During the past several decades there has been a rapid growth in the level and complexity of suburban activity. Suburban areas which were once bucolic bedroom communities for commuters into a central business district have become multifunctional areas with a full range of employment, business and institutional activities which rival the downtowns of most metropolitan areas. A diverse set of activities which includes all aspects of modern life have become available in the suburbs as well as the problems associated with these changes. No longer are suburban streets quiet avenues. They have become crowded arterials with severe traffic congestion and safety problems. In addition, unsafe levels of air pollution are a direct result of this growth in automobile traffic. Sprawl has withered the suburban ambience and the convenience and comfort of suburban living.

Beginning in the early 1980's these problems began to be recognized and solutions developed to relieve suburban congestion. Travel patterns in the suburbs are highly diverse with trips from many origins to many destinations and few concentrated corridors of demand. Activity centers and trip generators are poorly tied to each other and scattered in many locations. Suburban buildings are difficult to access by transit or by foot in a auto-dominated world. Finally, transit was not considered in land development, planning and implementation decisions and is difficult to retrofit transit into a suburban environment. Efforts to provide public transport to the suburbs have had limited success.

Most work on the problem of transit in suburban areas to date has concentrated on the development of new methods of operation or administration of public transit
services in suburban areas. Demonstration projects have been attempted and new services have been offered with the hope of finding a "magic" transit solution to suburban travel problems. While these efforts certainly have merit they tend to ignore the underlying land use planning and design issues that are the root of many of these problems. More recent efforts to rethink suburban land use as outlined in an accompanying report¹ provides new directions for suburban planning and design. These efforts have led to a model of the suburbs which integrates land use and transit services and a movement away from the auto-dependent suburbs.

This report provides guidelines for land use planning, design and development that are sensitive to the operational and economic requirements of public transit systems. These guidelines result in suburbs which provide a mix of land uses and a high quality access system using walking and bicycle pathways to link land use with transit service. The guidelines address all levels of the planning and design process including overall planning issues, such as the location and designation of transit corridors, to individual site decisions, such as pedestrian access to buildings.

Marketing considerations are critical to the success of any development project. The guidelines also include the features, amenities, identity, recreational uses and services necessary to attract users to these communities. They are meant to be used by developers and planners for the design of attractive communities that can readily accommodate transit services.

INTRODUCTION

This report was developed by a team with engineering, architectural, real estate, planning and geography backgrounds. Information was gathered from a large number of sources including guidelines issued by transit agencies, land use zoning ordinances developed in Loudoun County, Virginia; Montgomery County, Maryland; Sacramento, California and Kitchener, Ontario; and other technical sources; a complete bibliography for the entire project is provided as part of this report. In addition several site visits were made and interviews conducted with planners involved in this area. Our review of entries to the International City Design Competition and of exemplary development projects, outlined in the New Suburbs report, provided a useful way to formulate the ideas and concepts that are in this report as did the guidelines developed in our previous study dealing with transit station design.\(^2\)

\(^2\)Rabinowitz, Beimborn, Lindquist and Opper, "Market-Based Transit Facility Design."
B. Principles

“*The driving force in decisions regarding the planning, location, design, frequency, operation and maintenance of public transit should be to respond to customer needs.*”

Elements of Successful Transit

Though the development of the suburbs were originally based on access to the central city by transit and subsequent suburban growth was transit-based for more than half a century, currently the provision and quality of transit in the suburbs is limited, with some notable exceptions. However, transit has been, and can again be, an attractive alternative to the car. To be successful, it must compete with the automobile in terms of access, convenience, comfort, and feasibility. The guidelines developed in this study and the requirements for a viable suburb which includes transit are based on the following principles:

1) **Market Orientation.** Transit services should be operated from a market based, user-oriented point of view. The driving force in decisions regarding the planning, location, design, frequency, operation and maintenance of public transit should be to respond to customer needs. Transit can be successful in attracting a significant number of users from the automobile if it provides a user-oriented service. User-oriented transit operates directly between passengers' origins and destinations without transfer, on a convenient schedule, in an attractive setting and at a price which is competitive with the automobile. Transit stops should be easily accessible to building entrances to minimize walking and there should be clear pathways that connect activity centers and transit services. Transit services should also provide a high level of amenities and services and clean, attractive vehicles where passengers feel a sense of security, comfort, and safety. Under such conditions, and with the use of appropriate land use patterns, transit will be successful and limit reliance on the automobile.
2) A Land Use Pattern with Concentrated Trip Ends. There needs to be a concentration of trip ends along the transit service. Appropriate land uses generate and attract trips. Those activities which most relate to transit should be located as closely as possible to transit stops. Furthermore they should be concentrated to create a number of high volume destinations in order to support a high level of transit service.

3) A Quality Access System. Access to public transit by pedestrians, bicyclists and automobile users should be convenient, safe and direct. All transit trips begin as pedestrian trips and end as pedestrian trips. Pathways should be provided which minimize distances to points of activity, provide attractive waiting environments and incorporate other land uses and services that support pedestrians and bicyclists.

4) Transit-Oriented Streets. Street systems should be laid out to facilitate efficient transit operations. Streets which have transit service should be free of sharp curves or steep grades and through routing should be provided with no need for backtracking or circuitous routing. Transit service should directly connect activity centers; there should be no need for shuttle services which connect activity centers to primary transit lines. Geometric design criteria for transit routing should provide for adequate stopping areas, safe pedestrian crossings and proper visibility. Automobile traffic should be restricted if necessary, to assure that transit vehicles do not experience delays.

“All transit trips begin as pedestrian trips and end as pedestrian trips. Pathways should be provided which minimize distances to points of activity...”
Criteria for Transit-Sensitive Design

As part of our analysis of innovative suburban developments and of entries to the International City Design Competition (ICDC), both of which are reported in the first report of this project, we developed a set of criteria which can be used to analyze the compatibility between transit and land use. These criteria relate to land use, i.e., concentrations of trip ends, pedestrian movement, the ease of operation of the transit service and marketability. They are as follows:

Land Use Criteria

A. Size of Population: Are the total number of people who live and/or work within the market area of a transit stop or route sufficient for transit service?

B. Density of Land Use: Is the residential and/or working population concentrated enough to provide a market for transit services?

C. Concentrated Locations: Are the locations of land uses concentrated in relationship to potential transit stops?

D. Mix of Uses: Is there a mix of uses present to minimize travel to frequently used functions?
Access Criteria

A. Pedestrian Circulation: Are pedestrian paths short, direct, clear and interesting?

B. Minimize Walking: Does the design provide logical pathways which connect land uses with the location of potential transit services so that overall walking distance is minimized?

C. Safe and Secure Bicycle Access: Does the design permit safe travel to transit stops by bicycle and secure storage during travel?

Transit Operations Criteria

A. Through Routing: Does the location of streets permit easy movement of transit vehicles into and out of the area without backtracking or circuitous routing?

B. Turns Required: How many turns are required for transit vehicles to serve the area? Fewer turns are preferred.

C. Right-of-Way Available: Are rights-of-way provided (either streets or guideways) that can be used for transit operations?

Marketability

A. Identity: Do the communities and areas have a clear and distinct identity? Do the transit stops reflect that identity?
B. Amenities: How can amenities be provided to create an attractive living environment as well as be compatible with the high densities required for transit service?

C. Design: Does the design provide a sense of place and character to which a broad range of potential residents will respond?

Quantitative measures of the criteria also could be developed. Land use activity could be measured by the trip density (trips/acre) within the service area of a transit stop (1/4 mile radius). This would be the product of residential density and trip rate for residential areas. The use of transit trip generation rates for different land use categories, such as are provided for vehicle trips in the *ITE Trip Generation Manual*, would provide the transit trip density within the service area of a stop. Unfortunately little data of this sort exists. Rates of capture for transit trips vary widely and depend not only on land use type but on the quality of transit service and household constraints and activity patterns.

Access can be quantified by looking at the area or housing units covered within an appropriate walking distance (1/4 mile). Directness of path can be found by comparing actual walking distances to a straight line ("as the crow flies") path. Safety, security and amenities of the access system cannot be easily quantified; they relate to the openness of pathways and the features that they have. Transit service compatibility could be measured in a similar way to access with a ratio of route length to direct length. Some indication of curvature of the route (turns required) would also be needed.
C. Transit-Oriented Land Uses

Land uses serve diverse needs and have different transportation requirements. Certain land uses -- multifamily housing, office buildings, educational institutions, etc. -- are highly oriented to transit use. These uses have a concentration of demand, a regular trip pattern and little need to carry large parcels. Other land uses -- lumber yards, garden centers, drive-through restaurants, etc. -- are totally oriented to the automobile; it is difficult to imagine any circumstances where people would use public transit on a regular basis to visit such places. Accordingly, if land use patterns are to be modified to better relate to public transit, it is important to understand which land uses should be included in an area served by transit and which should be located elsewhere.

An analysis was made of various land use categories to rate them for their compatibility with public transit. Land use categories from the ITE Trip Generation Manual, 4th edition were used. This manual provides trip rates for 74 different land use categories and is frequently used by traffic engineers to forecast local effects of development on highway traffic. In all but a few categories rates of auto vehicle trips are given as a means to forecast the impacts of various land uses on traffic. Only in a few cases are rates of transit trip making given. Nonetheless, the land use categories and trip rates are useful in that they can help separate land uses by their compatibility with transit. A compatibility rating was determined for each ITE trip category using a 1 to 5 scale with 5 representing a high compatibility with transit and 1 representing a low compatibility. This was done by evaluating the following criteria for each land use: the frequency of regular travel to these places; typical sizes; and whether or not there is a need to carry large parcels. In addition, land use categories were also judged by their peaking characteristics, and type of potential users. Detailed results of this analysis are given in Appendix A.
The following land use categories were judged to have high transit compatibility (ratings of 4 or 5) and should be located in areas to be served by transit.

- Commercial Airport
- Park and Ride Station
- General Heavy Industrial
- Apartments
- Residential Condominiums
- High Density Residential
- Retirement Community
- Hotel -- non-CBD
- Stadium
- Elementary School
- High School
- Junior/Community College
- University
- Hospital
- General Office Building
- Office Park
- Shopping Center

Those land uses which were rated 2 or 3 have a low to medium orientation to transit and can generally be separated from transit in preference to category 4 or 5 land uses.
The following had low compatibility (a rating of 1) and it is unlikely that large numbers of people would use transit to get to these places on a regular basis. These land uses can well be separated from public transit services.

- Water Port
- General Aviation Airport
- Truck Terminal
- Mini-Warehousing
- Utilities
- Recreational Homes
- Resort Hotel
- Marina
- Golf Course
- Day Care Center
- Nursing Home
- State Motor Vehicle Department
- Building Materials and Lumber
- Hardware/Paint Store
- Nursery/Garden Center
- Quality Restaurant
- New Car Sales
- Service Station
- Car Wash
- Highway Oasis
- Truck Stop
- Furniture Store
- Drive-in Bank
- Drive-in Savings and Loan
D. Conceptual Design

A major goal in the project was to develop a conceptual framework for the design of transit-sensitive suburban areas. This effort was based on our reviews of the literature and an analysis of ICDC entries and the exemplary designs as outlined in The New Suburbs report. These projects, which are in various stages of the implementation process, indicate an incipient new direction in suburban planning and design which can lead to a new generation of suburban development. Though none of the designs we examined incorporates all the elements of a transit-sensitive suburb, taken together they provide a variety of concepts and features which could be the basis for such projects.

The principles behind the guidelines in this report are the integration of transit and land use planning to provide the features and services necessary to create a genuine and workable community. The following four factors form the basis of this planning.

Land Use Design. The suburban community must be planned to be an attractive and viable place to live and work as well as dealing with issues related to the provision of transit. The land use plan should have at its core a mix of uses and a pedestrian orientation which will encourage walking and bicycle use and reduce the use of the automobile. In addition the location of uses, streets and parking should support transit services. Part of the land use plan is the preservation of land in natural and agricultural areas which will also reinforce the milieu of the developments.

Access Systems. Access is the literal link between transit and land use. Transit stops should be located in relationship to the placement and density of population, employment centers and other destinations. Links and pathways between the transit stops and these destinations should be provided to insure that the transit-related goals of the project will be met.
CONCEPTUAL DESIGN

Transit Services. Transit is at the core of planning for this community, with a reduced reliance on use of the automobile. The provision of high quality public transit system, responsive to market needs, provides an opportunity for the residents or employees in one of these communities to use transit in lieu of the automobile. Transit should be easily accessible to almost all residents and we expect significant portion of the population to use transit.

Market. The project must function as a community. The design should provide features, amenities, design and services which will make an attractive place to live. Market considerations also includes the provision of a number of types of housing to attract a diverse market, demographically as well as in terms of economics, as well as a market which will use transit more frequently. Transit services should be market oriented in that the needs of users should be the driving force in the design and operation of services.

Based on these factors, a conceptual design was developed that separates transit- and auto-oriented land uses and calls for the creation of Transit Corridor Districts (TCDs) where public transit, walking and bicycles are to play a major role in providing mobility. Transit Corridors Districts would serve as prime locations of transit-oriented land uses and as a means of creating an environment where mobility is provided by non-automotive means. Transit corridors within these districts would ideally be separated from arterial highway corridors by a distance of at least 1/4 to 1/2 mile. These corridors would be protected through zoning actions and by the careful placement of periodic closures to non-transit traffic -- to avoid excessive automobile usage. Technological flexibility should be provided for in the design of transit corridor districts. Corridors for transit would likely by operated with buses at early stages of development, but they should be designed to be easily upgraded to light rail transit or other technological options. The critical feature is that there is

GUIDELINES FOR TRANSIT SENSITIVE SUBURBAN LAND USE DESIGN

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a concentrated land use pattern and pedestrian/bicycle access system that supports transit and is served by transit.

Separation of transit service from conventional auto-oriented arterials is attractive since conventional arterials in the suburbs are seldom suited to transit service. Suburban arterials are typically lined with strip commercial developments which are normally set far back from the roadway, and have little if any pedestrian facilities that can connect them to transit. Land uses along suburban arterials are also often inappropriate for transit use. Auto oriented uses such as lumber yards, garden centers, drive-in banks, fast food drive-through restaurants, funeral homes, and the like, which predominate along suburban arterials are intermixed with land uses that related to transit. On the other hand, those land uses which relate strongly to transit such as housing, office buildings, educational facilities, retail buildings and factories are often separated from the arterials which have the transit service. Thus the separation of transit and arterial routes and the location of appropriate land uses proximate to each of these modes creates a more efficient and convenient overall system.

Transit service which is not located next to arterial routes faces a different problem. Typical suburban streets often follow a curvilinear pattern with little opportunity for through routing. In addition, adjoining subdivisions may well have non-aligned streets or complete boundary separations. In this situation transit vehicles are required to make frequent turns and may need to ‘backtrack’ in order to provide service within a reasonable distance of homes or places of work. This results in lower operating speeds, additional noise and pollution as vehicles negotiate their way through a maze of suburban streets. Lower speeds and indirect routing also result in a lower level of service relative to the automobile and, in turn, lower levels of demand. In addition, operation in suburban residential areas can result in complaints.
CONCEPTUAL DESIGN

by residents because of noise, emissions and increased traffic. These factors, combined with a lower density of land use, lead to poor prospects for transit services located in suburban areas.

Based on the principles and criteria described earlier, we propose a separation of transit and automobile oriented land uses and the creation of separate transit corridors located parallel to, and 1/4 to 3/4 mile from, highway arterials. Such transit corridors would feature a central street that could be used for through movement by transit vehicles and for local automobile traffic. However there would be control of through auto traffic by periodic street closures or other devices. Transit corridors would be predesignated in advance of development and protected through the creation of Transit Corridor District (TCD) zoning. These corridors would be planned to anticipate various transit modes. Flexibility would also be provided within developments, including having a mix of land uses with density gradients away from the transit corridor. Transit corridor districts would also include pathway systems for bicycles and pedestrians, and a mixed, high density land use.

Part of the Transit District Corridor zoning would designate locations for activity centers where stops would be located. These centers, which would contain a mix of such uses and high levels of activity, would be the focus of individual neighborhoods, developed by various organizations, but all based on zoning which both creates an attractive community as well as a feasible public transit system.

These designated Transit Corridor Districts will capture much of metropolitan growth for some time. Areas between districts will either be preserved as agriculture and natural areas or contain low density uses. Through using only a portion of the land surrounding the central city for development the environmental quality of open and rural space is preserved.
Corridor versus Node Based Systems

Two conceptual approaches exist for land use planning in relationship to transit. These are a corridor based or a node based approach. Both techniques significantly improve the potential for expanded transit service and result in less dependency on the private automobile. A node based system generally assumes a central terminal or station which is reached by radiating pathways (see Laguna West in report number one as an example of this concept). Such a system is most appropriate when stops are widely separated along the transit route. The overall pattern of land uses then resembles a string of beads along primary transit routes. Such patterns are found historically on commuter rail lines radiating from older central cities. These systems have traditionally been used for commutation to the central city and have very few trips between the outlying stations.

Another approach is to use closer stop spacing and to provide more of a corridor-based system. In this system land use patterns look more like a string of sausages along the primary transit route. Station service areas overlap and it is possible to walk or bicycle to several stops from any one location.

Both approaches have significant advantages over conventional land use patterns because they concentrate demand near stops and provide good accessibility for transit. Our approach is to emphasize a corridor-based approach. Projects using this approach have been limited and a corridor-based approach results in efficiencies of scale, size and length of route as well as contending with political realities which often limits the scale of an overall transit system. Corridor-oriented systems can also lend themselves to evolutionary development of both transportation technology and land use changes. In addition, they may have a greater potential for intrasuburban
CONCEPTUAL DESIGN

travel and for expanded pedestrian/bicycle travel. Many of the guidelines in this report relate to both concepts and could be adapted to either a node based or corridor based design.