.75	5.84	5.55	5.45

Section 4. Notes

1. *North Metro I-35W Coalition Subregional Growth Study 2000-2020: Land Use and Transportation Analysis Summary Report* (Minneapolis: Design Center for American Urban Landscape, University of Minnesota, 2002)

Section 5. Conclusions

The subarea model was used to run two comparative analyses of growth scenarios for the I-35W Corridor Coalition. One analysis compared a conventional suburban growth scenario with a transit-supportive growth scenario. The other analysis compared two transportation systems options for the same transit-supportive growth scenario. (The growth scenario was nearly identical to the transit-supportive scenario used in the first analysis; the difference being one transit-supportive development site was removed.) Findings from these analyses have been synthesized into the following conclusions about the dynamics between transit-supportive urban design and transportation planning in suburban settings.

5.1 Regional Transportation Model Enhancements

- It was possible to develop a subarea transportation model that was sufficiently sensitive to transit-supportive design characteristics to show changes in tripmaking patterns. While these changes were most clearly demonstrated at the subregional scale, the estimation techniques were also demonstrated to be effective for tracking travel changes at the neighborhood scale. Two types of tripmaking patterns were evident—short-distance trips between neighborhoods and trips within neighborhoods. Previously, within the regional model, these types of trips were not modeled in detail, but were estimated by factors and not assigned to the highway network. The detailed network and zone structure of the subarea model provided the means for directly assigning short distance trips between neighborhoods and the estimation techniques provided the means for differentiating which of those trips were likely short enough that they would be made primarily by non-auto modes (walk, bicycle, etc.).

- The subarea model used estimations based on national data for calculating travel demand effects. A significant next step for the regional model would be validation to this region. Data required for the validation effort would include case studies of transit-supportive developments to determine actual mode use and the frequency and length of trips made by residents and users of the centers. Data would have to be collected in sufficient detail and volume to be statistically significant. The information collected would be used to calibrate the values used in the estimation techniques to determine primary walk trips.

- The current system of transit planning for the region has resulted in a functional hierarchy of transit service types that are based on cost-effectively serving the conventional patterns of development in the region. To a large extent, transit service in the outer suburban area is designed to serve the commute market to the core cities' employment concentrations. The pattern of transit-supportive developments proposed for the subregion is shown to substantially change the underlying patterns of tripmaking to make the hierarchical transit service pattern ineffective in serving a substantial portion of the (modified) demand in the subregion. This condition, in turn, suggests that an increased level of transit service planning needs to occur concurrent with the land use planning process to ascertain what types of transit service can most effectively serve the proposed pattern of mixed-use centers.

- With proper data inputs, it was found that the regional model has a high level of sophistication in tracking mode choice. The utility functions that govern the mode choice calculation are highly sensitive to travel time and to cost. The model effectively searches out shortest travel time paths by auto and by transit and also factors in costs to the user. For a particular trip, the model recognizes that it may be faster to drive, but that the cost for parking at the destination sufficiently offsets the driving time savings to make a transit trip more attractive. For trips within the suburban and outer suburban areas of the region, the offsetting effect of parking costs is effectively eliminated since parking is largely free. As these conditions of mode choice and transit assignment were explored through the modeling process, it became increasingly evident that the current transit service patterns were not attracting transit use for trips that largely stayed within the subregion. This resulted in a pattern of higher auto use for captured trips and is a reason why the aggregate transit mode choice results are not as high as desired.

- Essential to the success of the subarea model were detailed data inputs. The robust nature of the Coalition databases supported detailed land use analyses that were input into the model. These data were available for the entire subregion, which provided for consistent modeling across the subregion. Without the added detail available in the socioeconomic data for the subregion, the model effort would have proportionately distributed the inputs for the larger parent zones to the subdivided zones. With the detailed data available, the subdivided zones were able to more accurately reflect the land use and development patterns particularly in transit-supportive development areas.

5.2 Transit-Supportive Urban Design

- The transit-supportive growth scenario developed for the Coalition subregion demonstrated that there are some viable locations for such developments in suburban communities. These locations are consistent with local comprehensive plans and regional transportation goals and policies. Many of these sites lie in areas not currently identified for increased transit service in policy documents. Cities and the Metropolitan Council will need to work cooperatively and aggressively to plan and implement successful transit-supportive developments.

- The transit-supportive development areas were key to the positive findings of the subregional analysis. They provided the density and the activity needed to capture trips within the subregion and to convert trips from auto to walking. The detailed subTAZ structure was necessary to tracking this shift in the modeling process. Collectively at the subregional level, the pattern of transit-supportive developments was shown to increase the regional attractiveness of the subregion to employment trips from outside the subregion. While this resulted in a net increase in total tripmaking, it also demonstrated the role that development in the subregion could have in satisfying regional demand. The transit-supportive developments were shown to positively affect the jobs/housing balance in the subregion, such that trips were attracted from within the subregion to transit-supportive development. This latter effect caused the increase in trip capture within the subregion.

In summary, results from testing the subarea model with inputs from the micro and macro development sites and from use of the model for subregional analyses suggested the following for transit-supportive land use and transportation planning in suburban areas:

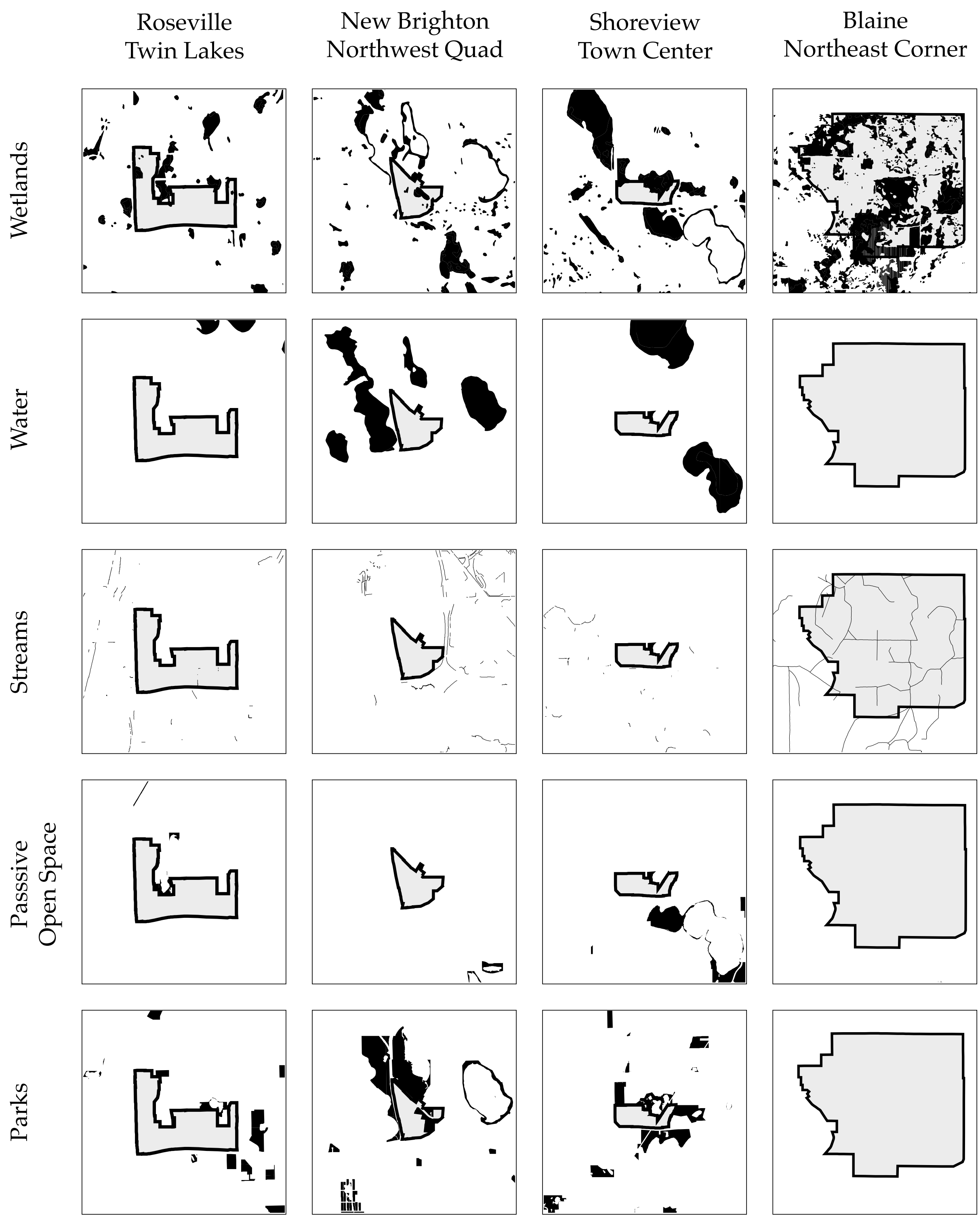
- Transit-supportive development shows its greatest potential when it is planned and implemented in the aggregate. Therefore, to fully understand the benefits of transit-supportive development will require a regional planning and data collection effort which will bring the regional model to a uniform level of specificity for the entire area.

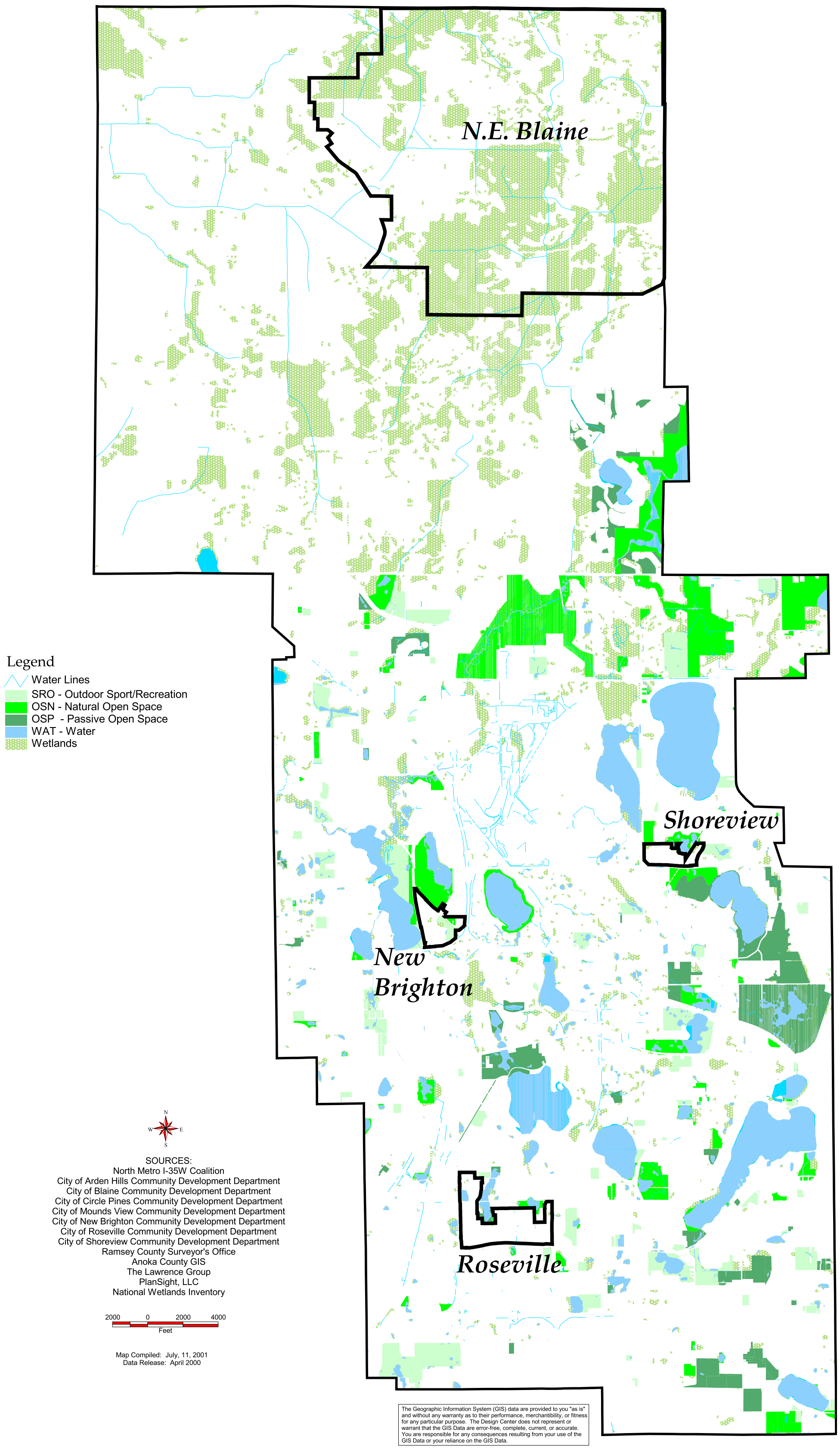
- Interjurisdictional planning will be needed. The regional model assumes that land use and transportation are working in concert. When adjustments to inputs were made on both sides of the equation, positive results were achieved. Counties, Metropolitan Council, and Minnesota Department of Transportation can play critical roles in facilitating this planning by being flexible with road design standards, but cities must respond with equal commitment to corresponding land use and design standards.
- To realize the benefits of transit-supportive development ,it is in the interests of suburban communities to plan cooperatively for transit-supportive development. Subregional modeling indicated that transit-supportive development works best in concert with similar sites and for one community to make significant strides with a development site depends upon other communities doing the same.

Appendix A.

Subregional Urban Design Analysis

Environment: Analytical Framework




N.E. Blaine
Shoreview
New Brighton
Roseville
Legend
Water Lines
SRO - Outdoor Sport/Recreation
OSN - Natural Open Space
OSP - Passive Open Space
WAT - Water
Wetlands
N
W
E
S
SOURCES:
North Metro I-35W Coalition
City of Arden Hills Community Development Department
City of Blaine Community Development Department
City of Circle Pines Community Development Department
City of Mounds View Community Development Department
City of New Brighton Community Development Department
City of Roseville Community Development Department
City of Shoreview Community Development Department
Ramsey County Surveyor's Office
Anoka County GIS
The Lawrence Group
PlanSight, LLC
National Wetlands Inventory
2000 0 2000 4000
Feet
Map Compiled: July, 11, 2001
Data Release: April 2000
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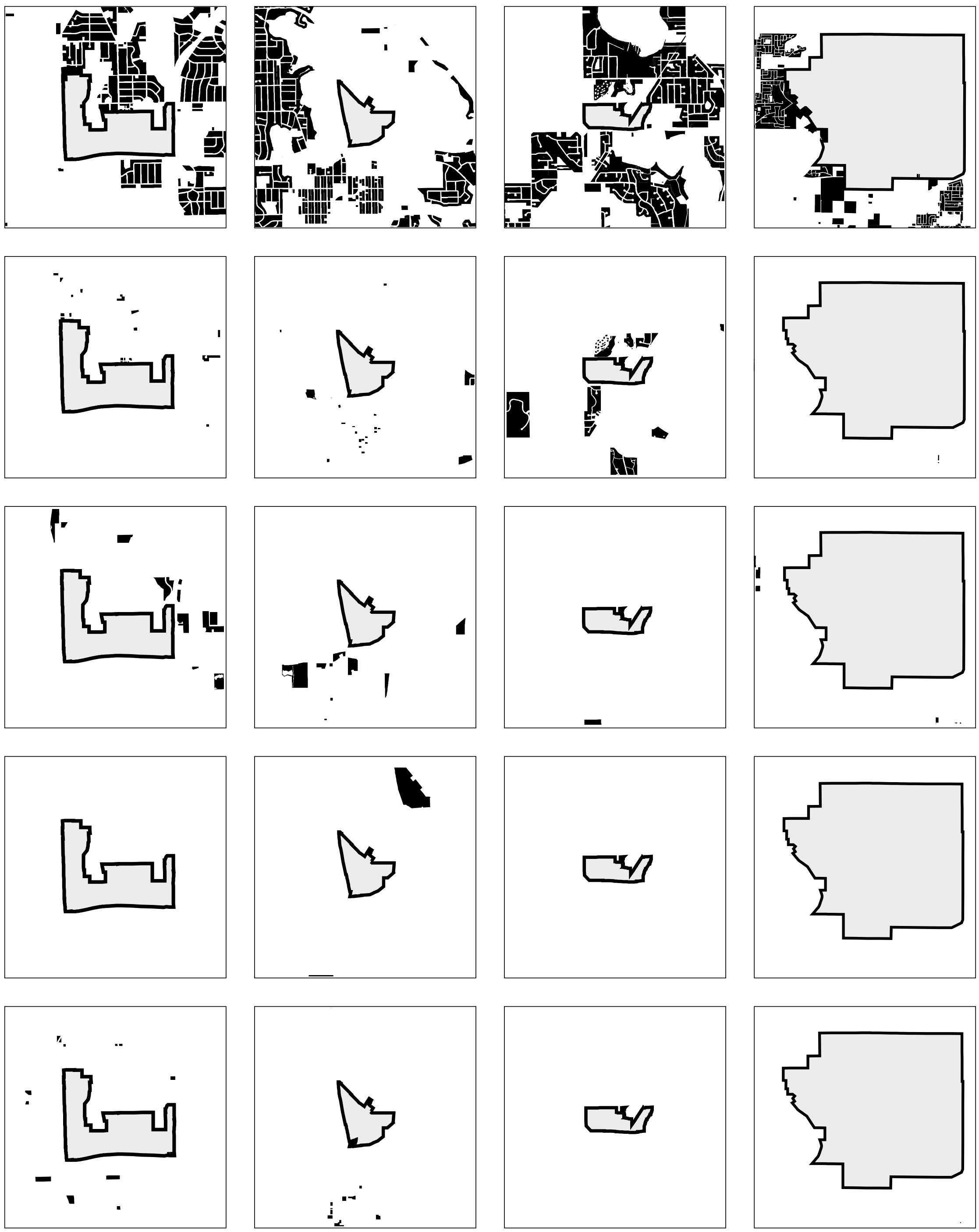
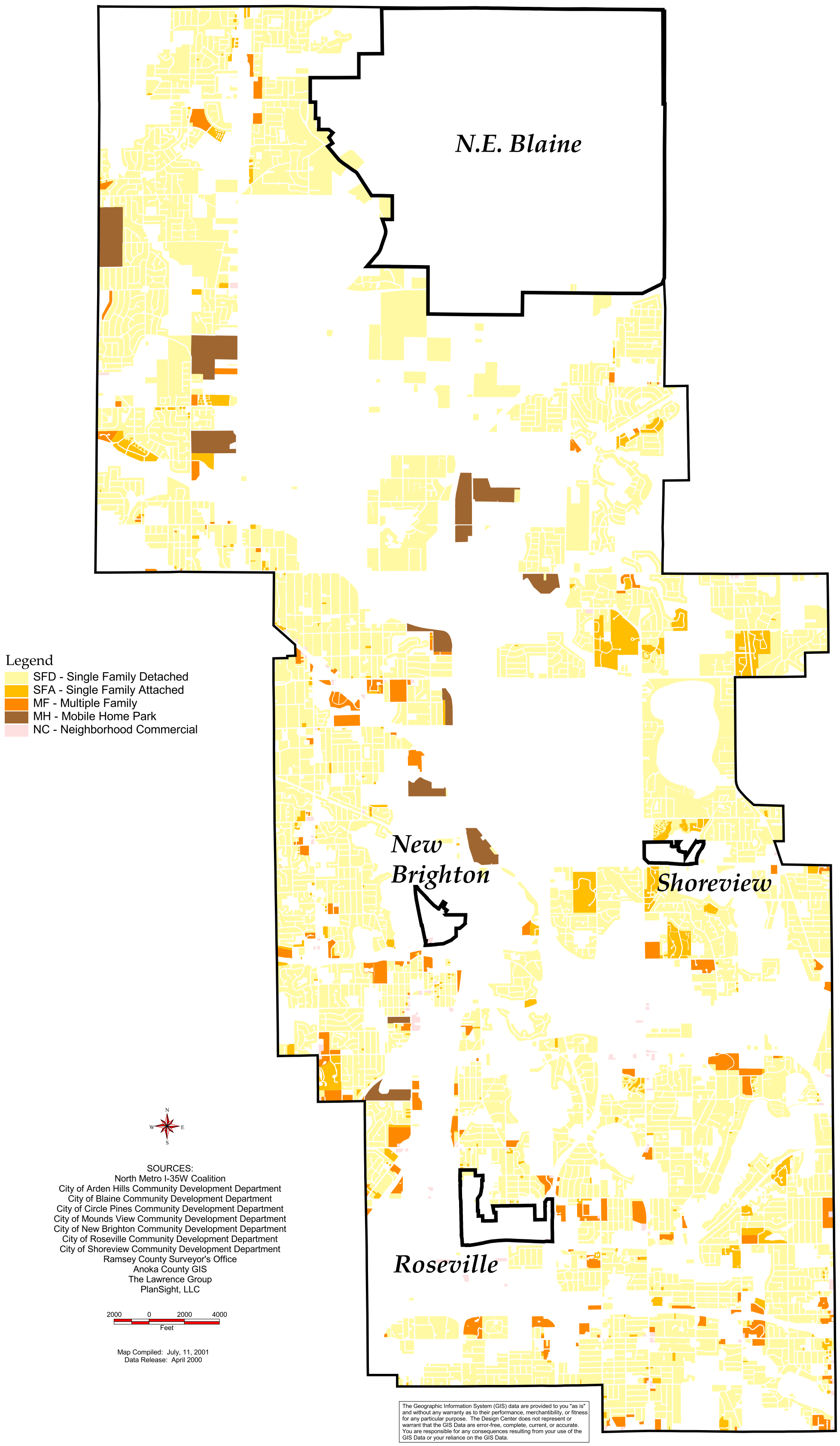
Neighborhood: Analytical Framework




N.E. Blaine
New Brighton
Shoreview
Roseville
Legend
SFD - Single Family Detached
SFA - Single Family Attached
MF - Multiple Family
MH - Mobile Home Park
NC - Neighborhood Commercial
N
W
E
S
SOURCES:
North Metro I-35W Coalition
City of Arden Hills Community Development Department
City of Blaine Community Development Department
City of Circle Pines Community Development Department
City of Mounds View Community Development Department
City of New Brighton Community Development Department
City of Roseville Community Development Department
City of Shoreview Community Development Department
Ramsey County Surveyor's Office
Anoka County GIS
The Lawrence Group
PlanSight, LLC
2000 0 2000 4000
Feet
Map Compiled: July, 11, 2001
Data Release: April 2000
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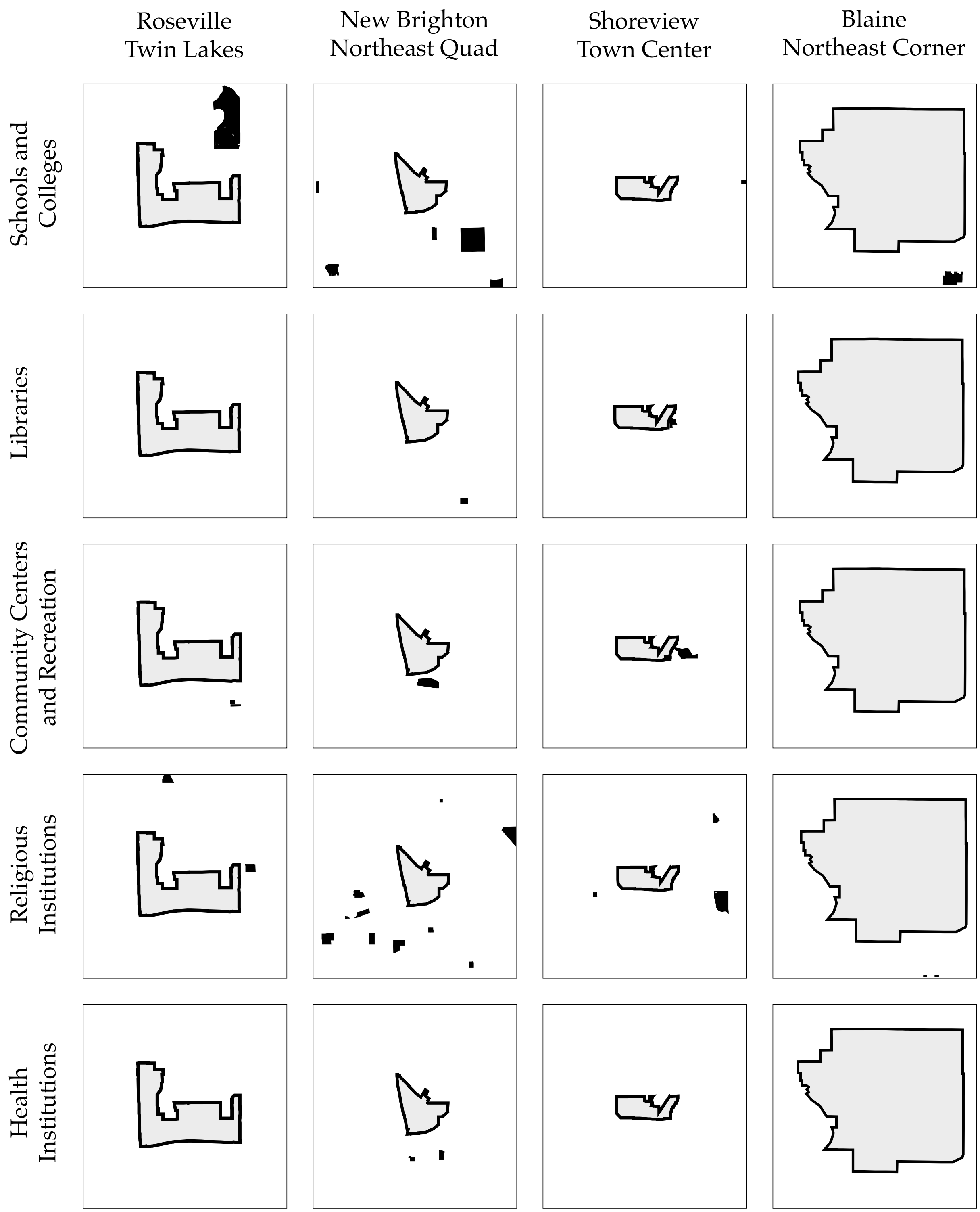
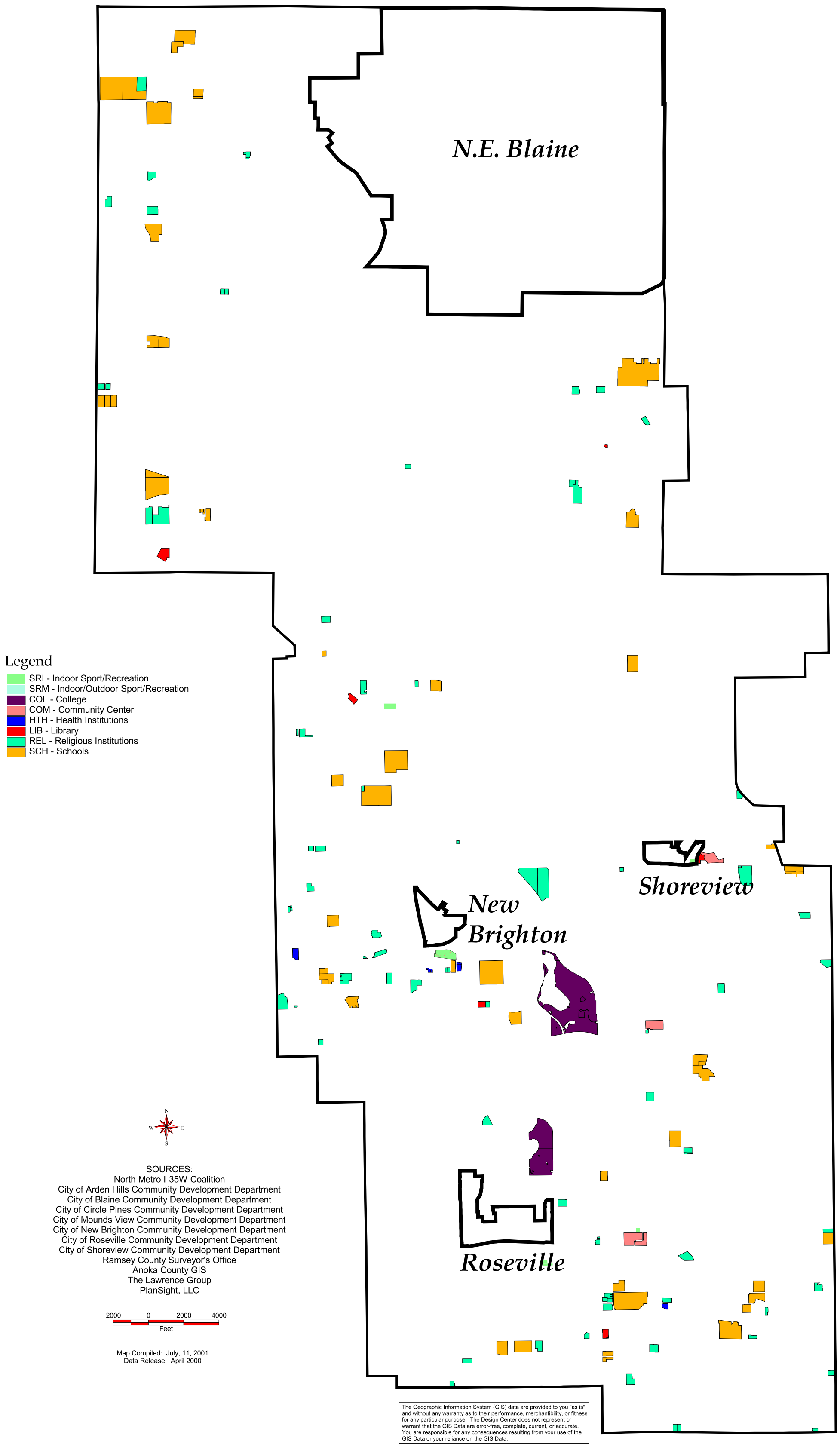
Social and Cultural Institutions: Analytical Framework





N.E. Blaine
New Brighton
Shoreview
Roseville
Legend
SRI - Indoor Sport/Recreation
SRM - Indoor/Outdoor Sport/Recreation
COL - College
COM - Community Center
HTH - Health Institutions
LIB - Library
REL - Religious Institutions
SCH - Schools
N
W
E
S
SOURCES:
North Metro I-35W Coalition
City of Arden Hills Community Development Department
City of Blaine Community Development Department
City of Circle Pines Community Development Department
City of Mounds View Community Development Department
City of New Brighton Community Development Department
City of Roseville Community Development Department
City of Shoreview Community Development Department
Ramsey County Surveyor's Office
Anoka County GIS
The Lawrence Group
PlanSight, LLC
2000 0 2000 4000
Feet
Map Compiled: July, 11, 2001
Data Release: April 2000
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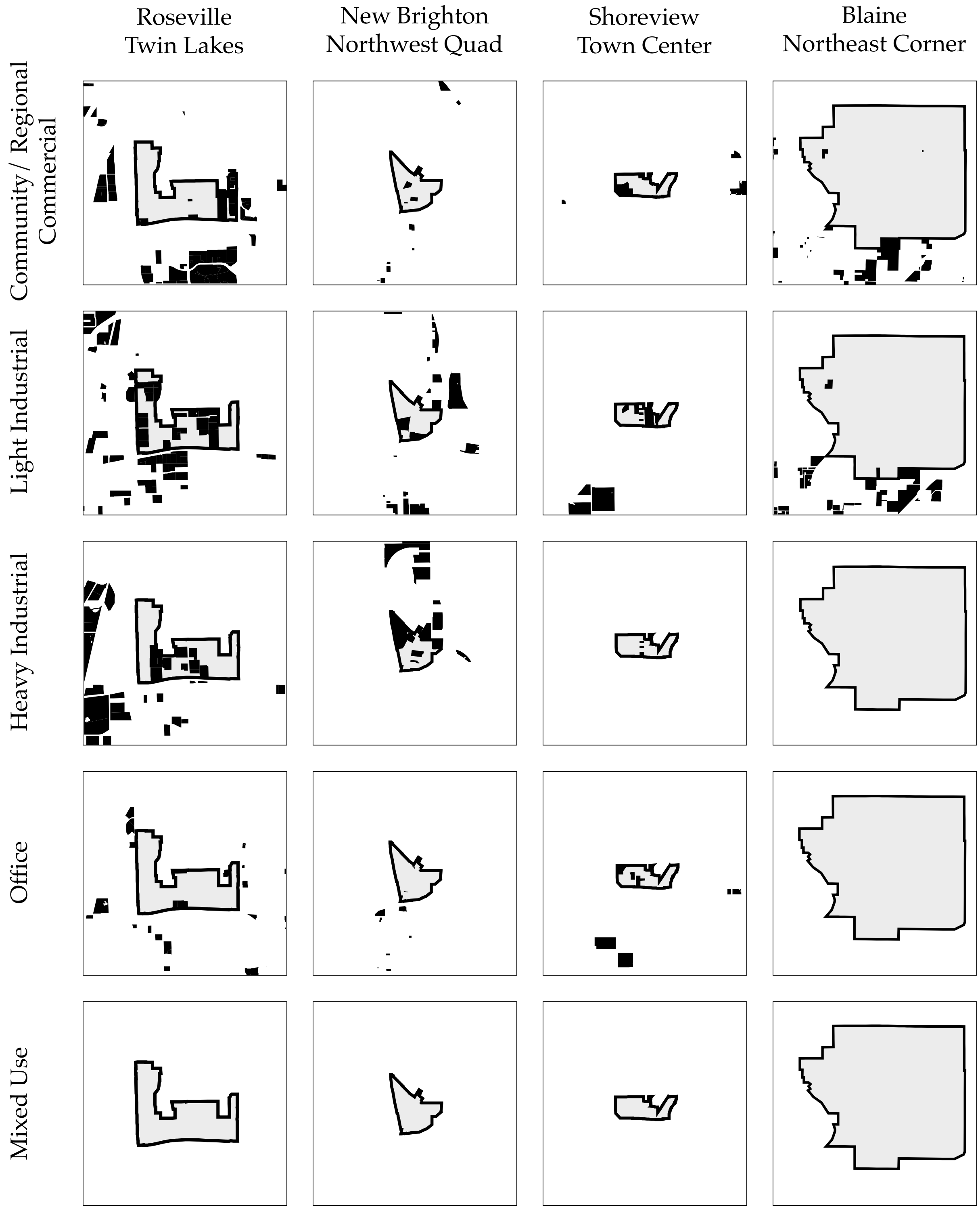
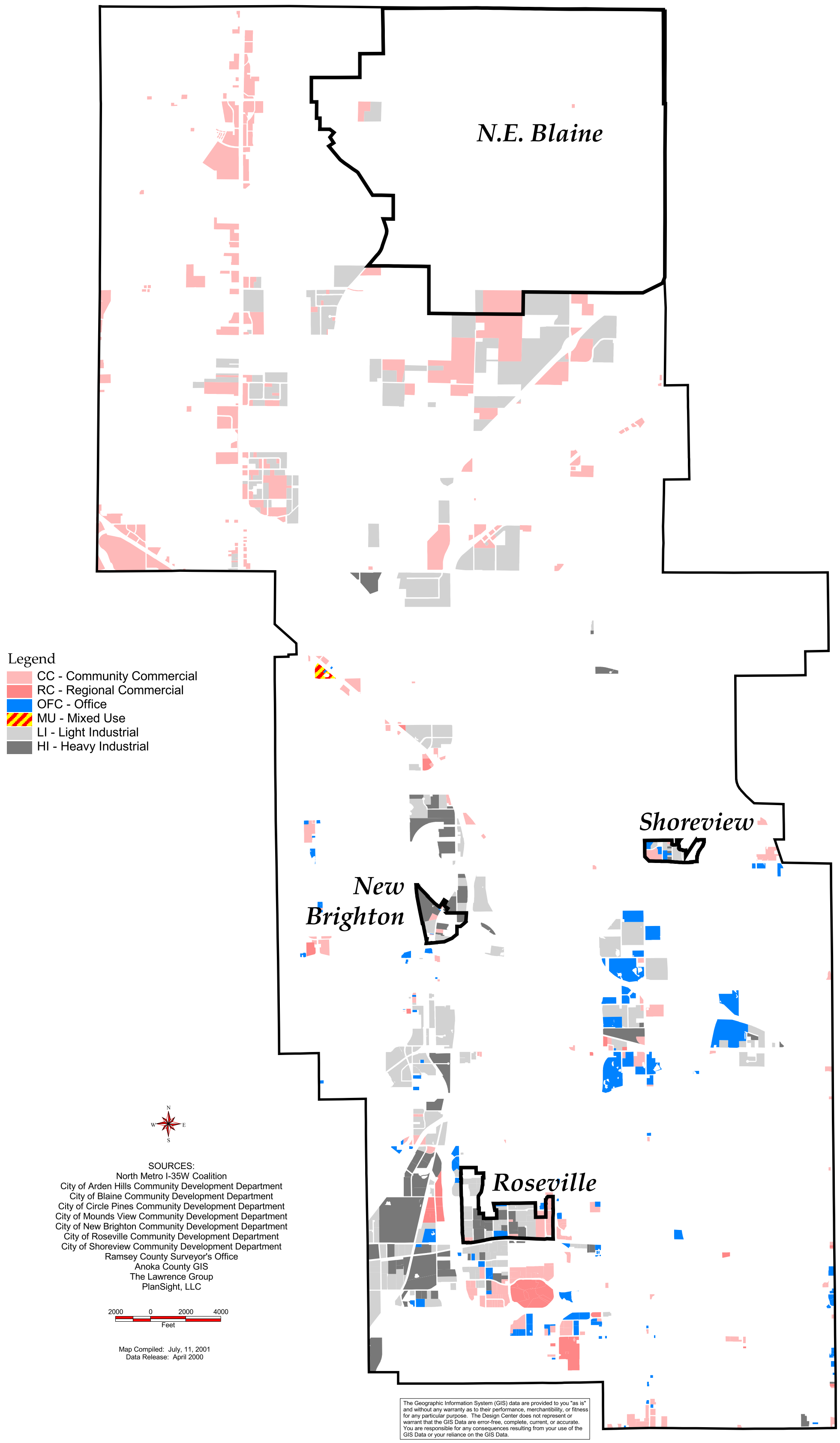
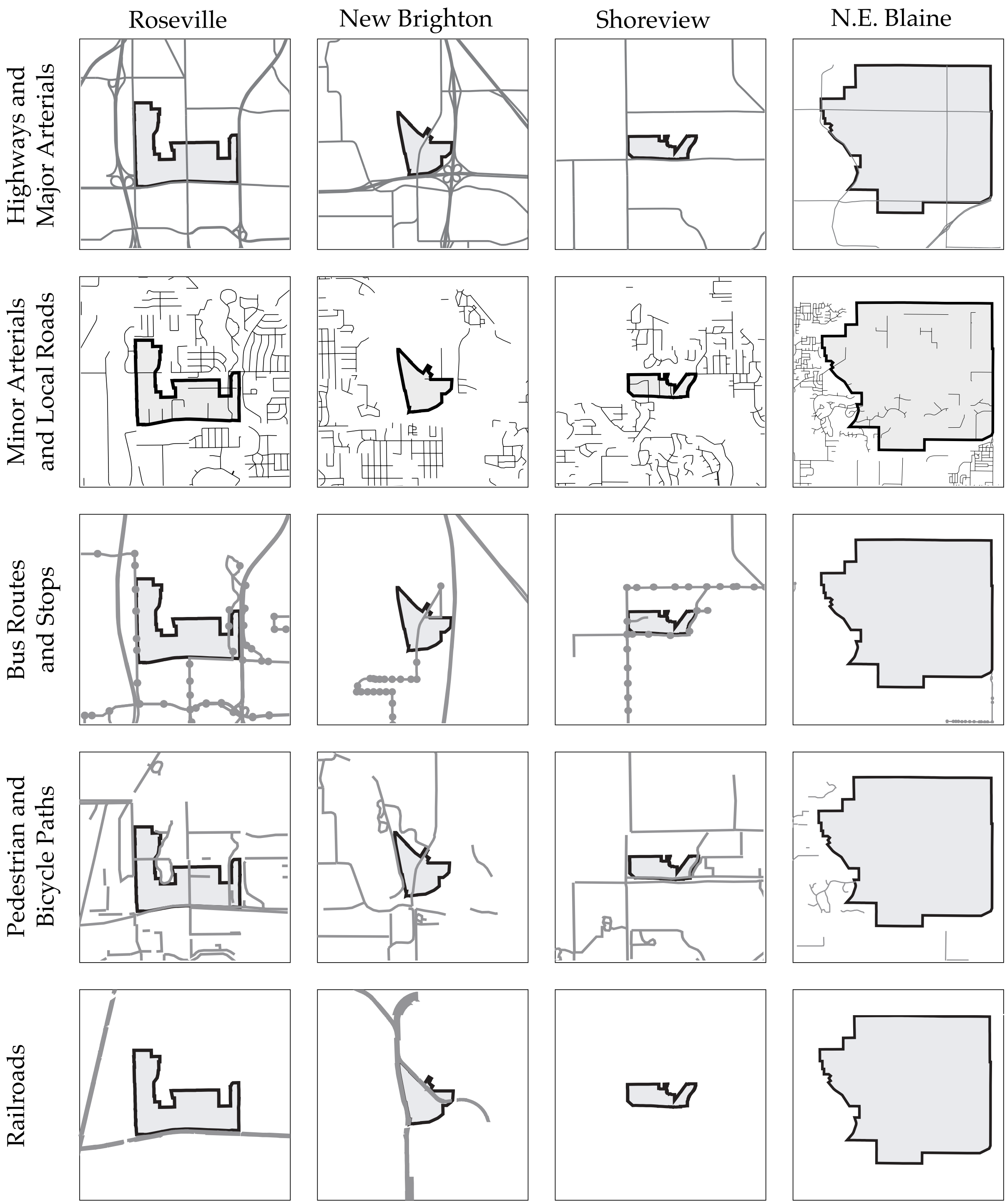
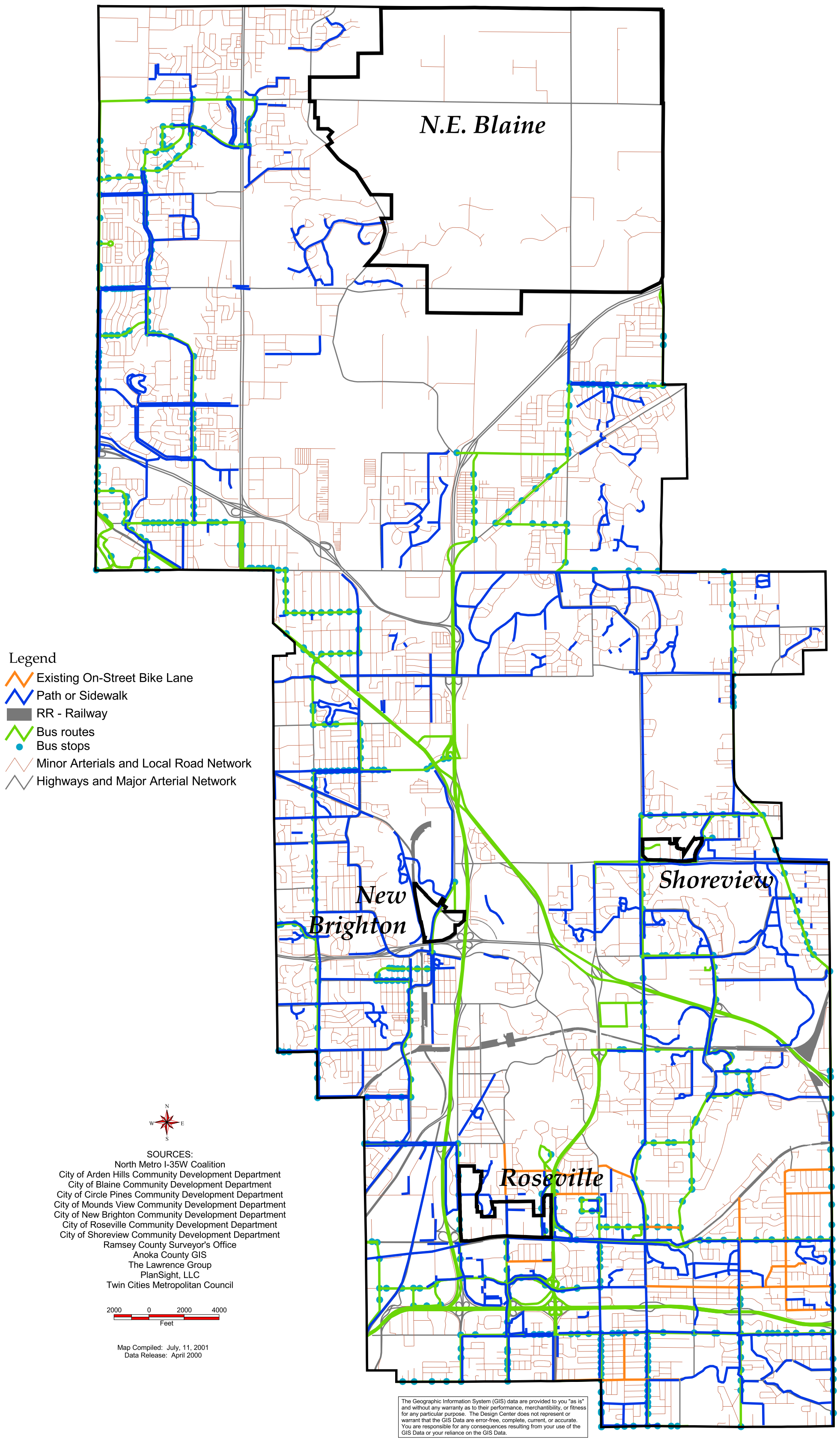
Economy: Analytical Framework




N.E. Blaine
Legend
CC - Community Commercial
RC - Regional Commercial
OFC - Office
MU - Mixed Use
LI - Light Industrial
HI - Heavy Industrial
Shoreview
New Brighton
Roseville
N
W
E
S
SOURCES:
North Metro I-35W Coalition
City of Arden Hills Community Development Department
City of Blaine Community Development Department
City of Circle Pines Community Development Department
City of Mounds View Community Development Department
City of New Brighton Community Development Department
City of Roseville Community Development Department
City of Shoreview Community Development Department
Ramsey County Surveyor's Office
Anoka County GIS
The Lawrence Group
PlanSight, LLC
2000 0 2000 4000
Feet
Map Compiled: July, 11, 2001
Data Release: April 2000
The Geographic Information System (GIS) data are provided to you "as is" and without any warranty as to their performance, merchantibility, or fitness for any particular purpose. The Design Center does not represent or warrant that the GIS Data are error-free, complete, current, or accurate. You are responsible for any consequences resulting from your use of the GIS Data or your reliance on the GIS Data.

Transportation: Analytical Framework




N.E. Blaine
New Brighton
Shoreview
Roseville
Legend
Existing On-Street Bike Lane
Path or Sidewalk
RR - Railway
Bus routes
Bus stops
Minor Arterials and Local Road Network
Highways and Major Arterial Network
N
W
E
S
SOURCES:
North Metro I-35W Coalition
City of Arden Hills Community Development Department
City of Blaine Community Development Department
City of Circle Pines Community Development Department
City of Mounds View Community Development Department
City of New Brighton Community Development Department
City of Roseville Community Development Department
City of Shoreview Community Development Department
Ramsey County Surveyor's Office
Anoka County GIS
The Lawrence Group
PlanSight, LLC
Twin Cities Metropolitan Council
2000 0 2000 4000
Feet
Map Compiled: July, 11, 2001
Data Release: April 2000
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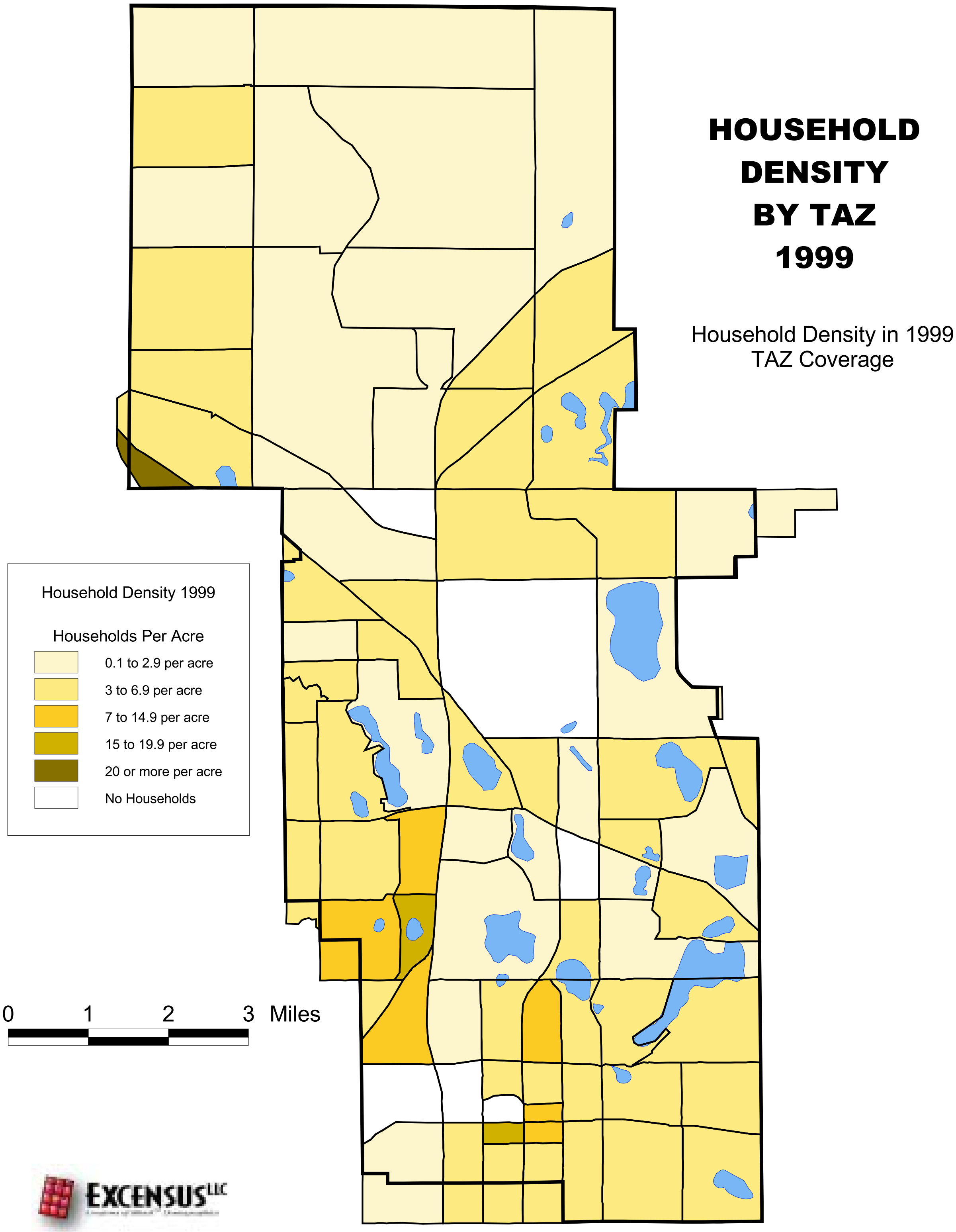
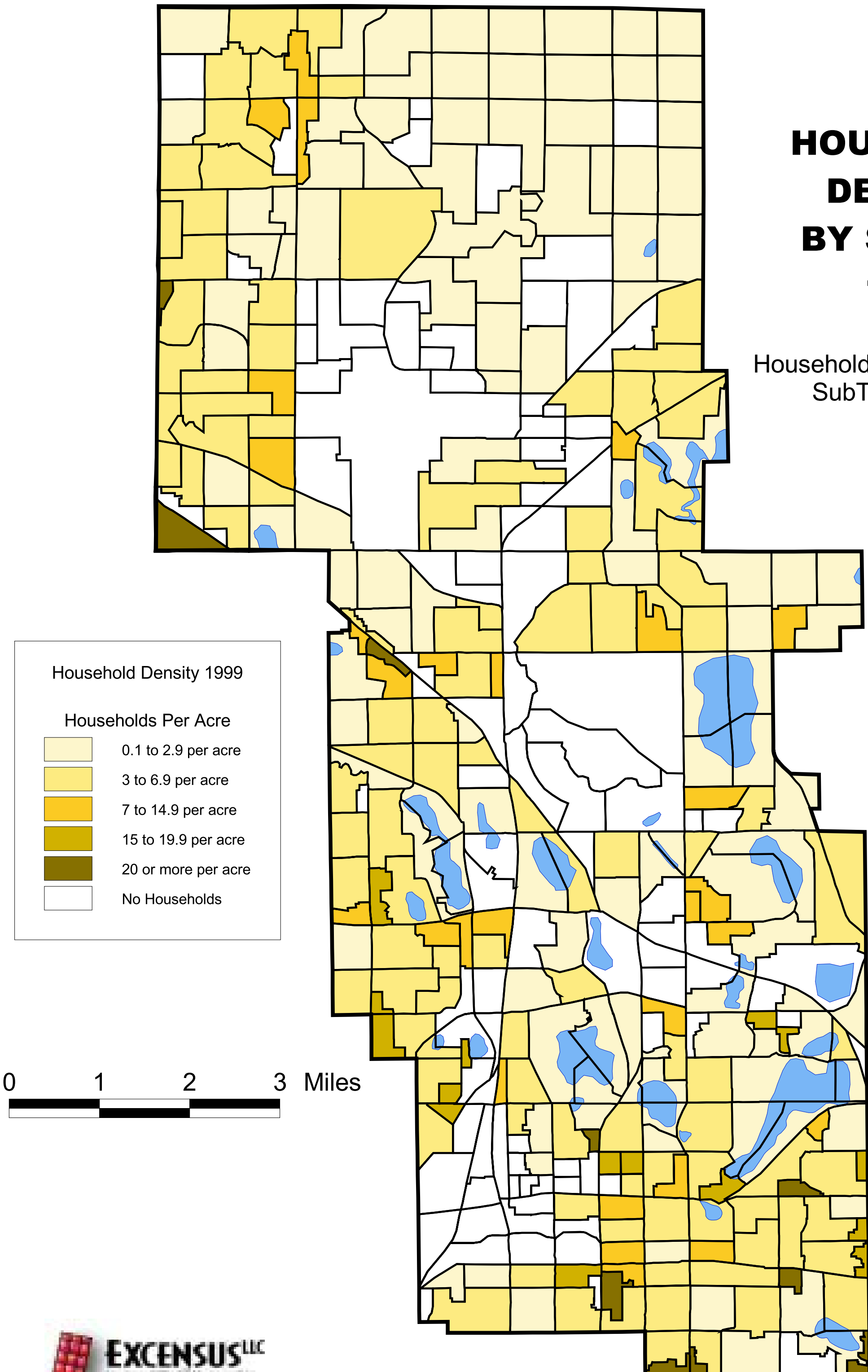
Appendix B.

Socioeconomic Maps


HOUSEHOLD
DENSITY
BY TAZ
1999
Household Density in 1999
TAZ Coverage
Household Density 1999
Households Per Acre
0.1 to 2.9 per acre
3 to 6.9 per acre
7 to 14.9 per acre
15 to 19.9 per acre
20 or more per acre
No Households
0
1
2
3
Miles
EXCENSUS LLC

HOUSEHOLD DENSITY BY SUBTAZ 1999

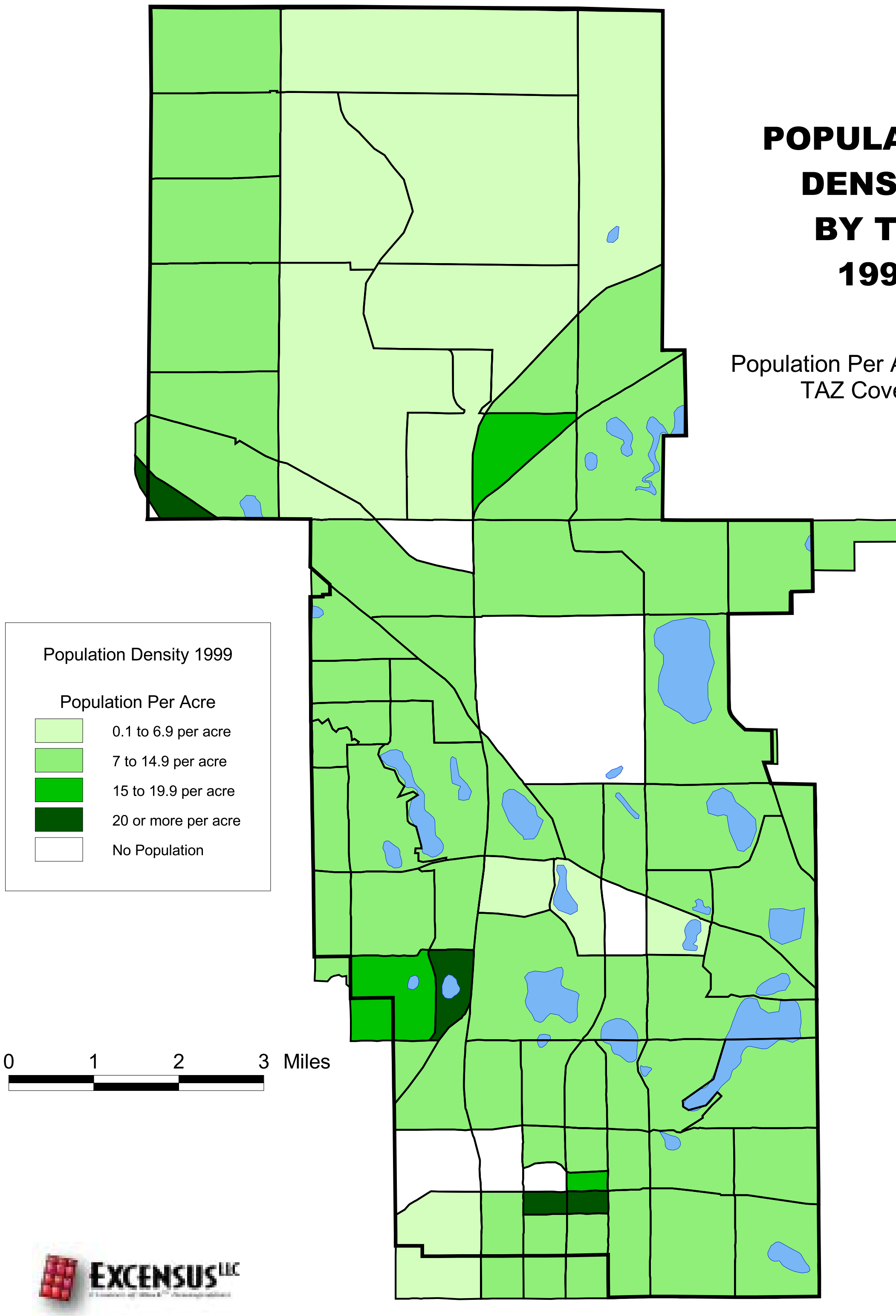
Households Per Acre in 1999
SubTAZ Coverage



EXCENSUS LLC

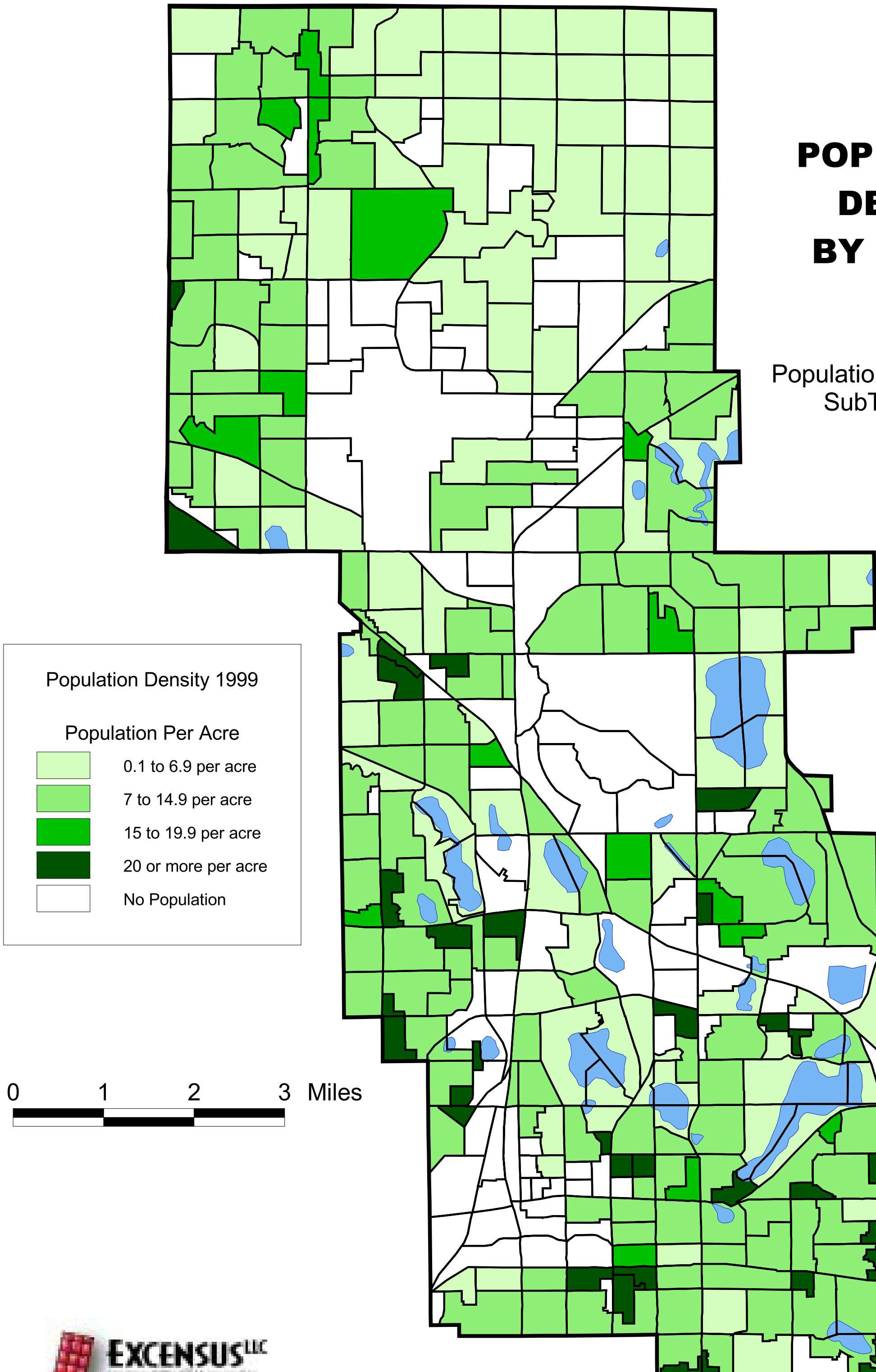
POPULATION DENSITY BY TAZ 1999

Population Per Acre in 1999
TAZ Coverage



POPULATION DENSITY BY SUBTAZ 1999

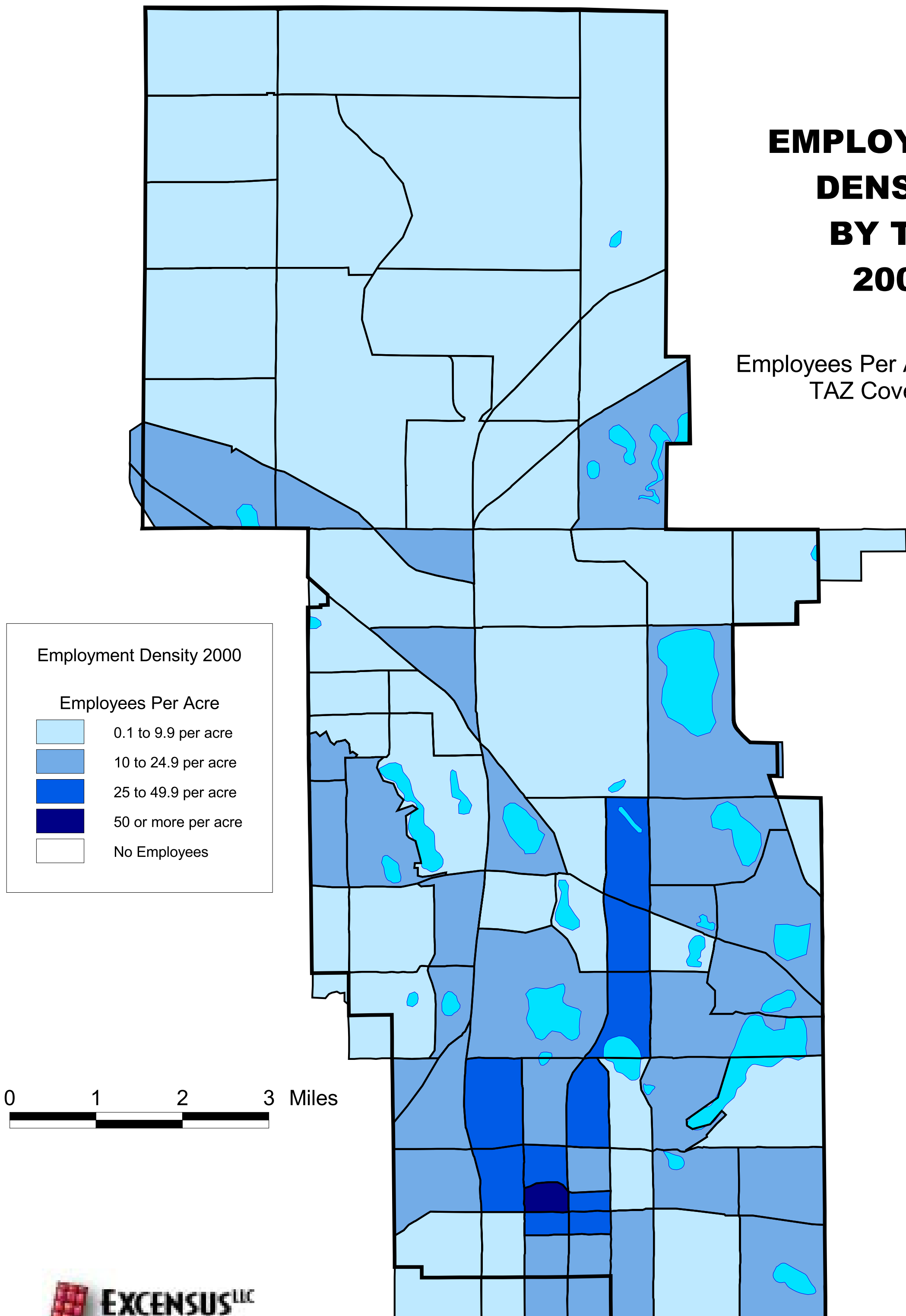
Population Per Acre in 1999
SubTAZ Coverage



EXCENSUS LLC

EMPLOYMENT DENSITY BY TAZ 2000

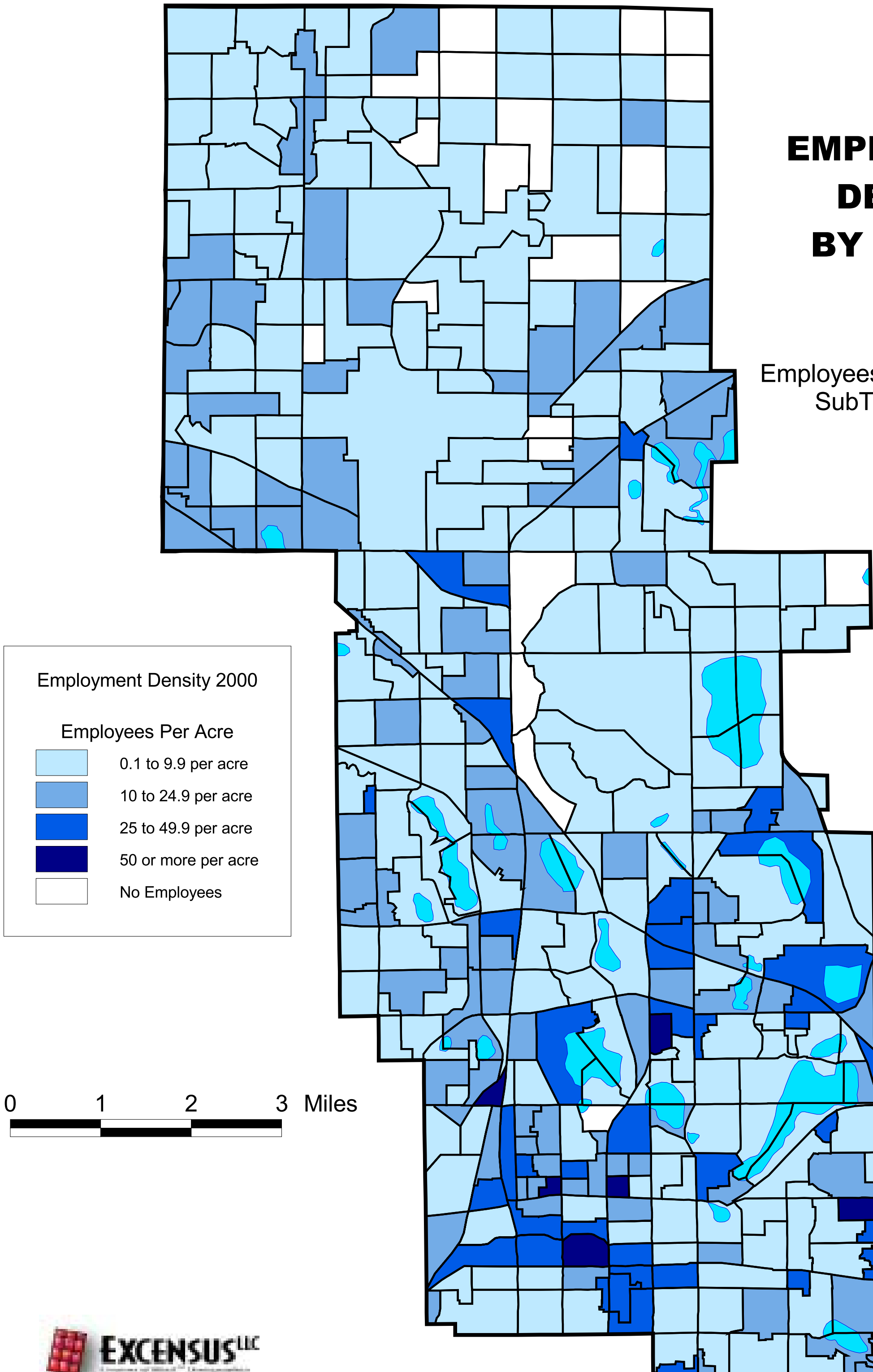
Employees Per Acre in 2000
TAZ Coverage



EXCENSUS LLC

EMPLOYMENT DENSITY BY SUBTAZ 2000

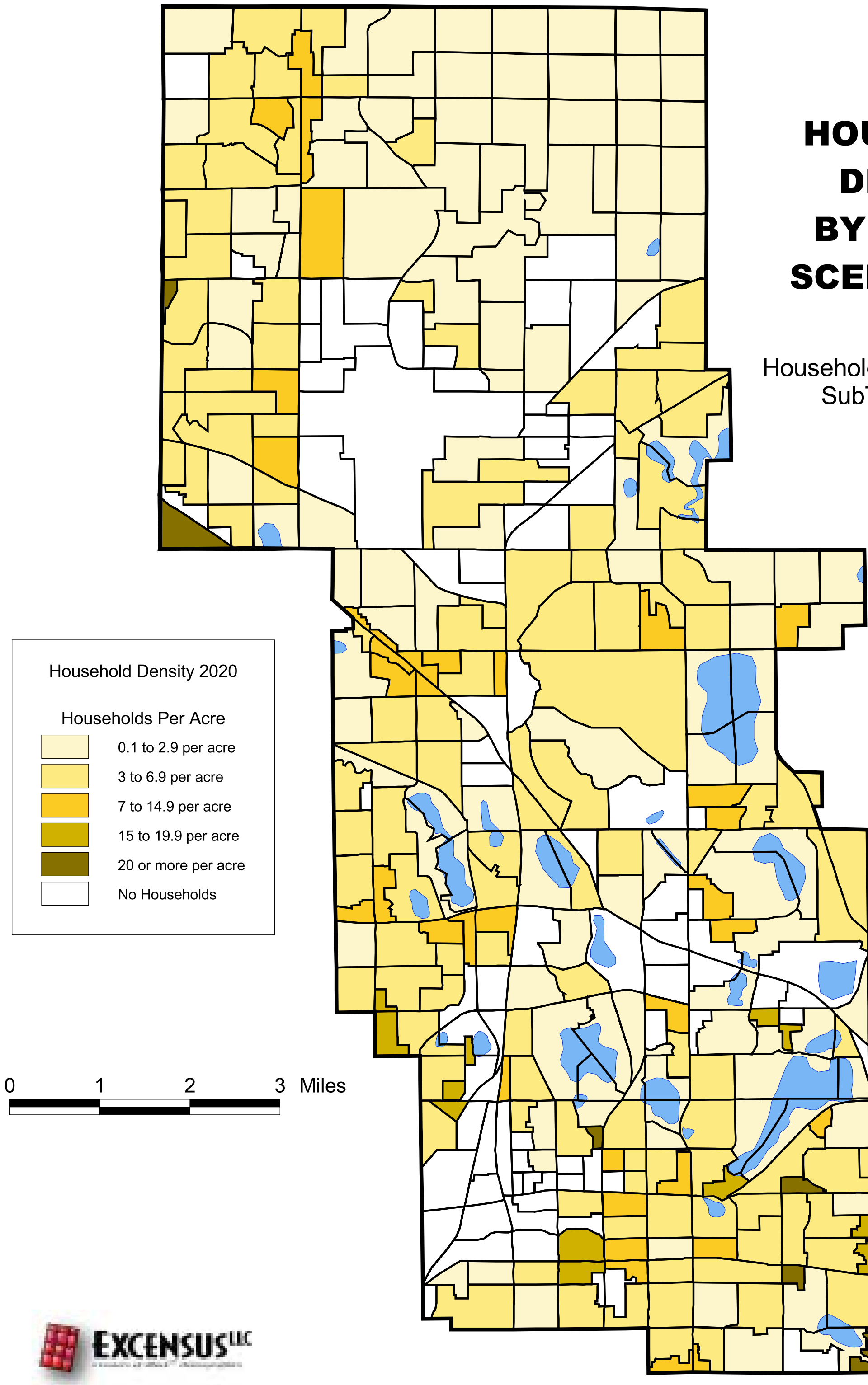
Employees Per Acre in 2000
SubTAZ Coverage



EXCENSUS LLC

HOUSEHOLD DENSITY BY SUBTAZ SCENARIO 1.5

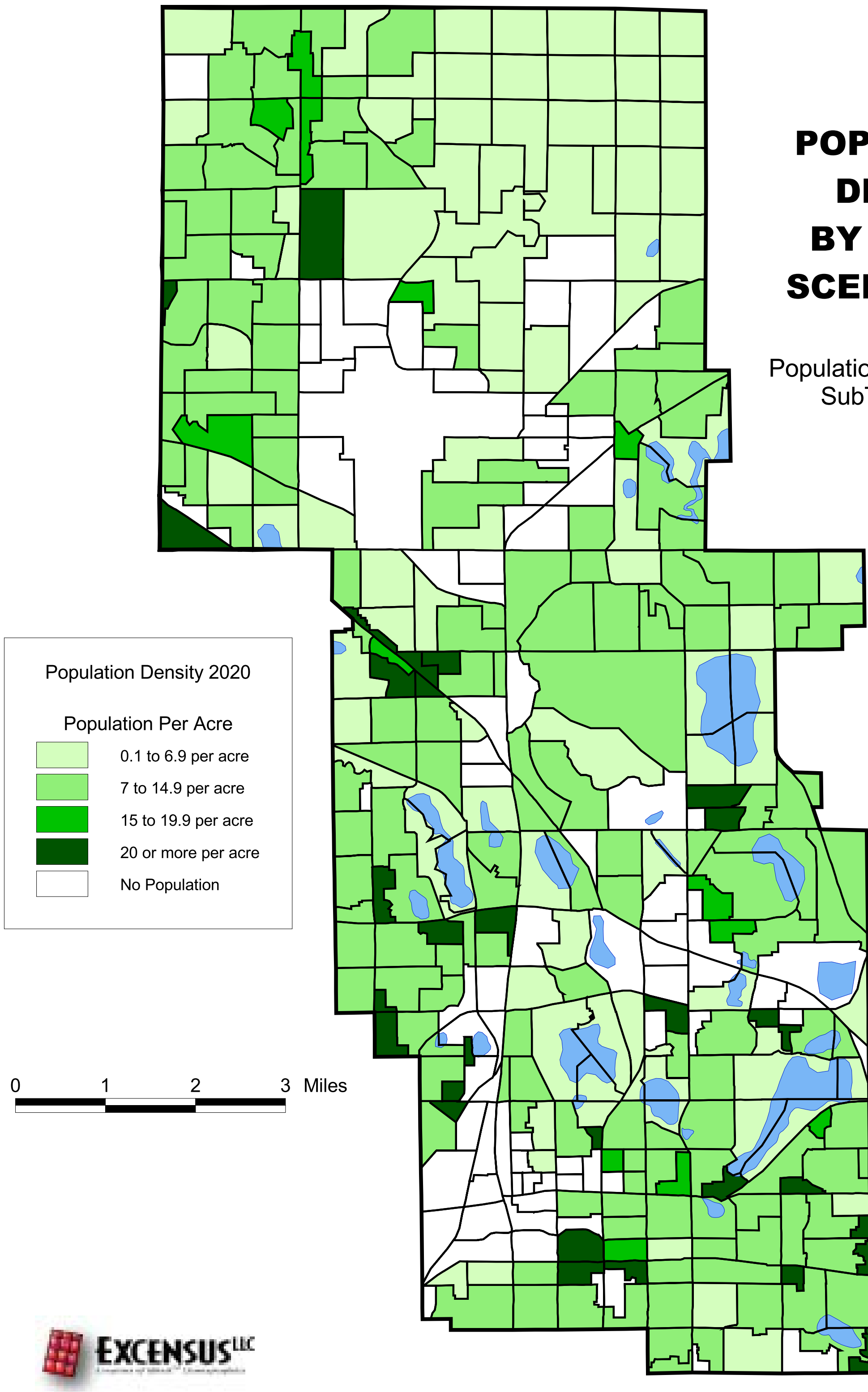
Households Per Acre in 2020
SubTAZ Coverage



EXCENSUS LLC

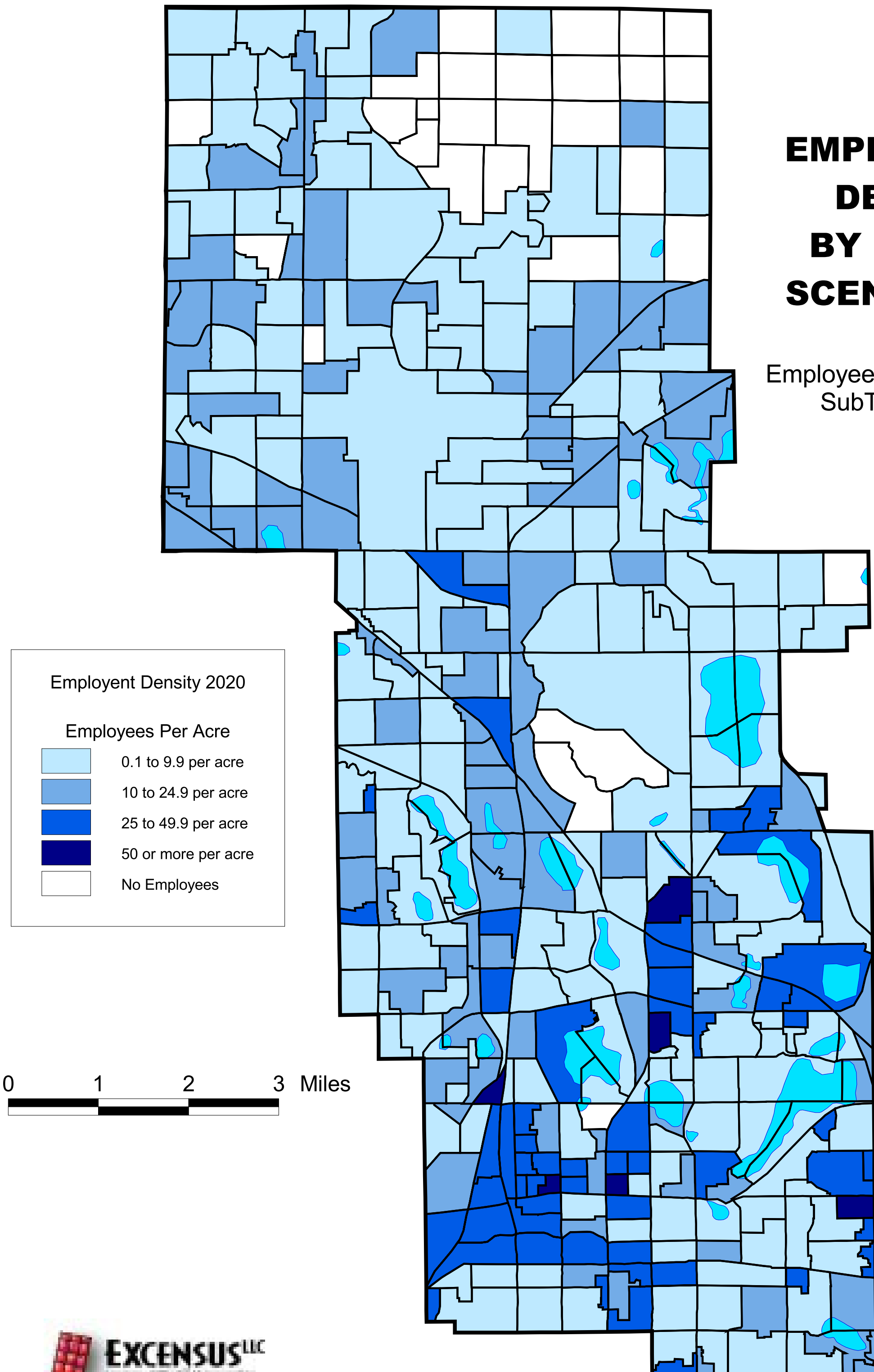
POPULATION DENSITY BY SUBTAZ SCENARIO 1.5

Population Per Acre in 2020
SubTAZ Coverage



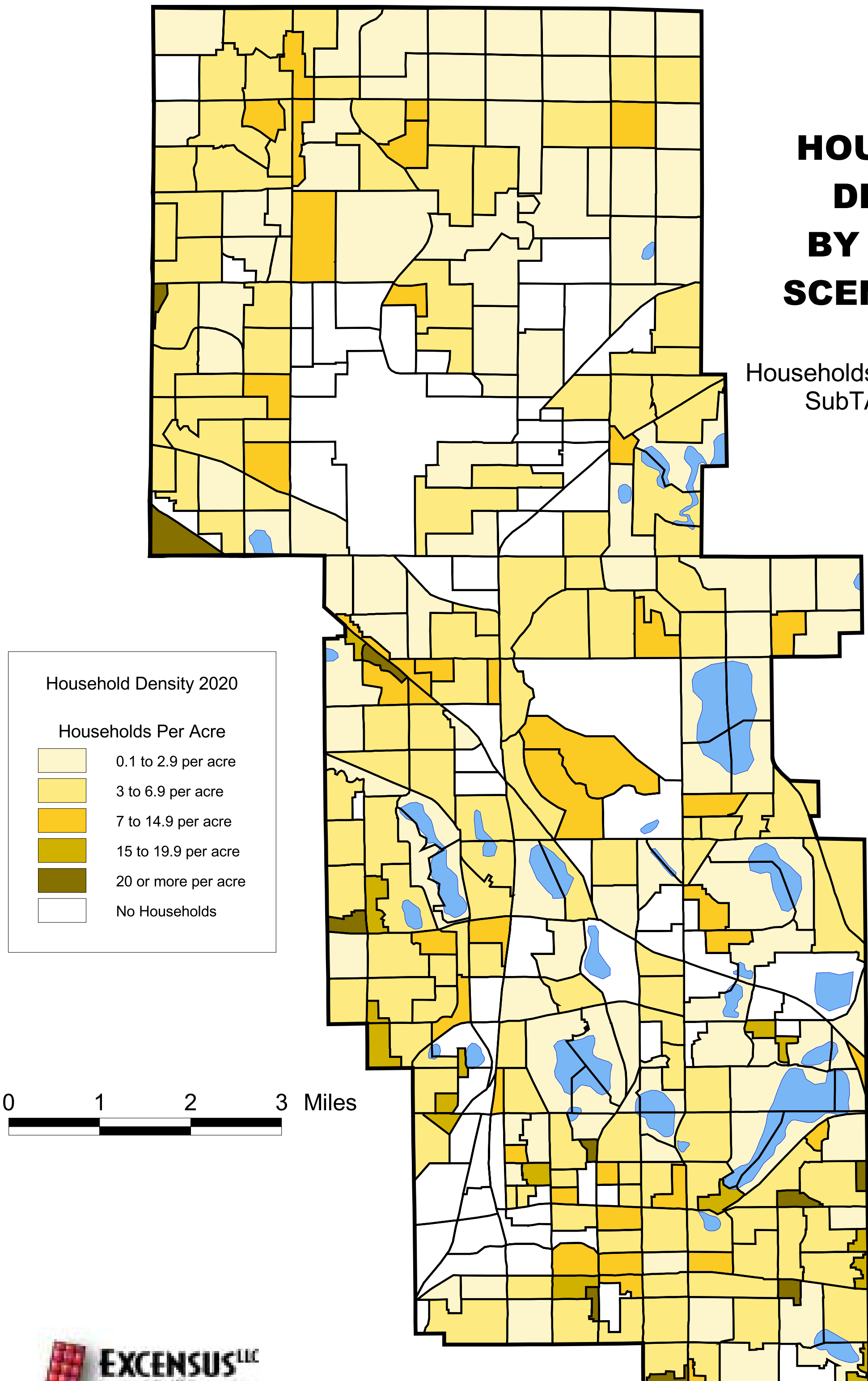
EMPLOYMENT DENSITY BY SUBTAZ SCENARIO 1.5

Employees Per Acre in 2020
SubTAZ Coverage



HOUSEHOLD DENSITY BY SUBTAZ SCENARIO 2.5

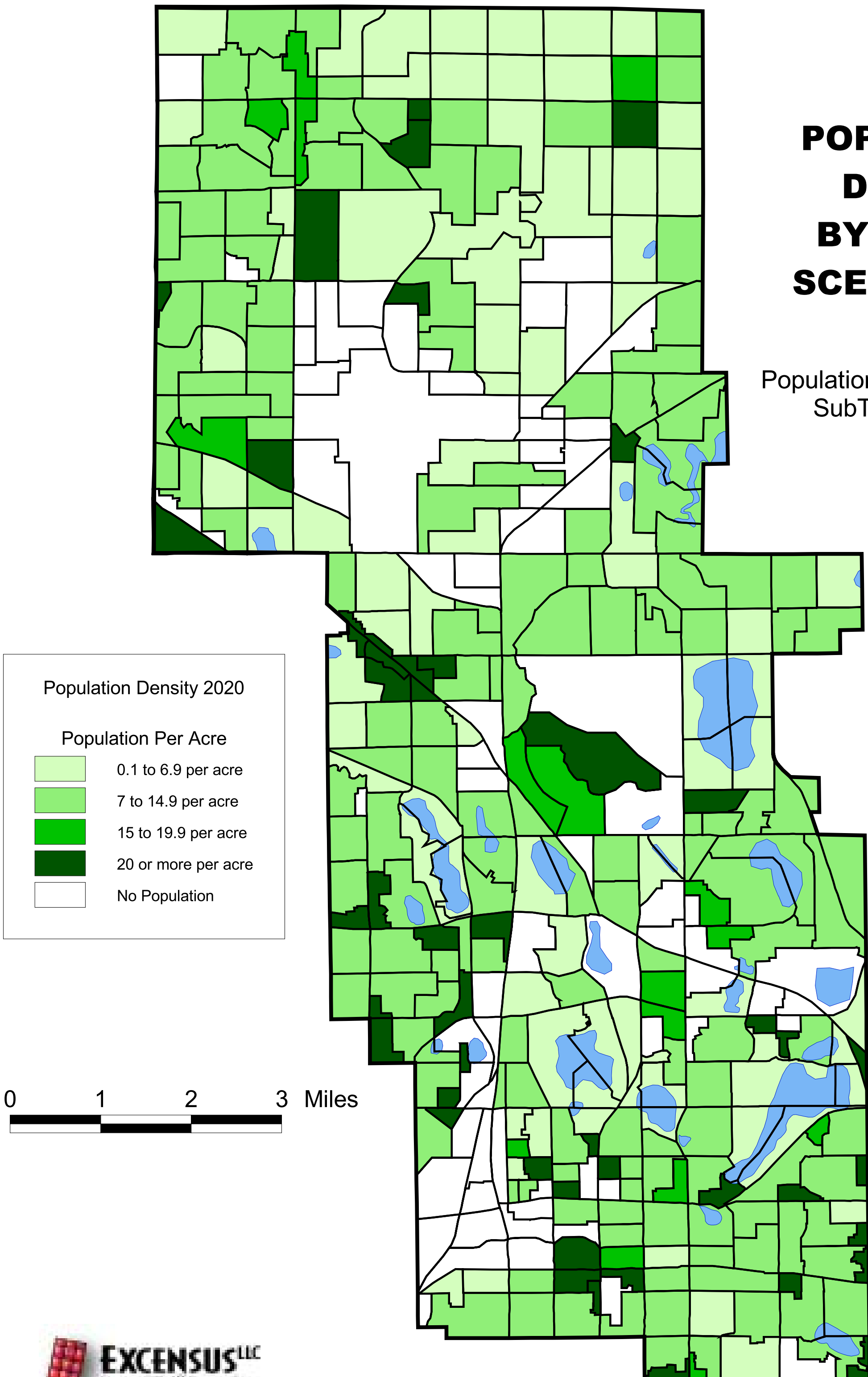
Households Per Acre in 2020
SubTAZ Coverage



EXCENSUS LLC

POPULATION DENSITY BY SUBTAZ SCENARIO 2.5

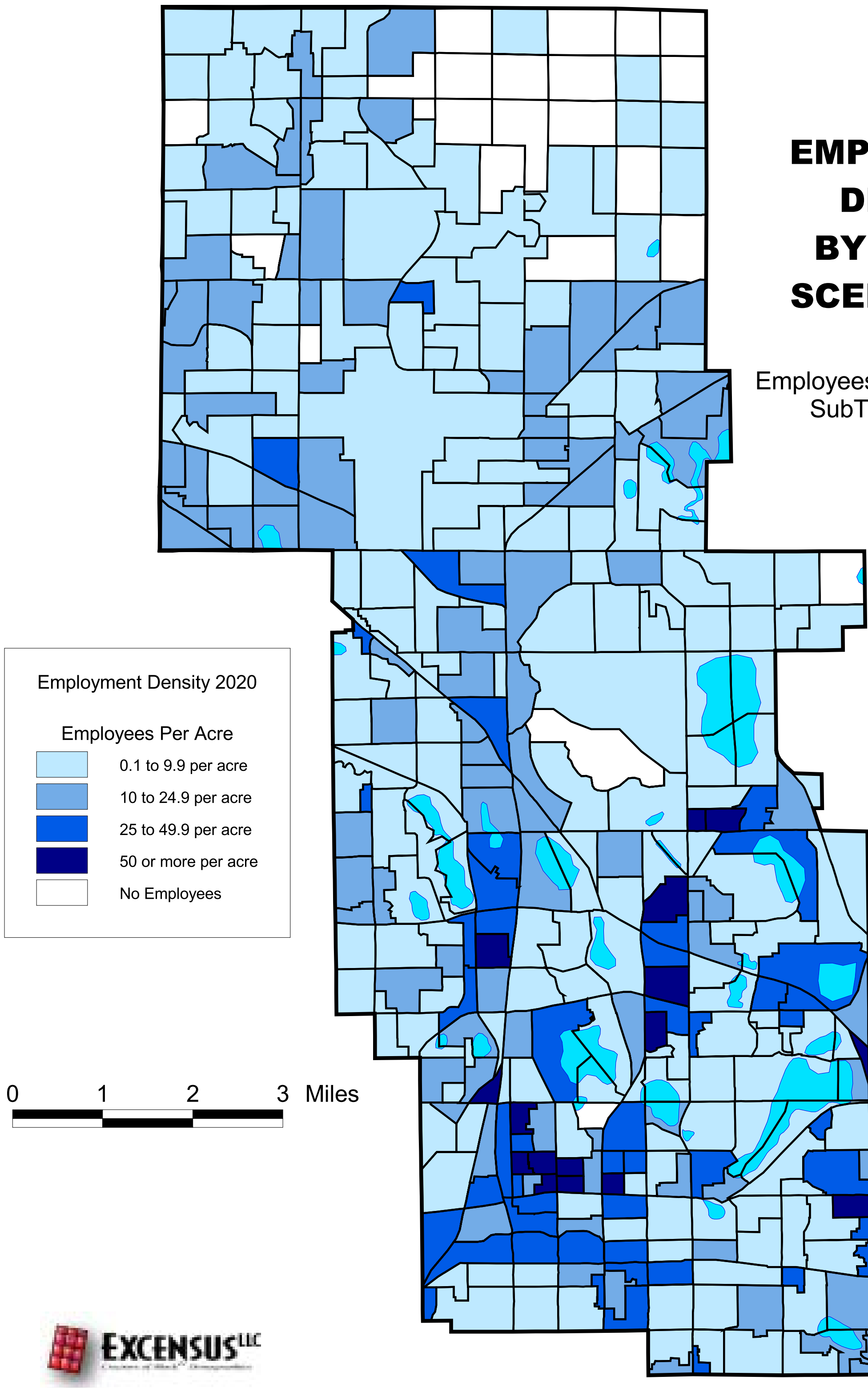
Population Per Acre in 2020
SubTAZ Coverage



EXCENSUS LLC

EMPLOYMENT DENSITY BY SUBTAZ SCENARIO 2.5

Employees Per Acre in 2020
SubTAZ Coverage



EXCENSUS LLC

Appendix C.

Subarea Model Screenline Tables

Validation Data Tables

Screenline 1	Northern Limits- City of Blaine							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Central Avenue	1,501	801	2,302	1,505	833	2,338	36	1.56%
Radisson Road	122	81	203	135	77	212	9	4.43%
Lexington Avenue	501	186	687	515	200	715	28	4.08%
Totals	2,124	1,068	3,192	2,155	1,110	3,265	73	2.29%

Screenline 2	Western City Limits- Blaine							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
125th Avenue	501	367	868	439	440	879	11	1.27%
117th Avenue	211	95	306	236	129	365	59	19.28%
109th Avenue	490	478	968	535	567	1,102	134	13.84%
99th Avenue	290	326	616	260	247	507	-109	-17.69%
89th Avenue	197	391	588	171	391	562	-26	-4.42%
Highway 10	1,700	2,070	3,770	1,683	2,188	3,871	101	2.68%
Totals	3,389	3,727	7,116	3,324	3,962	7,286	170	2.39%

Screenline 3	Eastern City Limits- Blaine and Circle Pines							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
125th Avenue	176	198	374	166	211	377	3	0.80%
109th Avenue	13	19	32	134	106	240	208	650.00%
I-35W	1,550	856	2,406	1,620	867	2,487	81	3.37%
North Road	189	164	353	61	58	119	-234	-66.29%
Lake Drive	359	366	725	389	275	664	-61	-8.41%
Ash Street	259	139	398	254	143	397	-1	-0.25%
Totals	2,546	1,742	4,288	2,624	1,660	4,284	-4	-0.09%

Screenline 4	City of Blaine- North of 109th Avenue							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
University Avenue	837	297	1,134	811	313	1,124	-10	-0.88%
Central Avenue	1,878	1,014	2,892	1,904	1,099	3,003	111	3.84%
Radisson Avenue	261	61	322	311	53	364	42	13.04%
Lexington Avenue	439	154	593	437	155	592	-1	-0.17%
Sunset Avenue	73	23	96	60	33	93	-3	-3.13%
Totals	3,488	1,549	5,037	3,523	1,653	5,176	139	2.76%

Screenline 5	City of Blaine- West of Lexington Avenue, North of I 35W							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
125th Avenue	126	106	232	128	109	237	5	2.16%
109th Avenue	163	190	353	175	186	361	8	2.27%
Totals	289	296	585	303	295	598	13	2.22%

Screenline 6	City of Blaine- north of I-35W/Lake Drive Interchange							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
I-35W	2,016	989	3,005	2,195	1,129	3,324	319	10.62%
Lake Drive	882	665	1,547	678	446	1,124	-423	-27.34%
Totals	2,898	1,654	4,552	2,873	1,575	4,448	-104	-2.28%

Screenline 7	City of Blaine- north of US 10 Freeway, west of airport							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
University Avenue	955	350	1,305	1,070	326	1,396	91	6.97%
Central Avenue	2,314	1,505	3,819	2,301	1,578	3,879	60	1.57%
Totals	3,269	1,855	5,124	3,371	1,904	5,275	151	2.95%

Screenline 8	s/o Anoka/Ramsey County Line							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
University Avenue	2,273	885	3,158	2,356	931	3,287	129	4.08%
Able Street	173	104	277	166	103	269	-8	-2.89%
Highway 10	2,109	1,753	3,862	2,132	1,767	3,899	37	0.96%
Central Avenue	1,822	1,156	2,978	1,854	1,150	3,004	26	0.87%
US 10 Freeway	1,341	691	2,032	1,255	665	1,920	-112	-5.51%
I-35W	3,274	1,774	5,048	3,336	1,860	5,196	148	2.93%
Lexington Avenue	208	159	367	192	131	323	-44	-11.99%
Hodgson Road	442	190	632	428	204	632	0	0.00%
Totals	11,642	6,712	18,354	11,719	6,811	18,530	176	0.96%

Screenline 9	City of Mounds View- west of I-35W							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
County Road J	480	338	818	479	288	767	-51	-6.23%
US 10 Freeway	691	1,341	2,032	665	1,255	1,920	-112	-5.51%
County Road I	440	385	825	437	414	851	26	3.15%
Highway 10	1,578	2,069	3,647	1,534	2,008	3,542	-105	-2.88%
County Road H	438	351	789	434	461	895	106	13.43%
Totals	3,627	4,484	8,111	3,549	4,426	7,975	-136	-1.68%

Screenline 10	North of Highway 96							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
5th Avenue	614	225	839	662	230	892	53	6.32%
I-35W	5,016	2,771	7,787	4,967	2,986	7,953	166	2.13%
US 10	1,178	1,013	2,191	1,204	1,000	2,204	13	0.59%
Lexington Avenue	783	263	1,046	809	302	1,111	65	6.21%
Hodgson Avenue	472	233	705	446	241	687	-18	-2.55%
Totals	8,063	4,505	12,568	8,088	4,759	12,847	279	2.22%

Screenline 11	City of New Brighton, south of Rice Creek Road, west of Long Lake							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Silver Lake Road	791	470	1,261	807	532	1,339	78	6.19%
Long Lake Road	172	72	244	131	41	172	-72	-29.51%
Totals	963	542	1,505	938	573	1,511	6	0.40%

Screenline 12	North of I-694, west of Hamline Avenue							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Silver Lake Road	1,163	646	1,809	1,166	641	1,807	-2	-0.11%
Long Lake Road	392	157	549	350	162	512	-37	-6.74%
Old Highway 8	601	197	798	683	182	865	67	8.40%
I-35W	5,238	3,067	8,305	5,269	3,036	8,305	0	0.00%
Old Highway 10	278	111	389	254	122	376	-13	-3.34%
US 10	746	1,204	1,950	712	1,250	1,962	12	0.62%
Totals	8,418	5,382	13,800	8,434	5,393	13,827	27	0.20%

Screenline 13	City of Arden Hills, west of Lexington Avenue							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Highway 96	905	915	1,820	956	950	1,906	86	4.73%
County Road F	416	256	672	374	225	599	-73	-10.86%
I-694/US 10	3,092	3,350	6,442	3,088	3,368	6,456	14	0.22%
County Road E	926	736	1,662	961	809	1,770	108	6.50%
Total	5,339	5,257	10,596	5,379	5,352	10,731	135	1.27%

Screenline 14	North of northern Roseville City Limits							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Old Highway 8	883	396	1,279	967	412	1,379	100	7.82%
New Brighton Boulevard	373	162	535	433	216	649	114	21.31%
I-35W	4,738	2,453	7,191	4,742	2,544	7,286	95	1.32%
New Brighton Road	0	0	0	28	27	55	55	#DIV/0!
Lake Johanna Boulevard	504	336	840	259	199	458	-382	-45.48%
Snelling Avenue	891	723	1,614	919	724	1,643	29	1.80%
Hamline Avenue	263	235	498	254	233	487	-11	-2.21%
Lexington Avenue	246	203	449	253	229	482	33	7.35%
Victoria Street	275	182	457	313	228	541	84	18.38%
Owasso Boulevard	112	92	204	124	93	217	13	6.37%
Rice Street	608	424	1,032	671	458	1,129	97	9.40%
Totals	8,893	5,206	14,099	8,963	5,363	14,326	227	1.61%

Screenline 15	Eastern Coalition Boundary between Highway 96 and Larpenteur Avenue							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Highway 96	632	513	1,145	697	538	1,235	90	7.86%
County Road F	10	65	75	42	71	113	38	50.67%
Hodgson Road	260	420	680	249	451	700	20	2.94%
Gramsie Road	478	232	710	466	167	633	-77	-10.85%
I-694/US 10	3,362	3,114	6,476	3,343	3,188	6,531	55	0.85%
Owasso Boulevard North	271	270	541	281	266	547	6	1.11%
Owasso Boulevard South	0	0	0	336	276	612	612	#DIV/0!
County Road C	672	399	1,071	510	141	651	-420	-39.22%
County Road B2	281	143	424	275	116	391	-33	-7.78%
TH 36 Freeway	3,593	2,518	6,111	3,597	2,523	6,120	9	0.15%
County Road B	312	203	515	349	198	547	32	6.21%
Larpenteur Avenue	211	153	364	272	224	496	132	36.26%
Totals	10,082	8,030	18,112	10,417	8,159	18,576	464	2.56%

Screenline 16	North of County Road C							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Long Lake Road	380	384	764	371	328	699	-65	-8.51%
I-35W	5,174	2,850	8,024	5,120	2,866	7,986	-38	-0.47%
Cleveland Avenue	369	290	659	347	348	695	36	5.46%
Fairview Avenue	548	539	1,087	559	537	1,096	9	0.83%
Snelling Avenue	972	741	1,713	1,019	844	1,863	150	8.76%
Hamline Avenue	287	232	519	248	161	409	-110	-21.19%
Lexington Avenue	501	360	861	498	449	947	86	9.99%
Victoria Street	551	419	970	531	371	902	-68	-7.01%
Dale Street	0	0	0	418	287	705	705	#DIV/0!
Rice Street	417	302	719	282	164	446	-273	-37.97%
Totals	9,199	6,117	15,316	9,393	6,355	15,748	432	2.82%

Screenline 17	City of Roseville, west of Lexington Avenue							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Josephine Road	105	95	200	213	199	412	212	106.00%
County Road C	764	246	1,010	856	255	1,111	101	10.00%
County Road B2	481	125	606	585	192	777	171	28.22%
TH 36 Freeway	3,958	2,812	6,770	3,938	2,733	6,671	-99	-1.46%
County Road B	550	355	905	338	313	651	-254	-28.07%
Roselawn Avenue	189	162	351	220	112	332	-19	-5.41%
Larpenteur Avenue	740	390	1,130	770	428	1,198	68	6.02%
Totals	6,787	4,185	10,972	6,920	4,232	11,152	180	1.64%

Screenline 18	Roseville City Limits between New Brighton Boulevard and TH 280							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
New Brighton Boulevard	1,189	502	1,691	1,080	500	1,580	-111	-6.56%
County Road C	257	447	704	334	560	894	190	26.99%
Walnut Street	73	147	220	90	164	254	34	15.45%
I-35W	4,471	2,873	7,344	4,361	2,837	7,198	-146	-1.99%
Broadway Drive	601	627	1,228	605	646	1,251	23	1.87%
TH 280	2,435	1,667	4,102	2,454	1,698	4,152	50	1.22%
Totals	9,026	6,263	15,289	8,924	6,405	15,329	40	0.26%

Screenline 19	City of Roseville, South of Roselawn Avenue/McCarrons Boulevard South							
	Original Model			Subdivided Model			Total Volume Change	
Street	N-E	S-W	Total	N-E	S-W	Total	Difference	Percent
Cleveland Avenue	407	312	719	451	316	767	48	6.68%
Fairview Avenue	409	352	761	375	361	736	-25	-3.29%
Snelling Avenue	1,212	1,012	2,224	1,235	1,193	2,428	204	9.17%
Hamline Avenue	348	307	655	257	214	471	-184	-28.09%
Lexington Avenue	291	256	547	377	298	675	128	23.40%
Victoria Street	213	220	433	178	137	315	-118	-27.25%
Dale Street	466	357	823	426	380	806	-17	-2.07%
Rice Street	495	282	777	463	269	732	-45	-5.79%
Totals	3,841	3,098	6,939	3,762	3,168	6,930	-9	-0.13%

Appendix D.

Suburban Regional Averages Table

Suburban Regional Averages

TAZ	Pop	Emp	Acres	Pop Density	Emp Denisty	Density	Emp/Pop	Transit Access	Acres near Transit
75	874	84	150.83	5.79	0.56	6.35	0.10	53%	79.74
79	814	36	140.47	5.79	0.26	6.05	0.04	32%	44.30
82	1677	87	187.96	8.92	0.46	9.38	0.05	97%	183.11
90	1474	114	216.51	6.81	0.53	7.33	0.08	26%	56.11
1201	1218	70	175.86	6.93	0.40	7.32	0.06	40%	70.88
1204	1348	94	217.00	6.21	0.43	6.65	0.07	0%	0.00
1205	470	11	79.26	5.93	0.14	6.07	0.02	19%	14.77
1206	1266	28	144.27	8.78	0.19	8.97	0.02	4%	5.91
1240	1094	76	210.49	5.20	0.36	5.56	0.07	13%	26.58
1247	1012	33	153.06	6.61	0.22	6.83	0.03	91%	138.81
1248	1316	363	239.94	5.48	1.51	7.00	0.28	63%	150.62
1255	1539	116	203.18	7.57	0.57	8.15	0.08	100%	203.78
1258	754	182	154.87	4.87	1.18	6.04	0.24	2%	2.95
1262	408	11	121.10	3.37	0.09	3.46	0.03	27%	32.49
1265	1637	110	177.50	9.22	0.62	9.84	0.07	52%	91.56
1288	743	75	121.08	6.14	0.62	6.76	0.10	73%	88.60
1291	662	75	116.56	5.68	0.64	6.32	0.11	91%	106.33
1292	511	25	89.15	5.73	0.28	6.01	0.05	99%	88.60
1299	1359	36	178.94	7.59	0.20	7.80	0.03	45%	79.74
1303	1190	89	156.93	7.58	0.57	8.15	0.07	72%	112.23
949	901	234	194.60	4.63	1.20	5.83	0.26	85%	165.39
950	971	43	130.98	7.41	0.33	7.74	0.04	32%	41.35
951	1743	499	194.70	8.95	2.56	11.52	0.29	56%	109.28
952	638	593	112.82	5.66	5.26	10.91	0.93	107%	121.09
953	739	14	90.93	8.13	0.15	8.28	0.02	107%	97.46
954	759	21	141.53	5.36	0.15	5.51	0.03	56%	79.74
955	630	87	155.67	4.05	0.56	4.61	0.14	80%	124.04
956	1065	146	159.43	6.68	0.92	7.60	0.14	98%	156.53
962	443	7	77.83	5.69	0.09	5.78	0.02	99%	76.79
963	946	259	146.94	6.44	1.76	8.20	0.27	56%	82.69
964	679	45	124.07	5.47	0.36	5.84	0.07	31%	38.39
968	875	34	128.65	6.80	0.26	7.07	0.04	32%	41.35
1000	382	28	75.48	5.06	0.37	5.43	0.07	3%	2.26
1006	598	31	169.36	3.53	0.18	3.71	0.05	0%	0.00
1014	1330	106	394.73	3.37	0.27	3.64	0.08	23%	91.56
1018	1318	19	198.90	6.63	0.10	6.72	0.01	33%	64.97
1021	1167	50	236.62	4.93	0.21	5.14	0.04	79%	186.07
1023	1242	148	159.66	7.78	0.93	8.71	0.12	100%	159.66
1025	803	212	157.56	5.10	1.35	6.44	0.26	0%	0.00
1026	729	60	132.65	5.50	0.45	5.95	0.08	71%	94.51
1029	1116	142	212.16	5.26	0.67	5.93	0.13	67%	141.76
1031	578	1138	88.38	6.54	12.88	19.42	1.97	60%	53.16
1033	935	193	189.50	4.93	1.02	5.95	0.21	69%	129.95
1308	759	44	130.58	5.81	0.34	6.15	0.06	100%	130.58
1311	678	11	160.85	4.22	0.07	4.28	0.02	75%	121.09
1312	650	50	134.50	4.83	0.37	5.20	0.08	97%	129.95
1316	804	16	211.51	3.80	0.08	3.88	0.02	63%	132.90
1322	524	59	138.99	3.77	0.42	4.19	0.11	55%	76.79
1328	922	283	133.07	6.93	2.13	9.06	0.31	60%	79.74
1331	679	58	163.01	4.17	0.36	4.52	0.09	9%	14.77
1343	576	118	142.06	4.05	0.83	4.89	0.20	56%	79.74
1357	521	58	118.30	4.40	0.49	4.89	0.11	15%	17.72
1362	669	29	149.66	4.47	0.19	4.66	0.04	0%	0.00
1368	952	588	168.91	5.64	3.48	9.12	0.62	80%	135.85
1382	1132	179	175.25	6.46	1.02	7.48	0.16	37%	64.98
1384	482	104	64.32	7.49	1.62	9.11	0.22	100%	64.32
1386	767	78	140.09	5.48	0.56	6.03	0.10	57%	79.74
1392	891	36	112.51	7.92	0.32	8.24	0.04	24%	26.58
1395	884	87	124.15	7.12	0.70	7.82	0.10	86%	106.32
1413	459	145	141.99	3.23	1.02	4.25	0.32	4%	5.91
1429	994	218	159.97	6.21	1.36	7.58	0.22	54%	85.65
1438	832	21	168.22	4.95	0.12	5.07	0.03	46%	76.79
1447	708	37	141.10	5.02	0.26	5.28	0.05	38%	53.16
1457	222	7	39.48	5.62	0.18	5.80	0.03	100%	39.48
1481	562	21	88.02	6.38	0.24	6.62	0.04	87%	76.58
1486	847	23	111.18	7.62	0.21	7.83	0.03	100%	111.18
1488	771	127	109.34	7.05	1.16	8.21	0.16	86%	94.51
1492	187	21	84.26	2.22	0.25	2.47	0.11	67%	56.11
Total:	59425	8242	10219						5495.58

	Pop Density				
Regional Density:	5.81	0.81	6.62	0.14	54%
Zonal Average:	5.87	0.88	6.74	0.15	56%