San Jose State University
SJSU ScholarWorks

Mineta Transportation Institute Publications

6-1-2002

Using the Internet to Envision Neighborhoods with Transit Oriented Development Potential, MTI Report 01-24

Earl G. Bossard
San Jose State University

Follow this and additional works at: http://scholarworks.sjsu.edu/mti_publications

Part of the Transportation Commons

Norman Y. Mineta
International Institute for
Surface Transportation Policy Studies
Created by Congress in 1991

Using the Internet to Envision Neighborhoods with Transit Oriented Development Potential

USING THE INTERNET TO ENVISION NEIGHBORHOODS WITH TRANSIT-ORIENTED DEVELOPMENT POTENTIAL

June 2002

Earl G. Bossard

with

Steven Colman, Jeff Hobbs, Kevin Keck,
Donald Reed, David Roemer,
Richard Taketa, and Dali Zheng

Technical Report Documentation Page

1. Report No. FHWA/CA/OR-01/24	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Using the Internet to Envision Neighborhoods with Transit-Oriented Development Potential		5. Report Date June 2002
		6. Performing Organization Code
7. Authors Earl G. Bossard, Steven Colman, Jeff Hobbs, Kevin Keck, Donald Reed, David Roemer, Richard Taketa, and Dali Zheng.		8. Performing Organization Report No. 01-24
9. Performing Organization Name and Address Mineta Transportation Institute College of Business—BT500 San José State University San Jose, CA 95129-0219		10. Work Unit No.
		11. Contract or Grant No. 65W136
12. Sponsoring Agency Name and Address California Department of Transportation Sacramento, CA 95819 U.S. Department of Transportation Research and Special Programs Administration 400 7th Street, SW Washington, DC 20590-0001		13. Type of Report and Period Covered Final Report
		14. Sponsoring Agency Code

15. Supplementary Notes

This research project was financially sponsored by the U.S Department of Transportation's Research and Special Programs Administration and by the California Department of Transportation (Caltrans).

16. Abstract

The Mineta Transportation Institute (MTI) at San José State University conducted this study to review the issues and implications involved in Using the Internet to Envision Neighborhoods with Transit-Oriented Development Potential.

SUMMARY OF PROBLEM: The *Using the Internet to Envision Neighborhoods with Transit-Oriented Development Potential* project seeks to provide guidelines and examples to facilitate use of the Internet to envision places with TOD potential, building on the envisioning techniques developed and presented in MTI Report 01-15, *Envisioning Neighborhoods with Transit-Oriented Development Potential*.

RECOMMENDATIONS: These recommendations are made in terms of general style and approach, because the Internet is evolving so rapidly that currently available program are likely to change soon. The envisioning neighborhoods principles presented in MTI Report 01-15 are useful for Internet applications. These principles are: Use small replicate maps, charts, images, and tables to facilitate comparisons across space, time, and scale, because data are best understood in a comparative context. The suggested solution for analyzing the transit-oriented development potential of neighborhoods is twofold: First, use the evolving digital information tools (especially the Internet) and information design principles to find, filter, transform, model, and synthesize neighborhood data. Second, use small replicate maps, charts, digital images, and tables to facilitate comparisons across space, time, and scale, presenting the resulting information in a form useful for understanding conditions, making decisions, and taking action.

17. Key Words Demographics, regional planning; transit-oriented development, urban planning; Web sites, information retrieval	18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages avg is 70	22. Price $20.00

Form DOT F 1700.7 (8-72)

To order this publication, please contact the following:

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY — PROJECT 2001

BACKGROUND

This study is an extension of previous research that uses the Envisioning tool to identify neighborhood characteristics that would be important for Transit-Oriented Development (TOD) developers and planners. The term TOD is used to describe land use development specifically designed to take advantage of close proximity to good public transit. An explosion of Internet information and means of displaying data, such as school test scores, crime statistics, and real estate listings using tools such as smart geographic information system-based maps, can be used to examine potential sites from both planning and development perspectives.

The previous project (MTI Report 01-15), *Envisioning Neighborhoods with Transit-Oriented Development Potential*, identified some of these new sources. This project focuses on developing systematic ways to find, filter, transform, model, and synthesize these data into small replicate maps, charts, digital images, and tables that can be combined to enable envisioning of areas with TOD potential. An Internet-friendly envisioning tool will be more usable and effective. The Web site files are the principal output of this study, as opposed to the written report.

This project improves upon the local transportation facilities data developed for the previous *Envisioning* project (MTI Report 01-15) by using Arc View Network Analyst software to help estimate travel times to transit centers from surrounding areas, and estimates the resident population within travel time zones using 2000 Census counts for city blocks. Bicycle route maps and bicycle accident locations have been added to the detailed neighborhood profiles. The West Oakland BART vicinity has been added because of its TOD potential and the availability of many Internet-based data for Oakland, including crime statistics. The report suggests data sets that communities may wish to use to facilitate TOD developments.

PROJECT SUMMARY

Using the Internet to Envision Neighborhoods with TOD Potential

The presentation of Envisioning Techniques on the Internet uses a variety of currently available techniques requiring varying levels of skills and experience. The easiest ways are to place Microsoft PowerPoint presentation files on a Web server where they can be accessed by users of Microsoft's Internet Explorer software, or to convert digital images of text, map, chart, or photo images into Adobe Acrobat (PDF) files that can be linked to simple Web pages. These templates can provide navigation controls for moving from page to page and buttons as hyperlinks to other sources.

The intermediate level of Internet Web site creation entails using Hypertext Markup Language (HTML) code to control the placement of objects (text and graphics, including maps, charts, and digital images) on pages. The format and placement of multiple objects or images can be controlled through the use of tables or frames controlled by HTML coding. The core of the Web site developed for this project presents the updated contents of the previous *Envisioning* project (MTI Report 01-15) with some of the links found in the PowerPoint CD-ROM file created for that project, with the addition of hyperlinks to Web sites containing data used for this and the previous project, and other data sources of possible interest.

Currently, the most advanced type of Internet Web sites are those that allow users to construct custom pages of information that is actually drawn from the host computer in the form the user prefers. A common, simple example of this approach is the location and routing maps available on demand via the Internet, which have become quite popular. With services such as *Mapquest* (available at http://maps.yahoo.com), Internet users can type in their current address and destination address, and in moments receive back maps and directions for suggested road routes. Christian Harder, in *Serving Maps on the Internet,* well-summarizes the impact of Internet mapping, saying:

> The convergence of geographic information systems (GIS) and the World Wide Web has changed mapmaking forever. Once painstakingly produced by mechanical means, detailed maps can now be generated on demand from huge databases of spatial information and transmitted instantly across the globe. Suddenly GIS, until recently a specialized tool of scientists and city planners, is dispensing all manner of geographic information to an enthusiastic Internet audience (Harder, 1998, page 1).

As a prototype example of custom map generation that can be undertaken to envision aspects of neighborhoods with TOD potential, we have used ESRI's Arc IMS software program (Arc Internet Map Server) to enable users over the Internet to create two types of custom maps of the Hayward BART Station vicinity. Choropleth shaded maps of census blocks can display recently released Census 2000 race/ethnic population data selected by the user. This application is indicative of the possible powerful uses of 2000 Census data once it is fully released in 2002. (For census data release schedules, see http://factfinder.census.gov/home/en/releaseschedule.html.) Users can also use ArcIMS to create business location point maps showing which of forty Standard Industrial Classifications (SICs) or seven groupings they would like to see maps for, with interactive capabilities to show either the name or address of each mapped facility.

New Features in Project 2001 to Envision Neighborhoods

As in MTI Report 01-15, this *Envisioning* project seeks to introduce planners, developers, and urban analysts to information design techniques and digital computer tools that can be used to undertake and study TOD. A basic premise is that effective TOD requires thoughtful planning to

be integrated successfully into the metropolitan fabric. This project expands that goal to include special emphasis on using the Internet to accomplish Envisioning.

A focus of both *Envisioning* projects is intraregional comparisons, focusing on decisions pertaining to the relative desirability of places within the region. Limited attention has been given to site-specific details, although this aspect merits additional consideration in the future. Both studies seek understanding of neighborhoods surrounding transit centers, and their context in terms of the character of areas within walking distance (less than one-half mile), bicycling distance (less than two miles), and five-mile driving or transit distance. These ranges of analysis include areas where residents of TODs might work, shop, or prefer to go for services.

Understanding these areas may be important for developers seeking to colocate work sites, service centers, retail, or other facilities for residents, workers, and visitors within walking, bicycling, and moderate driving or transit riding distance of the TOD focus area.

This project includes a comprehensive case study application envisioning the Hayward BART Station area. Other case studies cover the Fruitvale and West Oakland BART in Oakland; Redwood City and Mountain View Caltrain; the Campbell Light-Rail Transit (LRT) site; and Sacramento's 65th St. Station area.

This project (like MTI Report 01-15) is unique in that most graphics are not reproduced within the text, but included on the accompanying Web site and/or CD-ROM.

The transit centers chosen for the creation of prototype examples are oriented around rail transit stops, with three being at BART (Bay Area Rapid Transit) heavy rail stops in the East Bay region (Hayward, and the Fruitvale and West Oakland stops in Oakland); two at Caltrain heavy rail stops in the Peninsula region between San Francisco and San Jose (Redwood City and Mountain View); and three at light rail transit (LRT) stops (the Mountain View and future downtown Campbell stop in Santa Clara County, and the 65th Street stop in Sacramento County).

Four of the transit centers include the downtowns of small to medium-large cities. All served as farm market centers during their formative years. Redwood City and Mountain View were on the commuter steam rail line built between San Francisco and San Jose in the 1860s. Redwood City and Hayward are the county seats of large urban counties, having from 500,000 to more than a million residents.

The Web site, available on MTI's Web site, TransWeb (temporarily at http://geosun.sjsu.edu/tod) and on CD-ROM are the principal outputs of this study. This Web site includes full-color displays and links to facilitate access to related text discussions, video clips, animated time series maps, and most important, links to Internet Web sites providing data, examples, and other information. These links enable users to choose and immediately access areas of analysis or data sources they

want to seei This approach has many advantages compared to the straight linear approach of reading printed text. Reading the printed black-and-white version is most meaningful when accompanied by viewing on a computer monitor the color screens and links available from the Web site or CD-ROM, as most of the maps and diagrams have been designed for color viewing.

Operations Help with Web Site Access and Use of CD-ROM

Appendix A contains operating instructions to assist readers in accessing the Web site on MTI's Web site, TransWeb, or the CD-ROM disk that contains a copy of the final files placed on the Internet at the completion of this project. These files can be accessed using a Web browser on a PC or Macintosh.

System requirements to access the full features of the Internet Web site include a broadband Internet connection of at least 128k, with DSL or T1 connections currently preferred. Users with 56k dial-up modem connections will be able to access most, but not all, files. Half of the files can be accessed via a dial-up modem with fair to good access speeds, and the other half of the files, including the case studies from the previous *Envisioning* project, require so much bandwidth that a person with dial-up access is likely to have very slow download times and often may have their Internet connection freeze. Therefore, the printed version of this report is accompanied by a CD-ROM disk with both the final HTML Web site version of this project and the Microsoft PowerPoint version of the previous *Envisioning* study.

System requirements to use the enclosed CD-ROM include the following:

- Windows PC running Microsoft PowerPoint 2000, RealPlayer and Media Player to view video movie files. Microsoft Internet Explorer release 5 or later is required for the optional viewing of the Microsoft PowerPoint 2000 files.

- 32 MB or more RAM (Sacramento detailed views and Fruitvale views may require 64 MB).

- 270 MB hard disk space (for copying the CD-ROM to your hard disk for faster access).

- Preferably 17-inch or larger monitor with XGA resolution (1024 x 780). SVGA resolution (800 x 600) generally is OK, but has some graphics problems. VGA resolution (640 x 480) shows most text, but graphics are very poor.

USING THE INTERNET TO ENVISION NEIGHBORHOODS WITH TOD POTENTIAL

THE ROLE OF THE INTERNET IN MANAGING SPATIAL INFORMATION

Dangermond, in his preface to *Serving Maps on the Internet*, said:

> Systems for managing information according to geography …are as old as the earliest maps. Only recently, however, with computer technology, have we been able to manage vast quantities of information with speed and flexibility.
>
> Today, almost everything that moves or changes over time is being measured and converted into digital information, enabling us to organize our activities and our environment at unprecedented levels of detail and accuracy.
>
> The rate of change in less than twenty years has been phenomenal. In the early 1980s, there were several hundred people using geographic information systems, or GIS. Today there are at least a quarter of a million, and (soon) there will be tens of millions.
>
> This is partly because of simultaneous improvements in computing power, databases, measuring technologies, and GIS software. But the change has become exponential largely because of networking technologies, **the Internet, in particular**. (emphasis added) (Source: Jack Dangermond, founder and president of ESRI, in the preface to Harder, *Serving Maps on the Internet*, 1998.)

Pandey, Harbor, and Engel also note:

> Rapid growth of the Internet over the past decade has opened up exciting new ways to supply data, tools, models, and other information to potential users. Internet delivery provides opportunities to increase the involvement of stakeholders in the decision-making and planning process by providing knowledge and data through a widely accessible, fast, cost-effective, and easy-to-use medium.
>
> There are significant advantages to making planning and decision-support tools accessible on the Internet. The wide availability of models, decision-support tools, and databases on the Internet has the potential to empower users, allowing them to identify site-specific options that meet their needs and to perform analyses of alternative scenarios. (Source: Pandey, Harbor and Engel, *Internet-Based Geographic Information Systems*, 2000.)

The above two quotations clearly identify the Internet's expanding role in managing spatial information using GIS. This report provides guidelines and examples as to how the Internet can be used with effective information design and spatial data programs such as GIS to envision neighborhoods with Transit-Oriented Development Potential.

NEIGHBORHOOD PLANNING AND MEASUREMENT ISSUES

Envisioning Neighborhoods with TOD Potential

America is undergoing an urban renaissance accompanied by support for reconsideration of urban growth patterns and policies, paying increased attention to the diversity of residential lifestyle preferences. The "new urbanism," "smart growth," and "sustainable communities" are names for movements reflecting one residential lifestyle preference that has been neglected under policies that promoted standardized, automobile-oriented, suburban housing tracts (Katz; Van der Ryn, and Calthorpe). A key aspect of the New Urbanism movement is interest in integrating public transportation systems with well-planned, livable community developments having sufficient densities to support public transportation systems. Transit-Oriented Development (TOD) is the expression used to describe land use development specifically designed to take advantage of close proximity to good public transit.

TODs are distinguished from other urban settings by what Bernick and Cervero call the 3-Ds of density, diversity, and design.

Density means "...having enough residents and workers within a reasonable walking distance of transit stations to generate ridership." **Diversity** implies "...a mixture of land uses, housing types, and ways of circulating...within the TOD area." **Design** includes "...physical features and site layouts that are conductive to walking, biking, and transit riding" (Bernick and Cervero, p. 73).

Although transit-oriented development has been advocated in the United States for years (Bernick and Cervero, Ch.1), it has yet to realize its full potential. The *Envisioning* projects have developed techniques for regional planning agencies, local governments, and developers to screen, analyze, select, and promote areas with TOD potential. To facilitate TOD site selection, socioeconomic, demographic, land use, transportation, design, and other quality-of-life measures must all be considered in a spatial setting.

What is the appropriate scale for studying urban quality of life (QOL)? We suggest that quality of life is ultimately a distinctly personal measure for each person, reflecting his or her values and culture, nested in a set of spatial relationships. These spatial relationships begin with a person's home, reaching out to home-related facilities that help satisfy residential needs, and include a nested hierarchy of neighborhood communities, which may encompass school, shopping,

recreation, and service functions (see S. Brower, Chapter 2, "Neighborhood Settings," for an elaboration of these concepts.).

Personal quality of life may also be a function of the way in which different elements of various neighborhood communities are mixed together in space. Kevin Lynch uses a concept called **grain** to categorize spatial mixes, with fine grain existing "...when like elements, or small clusters of them, are widely dispersed among unlike elements, and coarse when extensive areas of one thing are separated from extensive areas of another thing." (Lynch, p. 265).

Therefore, QOL can be a function of the social, ethnic, and economic mix in neighborhood areas as compared to their contextual surroundings. As personal QOL preferences for grain coarseness and sharpness may be quite varied, it is desirable to make grain-related QOL information available in a variety of forms, with aggregate census tract and block group data in maps, charts, and tables used to determine coarseness, and census block data used to estimate fineness.

In summary, QOL is a personal measure, but depends on a hierarchy of facilities encompassing one's residence, and various definitions of neighborhood, as well as the grain, or spatial mix of groups or elements one interacts with. Thus, to understand QOL we must understand the spatial settings of urban components, starting with the smallest possible components (people, households, blocks, and so on) and moving out to encompass larger units such as clusters of blocks and other various conceptions of neighborhoods. Keith Devlin, in *InfoSense—Turning Information into Knowledge,* condenses his advice into one golden rule: "context matters" (Devlin, p. 201). This applies to urban QOL analysis in that spatial context is an important component, especially in urban settings.

While the digital/communications revolution (Mitchell) has created vast amounts of personal and household data, this data generally is not uniformly available to researchers and is scattered among survey research firms, geomarketers, utilities, real estate assessment officials, and a wide variety of semiWeb siteautonomous public service providers and Web sites.

Therefore, we usually start urban QOL analysis with readily accessible decennial Census data, which provided more than 2,000 pieces of data for block group areas averaging 1,000 persons, and the same detailed information for census tracts averaging 4,000 persons, as well as for towns, cities, counties, and states (Meyers).

While we would like to use as much personal data for individuals or households as possible, in many cases we are forced to use data for larger areal units, either block groups, census tracts, or even cities. This may entail serious problems, identified by quantitative geographers as the modifiable areal unit problem (MAUP) (Wrigley, et. al., p. 23; Openshaw, chapter 4).

Social scientists see the MAUP as a manifestation of what they call the "ecological fallacy." The ecological fallacy involves the inappropriate inference of individual-level relationships from areal-unit level results. It arises, typically, when areal-unit data are the only source available to the researcher, but the objects of study are individual-level characteristics and relationships. Routine analysis of census area data in the formulation of policy responses to individual household-level sociological and medical problems such as deprivation, deviance, and morbidity, carries considerable ecological fallacy risks and must be viewed as highly suspect (Wrigley, et. al., p. 30).

QOL analysis based on citywide data has similar problems. While there is no easy, patent solution to the MAUP, often it can be dealt with by judicious selection of zone boundaries or using the lowest possible level of aggregation. Therefore we suggest, where possible, using census block or block group rather than census tract or citywide data, and where citywide measures are desired, building them up from smaller area measures wherever possible. This is a complex topic worthy of a detailed study of its own.

Our conclusion to the question of what is the appropriate scale for studying urban QOL is to strive for a scale that best reflects peoples' varied preferences, with substantial analysis at the neighborhood level. We believe that residences and development sites should be studied in their context, which means looking at data for blocks, block groups, and combinations of block groups in the setting of the larger urban region. Therefore in studying urban QOL, we recommend that locations be studied in the context of their block, neighborhood, and the location of neighborhood relative to the spatial patterns of the region (Bossard, 1998).

Envisioning Neighborhoods as a Technique for Estimating QOL in Neighborhoods with TOD Potential

An innovative technique, called Envisioning Neighborhoods (EN), is used in this project to determine, analyze, and promote potential TOD sites. The envisioning technique, being developed by Professor Bossard with the help of many others for this project (see acknowledgements), is building on the work done using Census data to envision neighborhoods in California (Bossard and Tallam; Bossard and Kelly).

The EN technique enables decision-making regarding places by effectively bringing together information as multiple maps, charts, and images. Pioneering EN applications, including a revised version of the presentation initially presented at ICQOLC 98, are available at http://www/ transweb.sjsu.edu/bossard/census.html.

This and the previous *Envisioning* project have designed, documented, and applied techniques to envision the quality of life and contextual nature of potential TOD sites, along light and heavy rail corridors in the San Francisco Bay region. Data screening techniques have mostly used 1990 Census data, but are designed to facilitate use of year 2000 data as it becomes available. Digital

ortho photos are used to find available developable land. GIS map analysis techniques are used to estimate population densities in rings around transit stops, as well as densities of potential riders, workers, and customers with access to transit centers with TOD potential. Understanding of TOD site potential is enhanced by multiple digital images of block fronts linked to digital video and seeing the contextual relationships of structures, transit facilities, and developable sites.

The *Envisioning* projects have developed case studies with guidelines to enable regional planners, local governments, and private developers to use the evolving tools of the digital communications revolution to screen, analyze, select, promote, and develop sites with TOD potential.

GUIDELINES FOR SYSTEMATIC DEVELOPMENT OF RESOURCES

Find, Filter, Transform, Model, Synthesize, and Present Using Envisioning Techniques

Project Overview 8 in MTI Report 01-15 presents three aspects of solutions to urban analysis problems in the digital data era that have been explored in the *Envisioning* projects. The use of digital information tools and information design principles to find, filter, transform, model, synthesize, and present data is discussed below.

Find data: The Internet has fostered a phenomenal increase in the quality and quantity of data available for urban analysis in recent years. Private vendors and government agencies also have made available large quantities of data on CD-ROMs. Sophisticated search engines have been developed to search the Internet for relevant data. We used several search engines including Yahoo.com to the search the Internet for sites with the keywords "TOD," "Transit-Oriented Development," or "Transit Oriented Development," and obtained a list of Web sites that were reviewed and used as a basis for links from this project's Web site to other TOD-related sites. Although search engines become more efficient each year, they are still crude and often include false leads and miss some key sites. Search engines are subject to bias, such as giving favored locations in the "sites found" listing to sites that have paid for prominence. Nevertheless, Internet search engines have great potential, as envisioned by Michael Batty who provides a discussion of the future of data-finding "agents" that can digitally act for data seekers and search the information for desired data (Batty, 1998).

Filter data: A major problem with digital information obtained from the Internet is that procedures to screen data to select only data relevant to the task at hand have not kept up with increases in the quantity of raw data found. A solution is for broadly based standards to emerge for "metadata." Metadata is data about data, describing its origin, character, accuracy, and timeliness. Metadata can be used to help filter data down to that likely to be appropriate for further analysis. Data found on the Internet may be of uncertain origin. It is often a good practice to select data that has been widely used and accepted. Therefore, government census data is often

selected because of its well-studied and known characteristics, in contrast to some data provided by private vendors who keep secret their data collection and estimation procedures.

Transform data: Relevant raw data often needs to be transformed so that it can be readily comparable to other data. Frequently, it is desirable to transform raw count data into relative share or intensity measures to facilitate comparisons of the character of places of different sizes. Calculating the mean and standard deviations of census measures for small areas in a county, such as block groups or census tracts, can produce Z-scores that compare measures for a place to mean values for larger areas such as counties. Z-scores have the desirable property that the unit of measurement is standard deviations, a measure of dispersion that allows comparisons of factors that originally may have been measured in a variety of units such as dollars, numbers of persons, numbers of households, or persons per square mile. When using Z-scores, concern should be given to the norm areas used for the average. Ideally it should be for the region within which comparisons are being made, such as counties, or aggregations of counties for intrametropolitan region location decisions, such as choosing the neighborhoods with the most favorable TOD potential for a particular type of project.

Model data: Transformed data can be input into projection, simulation, and other types of transportation-land use models to estimate relationships and future conditions. The *Envisioning* studies rely on the modeling efforts of the Association of Bay Area Governments (ABAG), the regional agency for the nine counties around San Francisco Bay, for estimates and projections for periods from 1990 to 2020 for areas as small as census tracts. Modeling efforts undertaken with the data include estimating various data counts for areas within a half mile of rail stations and transit centers shown in Project Overview 18 in MTI Report 01-15 or on the Project Overview 9810 link on our Using the Internet Web site. ***which would be found where??***

Another way to model data is to construct indices of ranking areas by some measure. Residential quality of life can be rated by indices that focus on particular aspects of urban life, such as areas with good potential for middle-income residential TOD projects. Z-scores measures of neighborhood characteristics can be aggregated to produce composite measures that rank areas (Bossard and Tallam, 1997; and Bossard, 1998).

Synthesize and present data: A key aspect of the envisioning neighborhoods technique is bringing together pieces of data in replicate multiple maps and charts as a way to synthesize data into useful information. This topic was covered in **Project Overview 9: An Analysis and Presentation Solution For Envisioning Neighborhoods** in MTI Report 01-15, which details the technique to synthesize neighborhood condition data into small, multiple, replicate map, chart, digital image, and table displays. "**Small multiples, whether tabular or pictorial, move to the heart of visual reasoning**—to see, distinguish, choose.... Multiplied smallness enforces local comparisons within our eyespan, relying on an active eye to select and make contrasts rather than

on bygone memories of images scattered over pages and pages." (Source: Edward Tufte, *Envisioning Information*, p.33.)

Small multiples of maps enable us to see the spatial distribution of several different factors, such as the seven categories of business activity within two miles of the Hayward BART Station shown in the "Business Locations" screen on the Hayward part of our Web site. One can identify where concentrations of particular types of businesses occur and where particular types of businesses may be lacking. This may enable developers to look for unmet market niches they can choose to fill from a TOD site, or may convince potential tenants that a TOD project has sufficient services to satisfy their needs. A further synthesis of the business location data could be undertaken by applying a grid pattern over the neighborhood area maps and using a program such as the Arc View Spatial Analyst to sum the number of businesses of various types within different distances of the transit center to rate the neighborhood business character. Such work was done recently at MIT under the supervision of Professor Joseph Ferreira (CUPUM01).

Small multiples of charts, such as the multiple stacked bar charts in our Hayward BART vicinity Web site (the Hayward Summary 3 screen, which is number 9 of 14), enable analysts to compare the relative distributions for a number of key census data measures for block groups to the distributions for the city of Hayward, Alameda County, and State of California. These charts facilitate **comparisons across space** of the block groups surrounding transit centers and **comparisons across scale** by facilitating comparisons of block groups to successively larger scales of their city, county, and state. Small multiple stacked bar charts can be prepared easily using a template into which fresh data and titles can be readily added. (See *stacked bar template.xls* on the Envisioning CD-ROM). With a little practice, analysts can use small multiple stacked bar charts to envision quickly the general conditions in areas with TOD potential.

ANNOTATED WEB SITE SOURCES

Presented below are examples of Web sites providing information that could be used to envision neighborhoods. These examples are indicative of the resources available, rather than exhaustive. Annotated comments are provided to give a feel for the design of the sites. Click on the URLs below to access these files.

San Francisco Bay Area Annotated Internet Municipal and County Government Links, June 2001

Association of Bay Area Governments (ABAG)

http://www.abag.org/

The Association of Bay Area Governments' Web site is a clearinghouse for Bay Area government transportation-oriented development and transportation information. The home page is full of information and further links.

Alameda County

http://www.co.alameda.ca.us/

Alameda County's Web site is well-sorted and easily maneuvered. All the important links are on the right side of the home page, making it fast to move on to your target. The county does not have direct information on Transportation-Oriented Development but does have extensive information on local governments within the region, economic trends, and transportation.

State of California's County of Alameda Site

http://www.ci.alameda.ca.us/

This Web site home page reads like a newsletter, with short articles of city news covering the page. Of interest at the time of this survey was a story on the final report on Alameda's Transit Plan. The report was available complete as a downloadable (PDF) file. Other articles on redevelopment and an update of the General Plan were also headlined and discussed. Site searches are also possible from the top menu bar, making this a very usable and informative Web site.

City of Campbell

http://www.ci.campbell.ca.us/

The City of Campbell has a graphics-intensive Web site that is slow to load and not immediately intuitive. After the link page is ferreted out under the heading "History and Information," links of interest to this survey can be found. Of great interest is the "Silicon Valley Transportation Guide." This guide is actually another links page that has many transportation links not found on other sites.

Santa Clara County

http://claraweb.co.santa-clara.ca.us/

Santa Clara County's Web site has a good balance of general information with jump menus along the sides of the page to take you to your subject of interest. This density of information comes at a price, however: A high-resolution monitor is needed to see the whole width of the page without panning.

At the bottom of the main menu is "Helpful Links," which takes us to another layer of links. These links include cities within the county and local (regional) government agencies. There are links to Santa Clara Valley Transportation Authority (VTA), Metropolitan Transportation Commission (MTC), and Association of Bay Area Government (ABAG).

City of Mountain View

http://www.ci.mtnview.ca.us/

The City of Mountain View's Web site is simply and cleanly laid out with a search box prominently displayed about mid-page. Of interest at the time of this survey was the heading at the right-hand side of the page titled "Downtown Construction." Selecting this page, one could check an up-to-date review of all downtown redevelopment, with many TOD elements.

City of Oakland

http://oaklandnet.com/

The City of Oakland has a Web site that begins with a very graphical search engine and a list of links. Much of the information available there can be viewed directly in a browser, but much of it can be used only after plug-ins have been downloaded. This is not a bad thing, but should be known before the user accesses the information.

Redwood City's Home Page

www.ci.redwood-city.ca.us/ <http://www.ci.redwood-city.ca.us/>

Redwood City's home page is cleanly laid out and loads quickly. The links page may seem lackluster with too much unused space and a font that is too small if you are using a high-resolution monitor, but it is easy on the eyes at 800 by 600 and there is no need to pan across the page as in many more elaborate Web sites. In small print under the heading "About Redwood City," the subheading "Transportation" can be found.

Clicking this choice brings up a nice page of the Bay Area's transportation links. Along with "SamTrans," San Mateo County's own public transportation service, San Francisco and Santa Clara County's local services and the regional service links of BART, Amtrak, and Caltrain are listed. Also in the link listing is Etak's Bay area traffic pages Web site that give real-time traffic information. This is an interesting site to get a feel for what you will be up against if you need to travel. The Web site has no direct references to TOD on the Web site, but infill developments downtown and commercial developments on the Caltrain corridor are mentioned. So although Redwood City does not use the name TOD, it seems to be following the path of TOD.

City of Hayward

www.ci.hayward.ca.us <http://www.ci.hayward.ca.us/>

The City of Hayward, California, Web site (as of June 27, 2001) opened to a slow-loading, useless title page that showcases a graphic of their new city hall and a rollover button shaped like a key that leads to the next page of the site. The next page is little better in terms of loading and content, but at least gives some city links, one of which is titled "Downtown Development." On this page is a small article on a transit-oriented development being built next to City Hall. The project of 77 townhouses is advertised as a short walk from the Hayward BART and AC transit buses.

The rest of the site gives no clear paths to coverage of TOD or transit information. The best way to explore it may be by going to the bottom of the page and trying to find information using SEARCH. Even then you may not find everything you hoped to find but perhaps secondary ideas on which to search.

Annotated School Links of Target Areas, June 2001

Individual school's Web sites can be reached by the use of these sites. The nature of residential development can be affected by the characteristics of local schools. Residential TOD developers may want to use the Internet to determine the characteristics of the local neighborhood to better plan their projects. However, statistical information often is more readily available on district Web sites.

Great Schools

http://greatschools.net/modperl/go

This one Web site gives more statistical data and useful information than you are likely to find at any of the individual school Web sites. It is clearly laid out and well-written with instructions that are easy to understand. The URL given here brings you to the title page from where you can navigate to nearly any school, public, private, or charter; just by following the directions.

After navigating to an individual school, you will see its complete profile. School and teachers' information and school board actions are given before school statistics. Grades, test scores, and student ethnicity are presented in tables, in graphs, and numerically. The "Great Schools" Web site does not link to individual school Web sites.

Alameda Unified School District

http://www.alameda.k12.ca.us/

This is a good local school district Web site, well thought out and executed. This is a central site that gives district-level statistics and links to individual school Web sites within the district.

Hayward Unified School District

http://husd.k12.ca.us/

Hayward Unified School District's Web site gives more local information than many of the other Web sites. Statistical data about the schools is lacking, but there are links to other Web sites that do give such information.

Oakland Unified School District

http://www.ousd.k12.ca.us/default-ad.htm

Oakland Unified School District has an informative Web site. It is densely populated with current affairs and class requirements and seems to be updated quite regularly.

Santa Clara Unified School District

http://www.scu.k12.ca.us/

Santa Clara School district is another good Web site allowing quick navigation to useful information. All the common statistics and contacts are here for the district schools.

Sunnyvale School Unified District

http://sesd.org/index.html

The Web site for the Sunnyvale School District gives the district's objectives, strategies, and administrative and educational services. It also includes many of the statistics given by the Great Schools Web site.

Annotated Real Estate Links, June 2001

There is an abundance of real estate Web sites, some of which contain useful local area statistical data. Perhaps the best approach is to try a browser search using any of the popular search engines. Begin by searching on your target city and then refine your search to the area that you want for the scope of your study.

Real Estate.Com

http://www.realestate.com

This is a clearinghouse for real estate information. Pricing and market statistics along with locally specific information can be found here. The home page is effectively organized to get you to where you need to go.

Real.com

http://www.reals.com/state/california/hayward.htm

This Web site is a good example of a real estate site that offers a lot of information on the housing market but not much on the local markets per se.

Hayward Real Estate Online

http://www.iselleastbay.com/welcome-hayward-alameda-county-homes.asp

This Web site has a more personal feel and contains more local information. City, regional, and school information are all covered, as well as local realty information.

Annotated Crime Links–June 2001

City of Oakland CrimeWatch

http://www.oaklandnet.com "CrimeWatch"

This Web site allows persons to create crime maps and statistics for neighborhood areas for the crimes and recent periods they chose. It includes a tutorial and requires the use of cookies placed on users' PCs. See Chapter 2 for downloads from this site for Fruitvale BART and West Oakland BART Station areas.

OPTIONS FOR PRESENTING NEIGHBORHOOD DATA ON A WWW SERVER

The World Wide Web provides new opportunities for sharing text, graphics, photographs, video, data, and animations with members of the transportation planning community. New approaches include database-driven page construction at the selection of the user, which provides exciting potential for future studies. All these materials can be viewed at the convenience of the user with a variety of viewing options, often at the discretion of the user. Here we convert a series of *PowerPoint* presentations, typically used by a single presenter to an audience of limited size, to a Web site that can be accessed by all interested parties. Information displayed on the Web site can therefore be examined in great detail at the pace of the user, which leads to a significant amount of additional analysis. We explored a number of methods of presenting these data, each with characteristic strengths and weaknesses. Currently we have settled on a site that is best viewed over a high-bandwidth connection, 128 kbps or higher, and a monitor setting of 1024 x 760. We

have selected these parameters to maintain the integrity of the high-resolution images and video available on the site. We are currently working on a low-bandwidth (56 or 33.8 kbps) version, which will be accessible from the home page in the future. We seek input from reviewers and other users about the appropriateness of designing for monitor settings of 1024 x 760 as this allows better resolution of graphics with today's large monitors (19 or 21 inch), but causes users of lower-resolution monitors (800 x 600) to scroll horizontally to view the material on each page.

As part of the proof-of-concept aspect of this project, we have decided to display the information through a combination of HTML-based Web pages with Adobe Acrobat files converted from PowerPoint format. In the following sections, we describe some of the criteria used in making decisions on file formats; however, many of the Acrobat files could be further modified into HTML-based pages depending on feedback from the user community.

Easy Method—Placing PowerPoint files on the World Wide Web

PowerPoint presentations, such as those created under the *Envisioning Neighborhoods* project (MTI Report 01-15), can be displayed on the Web through a variety of currently available techniques. Selection of the specific method to be used depends on the skills of the developer, computer software to be used for conversion, and capabilities of the server. One of the easiest methods is to place Microsoft PowerPoint presentation files directly on a Web server where they can be fully accessed by users of Microsoft's Internet Explorer. The strengths of this method are that no format conversions are required, the original animations are preserved, navigation follows the same flow as the PowerPoint presentation, and any audio files created in PowerPoint can also be accessed over the Web. Significant difficulties with this strategy include: (1) the bandwidth required to view the PowerPoint presentations is much larger than required with Web pages constructed with Hypertext Markup Language (HTML) and Web-optimized graphics; (2) some end users prefer the Netscape browser and therefore cannot view the presentations; (3) the user may not be familiar with the design flow or presentation order of the PowerPoint file and become frustrated when navigating through large datasets, often skipping over critical information.

Intermediate Method—Converting to HTML-Based Pages

PowerPoint presentations also can be previewed and converted to HTML-based Web pages through the "Save as Web page" command, which allows for viewing through an assortment of Web browsers. Although this method is relatively simple, the results are often less than satisfactory, as animations are lost, unwanted menus may be created, and formatting of text and placement of objects, such as images, may be altered. One beneficial aspect is that simple navigation menus are created.

Another method is to save the PowerPoint presentations as Adobe Acrobat Portable Document Format (PDF) files. The Adobe Acrobat authoring software must purchased to produce the

Acrobat files, which then can be placed on the Web server. Viewing Acrobat files over the Web is relatively simple, but requires the free Acrobat Reader plug-in for the browser (downloadable from http://www.adobe.com). The plug-in usually is bundled with the most recent versions of Microsoft Internet Explorer and Netscape Communicator. Acrobat files have several distinct advantages for certain types of documents, including: (1) formatting of PowerPoint presentations is preserved in excellent detail, although animations may be inoperable regardless of which browser is used to view the information; (2) vector-based graphics can be viewed in high resolution with the magnification utility of Acrobat Reader; (3) hyperlinks can be inserted within Acrobat files, thus adding a level of interactivity; (4) minor editing of Acrobat files can be performed within Acrobat Reader and saved locally; and (5) production of hard copies using most printers is relatively robust as formatting is preserved. In general, Acrobat files are the preferred method of sharing structured documents where preservation of formatting is critical.

The series of Acrobat files can be linked together with simple Web pages written in HTML with any Web authoring software, such as Microsoft FrontPage. HTML pages can provide navigation controls for moving from one Acrobat file to the next (links may also connect one Acrobat file to another). A somewhat higher level of interactivity as well as additional controls on formatting the information and other useful options, such as including animations, is provided by HTML-based Web pages. Use of Acrobat files will generally shorten download times as compared to files in PowerPoint format; however, Web pages written in HTML typically have the quickest transmission times.

Another level of Web site creation entails using HTML code to control the placement of objects (text and graphics, including maps, charts, and digital images) on Web pages and to add a level of interactivity. Hyperlinks can be made to various forms of multimedia, including video, sometimes residing on external Web servers. If multiple objects or images are to be placed on a screen, then a construct using either "tables" or "frames" can be used to reserve places on each page for maps, charts, digital images, tables, or links to files that contain these components.

The core of the Web site developed for this project presents the updated contents of the previous *Envisioning Neighborhoods* project (MTI Report 01-15) with additional links to Web sites containing new data and additional data sources of possible interest. We have selected a combination of media and digital formats to provide the *Envisioning Neighborhoods* project across medium- to high-bandwidth connections to the Internet. High-bandwidth connections take advantage of the multimedia capability of the World Wide Web, and images are provided in high-resolution detail to enhance usability; MPEG video clips can be downloaded to provide dynamic viewing of neighborhoods.

The main user interface takes advantage of "frames" to easily access the principal components of the Web site from a consistent format. Formatting within each frame uses the "table" utility to layout text, graphics, animations, and video. Individual Web pages are written in HTML to access

a wide assortment of documents in PDF format. The user is offered a choice of resolutions for graphics through thumbnail reproductions, which can be used to access higher-resolution graphics that may have significant download times if accessed over low-bandwidth connections (for example, 33.6 or 56 k telephone modems). In other regions of the Web site, Flash and GIF animations are used to examine data that illustrate temporal or spatial variations. Additional levels of user interactivity could be added in the future through the use of Javascript and Java-based programming, although this effort is beyond the scope of the proof-of-concept nature of this project.

USING INTERNET MAP SERVERS FOR ACCESSING TOD INFORMATION

Information about the neighborhood surrounding a transit station can be extremely useful in encouraging businesses to locate near the station. However, developing such information can be a challenge, especially for a small business. Gaining access can still be a challenge, even if the information is already available as a printed map.

The World Wide Web provides an exciting new way to enable potential businesses to access information. Thus, the demographic and business characteristics of an area can be made available, even in map form. A new technology—the Internet map server—promises to give even more functionality to the end user via the Web.

An Internet map server is a Web application providing geographic information system functionality to a client using a standard Web browser. The client page communicates with a standard Web server, which communicates with the map server application (Figure 1). The client submits requests such as "zoom," "pan," or "display layer," based on user operations such as clicking a button. The Web server/Internet map server system returns updated information for the Web page, including updated map displays (for example, magnified around a specific location) and tables listing information about a feature selected on the map.
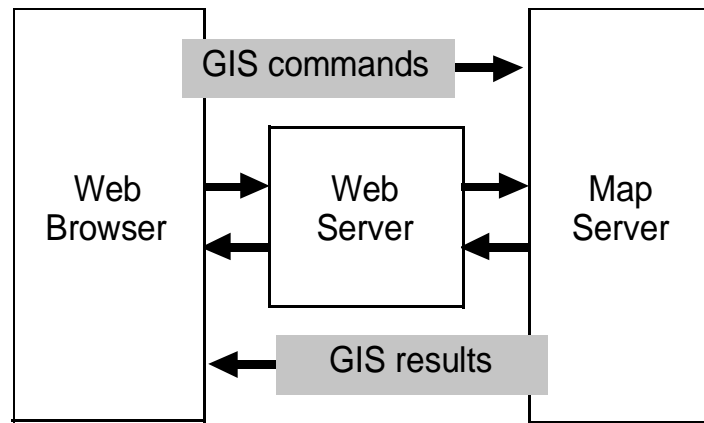
The Internet map server is an application that communicates with the user's Web browser through a standard Web server. GIS commands are sent to the server environment based on user actions such as clicking a button to enlarge the map. The map server processes the command and sends update results back to the client page. The user then sees an updated display of the mapped information.

Figure 1-1. Internet Map Server Schematic

The Hayward BART station neighborhood was used to create a sample Internet map server application using ArcIMS from Environmental Systems Research Institute. This application can be used with a Web browser to display information about the population and businesses near the BART station. Users also can query the GIS data and search for businesses by distance and business type. The application enables the public and businesses to access information about an area of interest and display that information in map form without a sophisticated computer mapping application on their computer.
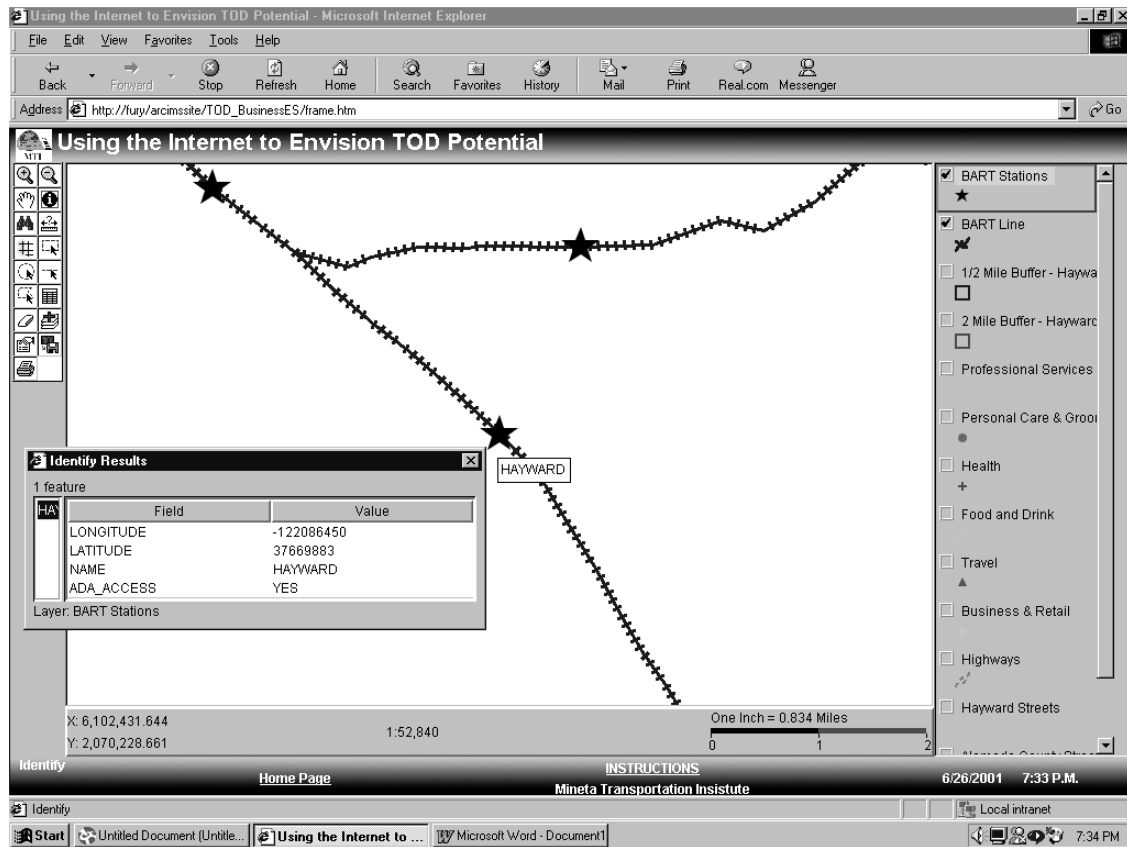
This map was created by unchecking all the legend entries except BART Stations and BART Lines. The BART Stations legend entry was then made active (highlighted) by touching on the legend entry. Once made active, a BART station was touched with the Identify tool, and the attribute table appeared with all of the corresponding data about the BART station.

Figure 1-2. Displaying Information About a BART Station
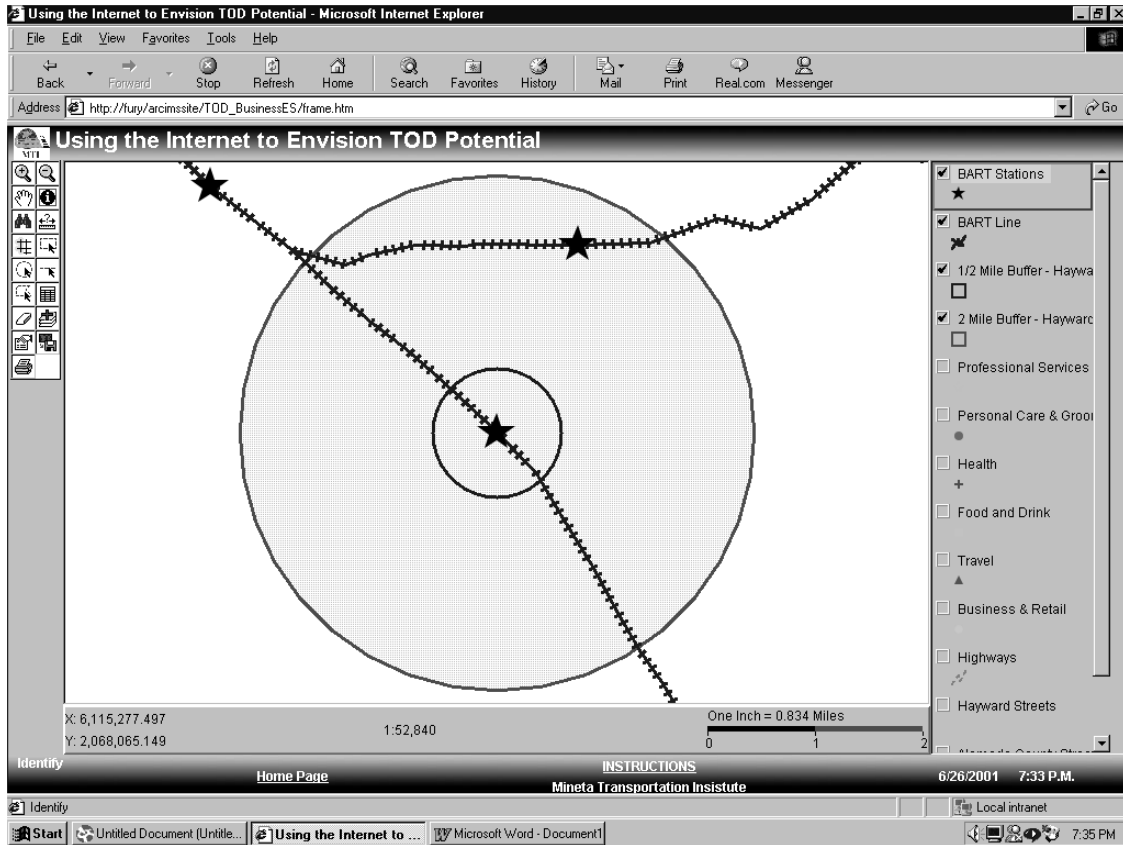
This map was created by checking the legend entries for BART Stations, BART Line, 1/2-Mile Buffer, and 2-Mile Buffer.

Figure 1-3. Displaying Information for Area Around the BART Station
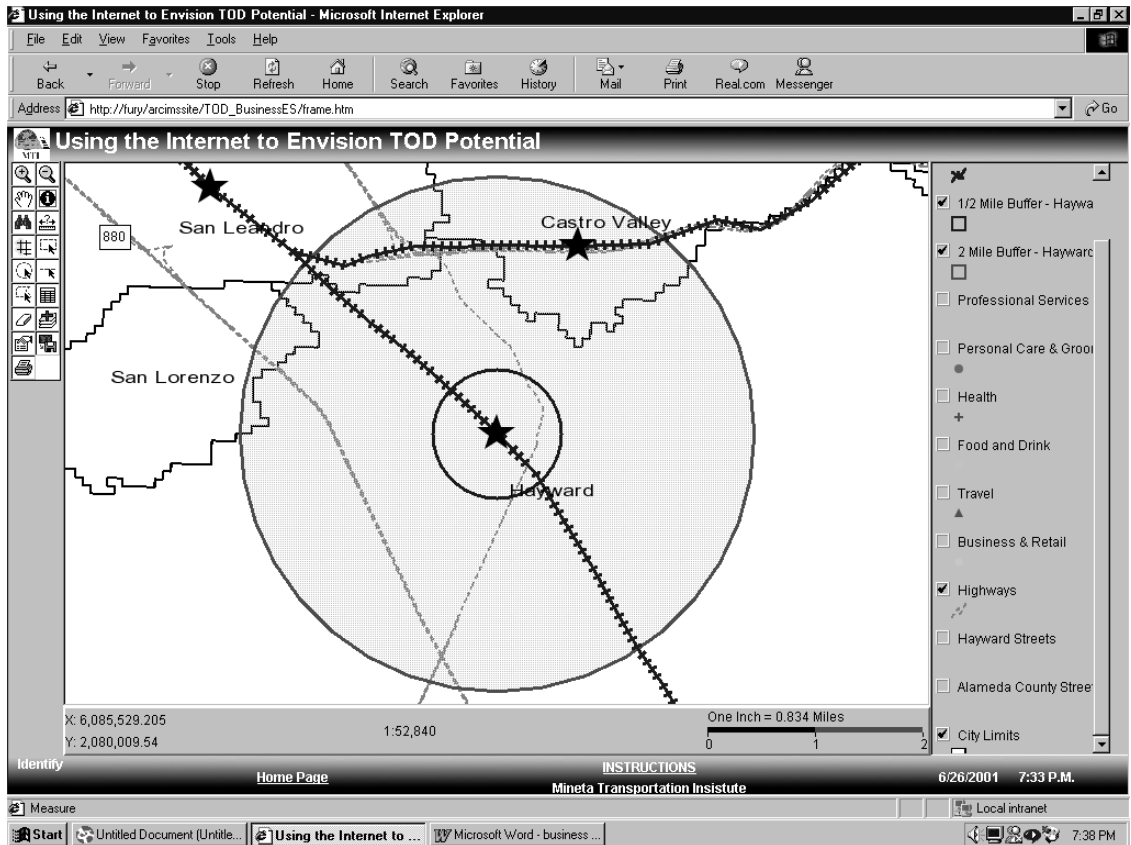
The yellow and black "880" tool tip automatically appears when the Highways legend entry is checked and the mouse rolls over any part of Interstate 880, a linear feature.

Figure 1-4. Displaying Highway Information
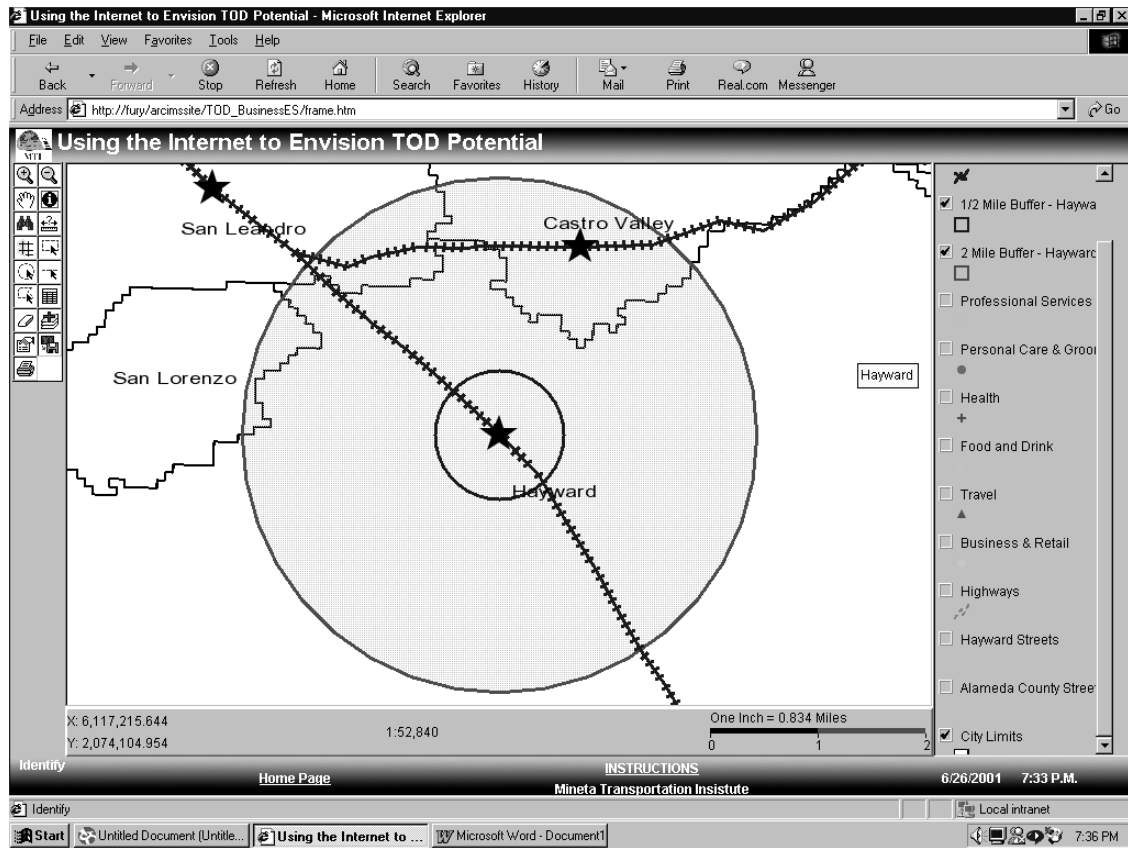
The yellow-and-black "Hayward" tool tip appears automatically when the City Limits legend entry is checked and the mouse rolls over any part of the Hayward city limit, an areal feature.

Figure 1-5. Displaying City Limits Information
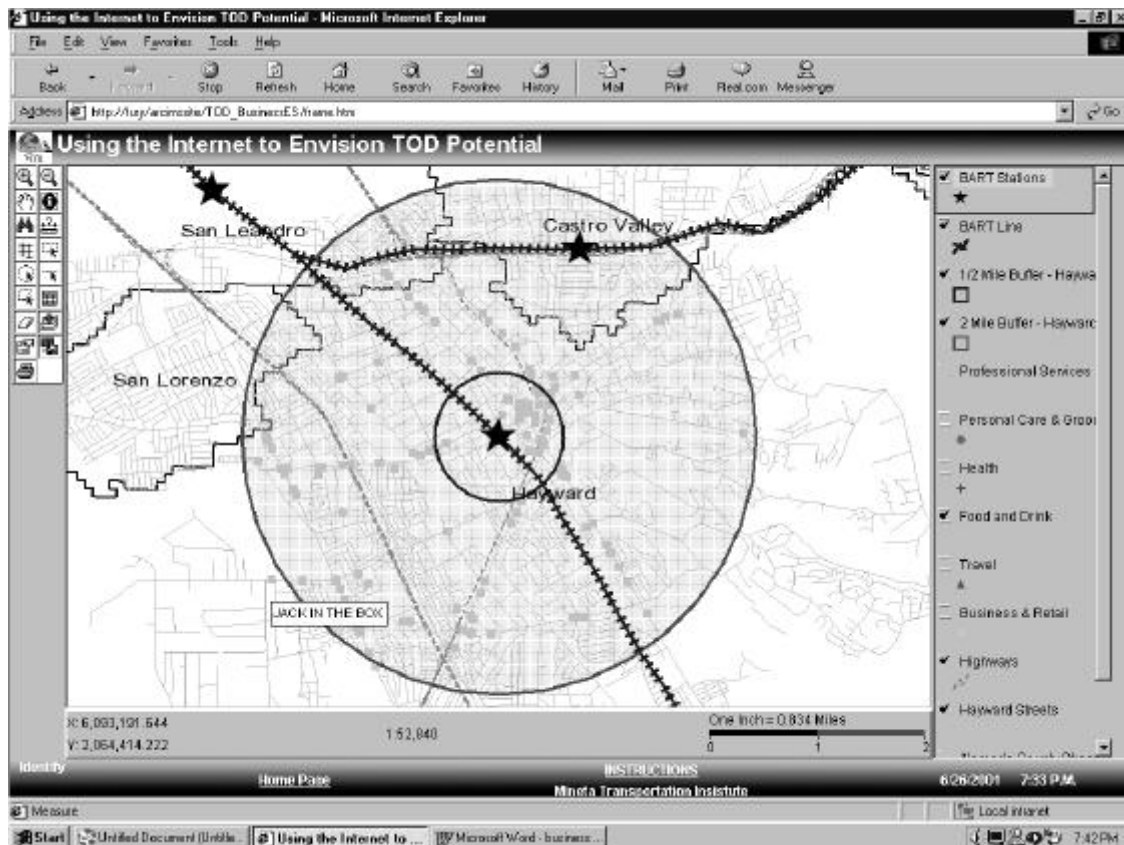
Pointer arrow or other tools will display name of establishment when the cursor is place on the dot.

Figure 1-6. Displaying Name of Business
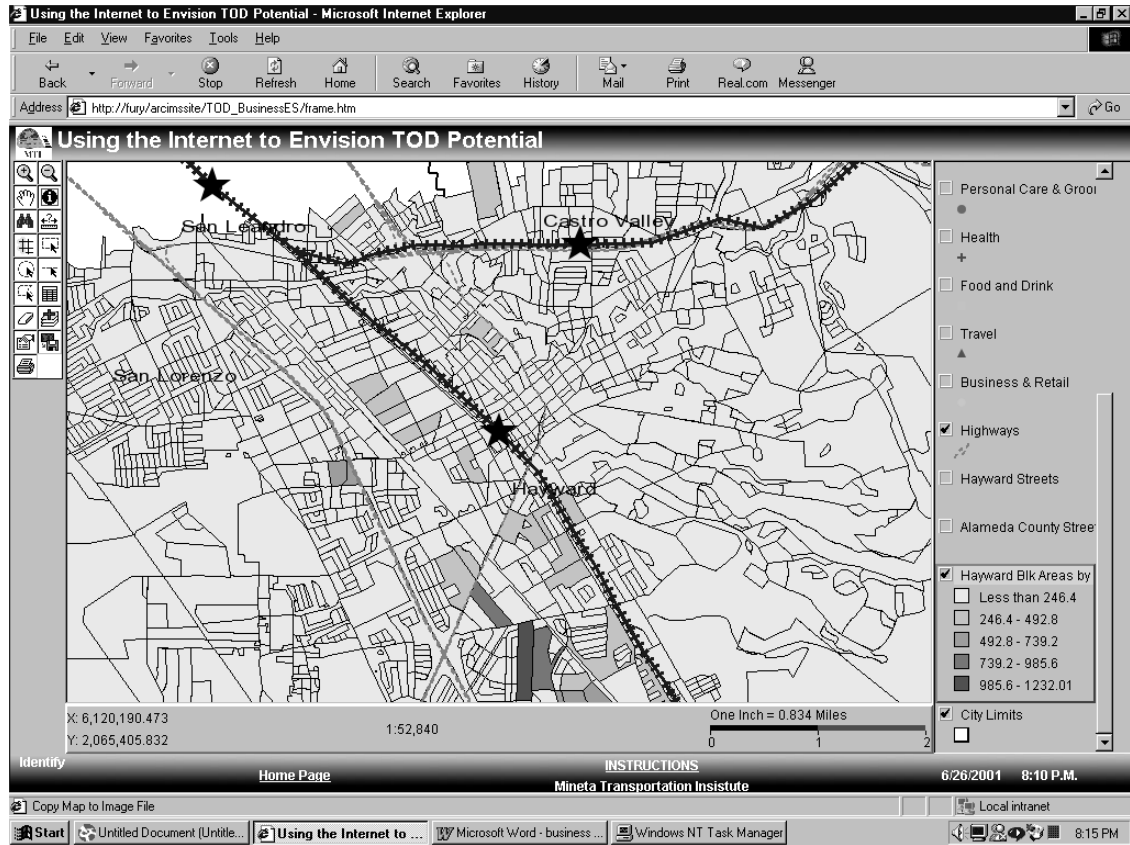
The Identify Tool can provide information about a specific business.

Figure 1-7. Displaying Information on a Specific Business

The map can also display information about geographic areas. In this case, the 2000 population for blocks near the BART station. The Identify Tool can be used to get information about the population

Figure 1-8. Displaying Information About Geographic Areas

1. Currently, the most advanced type of Internet mapping Web sites are those using programs such as ArcIMS that allow users to construct custom pages of information that is drawn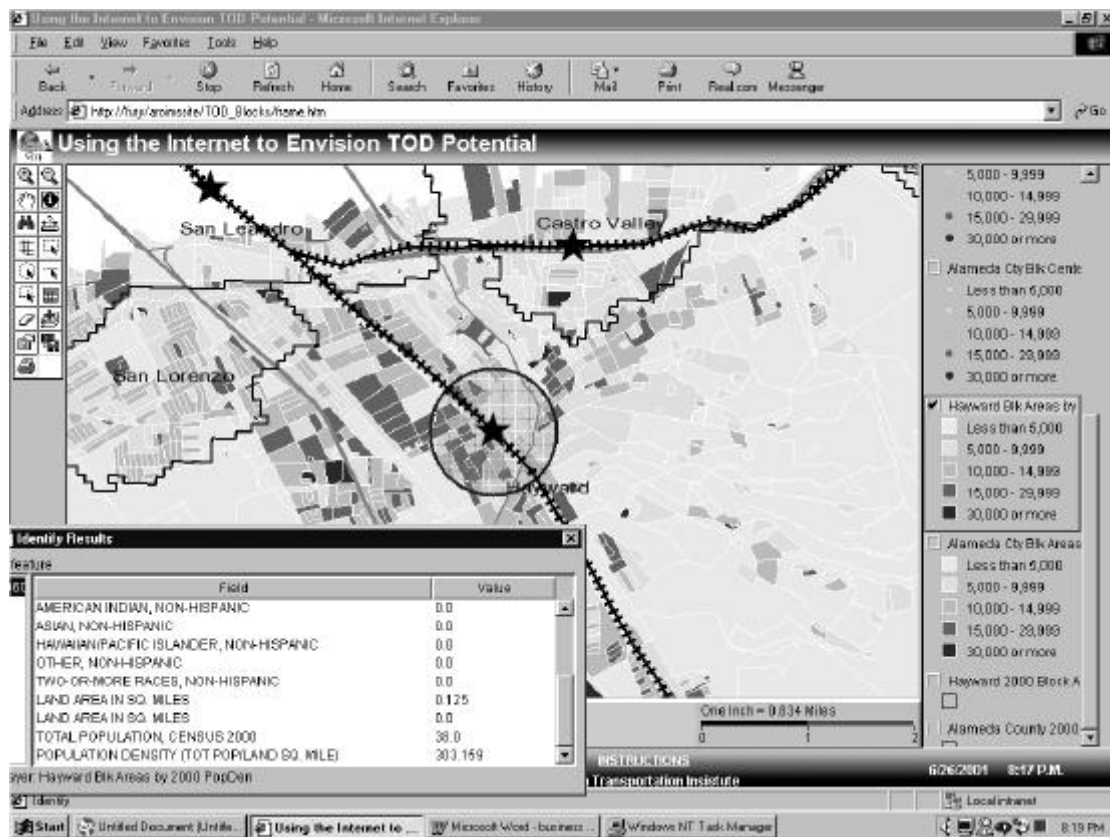 from the host computer in the form the user prefers. A common simple example of this approach is the location and routing maps available on demand via the Internet that have become quite popular in the past few years. With services such a Mapquest (available at http://maps.yahoo.com), Internet users can type in their current address and destination address and in moments receive back maps and directions for suggested road routes. Christian Harder, in *Serving Maps on the Internet,* well-summarizes the impact of Internet mapping, saying:

The convergence of geographic information systems (GIS) and the World Wide Web has changed mapmaking forever. Once painstakingly produced by mechanical means, detailed maps can now be generated on demand from huge databases of spatial information and transmitted instantly across the globe. Suddenly GIS, until recently a specialized tool of
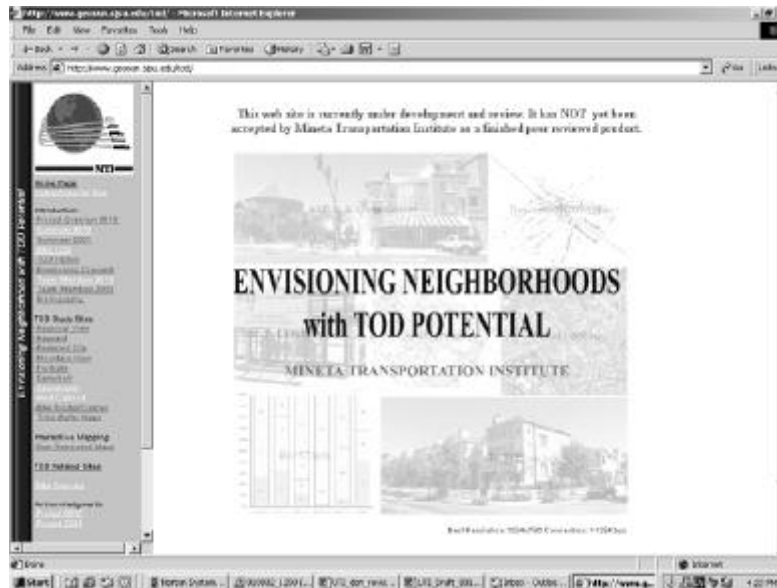
scientists and city planners, is dispensing all manner of geographic information to an enthusiastic Internet audience. (Harder, 1998, page 1).

The prototype example of custom map generation that can be undertaken to envision aspects of neighborhoods with TOD potential, discussed above, uses ESRI's Arc IMS software program (Arc Internet Map Server) to enable users over the Internet to create two types of custom maps of the Hayward BART Station vicinity. Choropleth shaded maps of census blocks can display recently released census 2000 race/ethnic population data selected by the user. This application is indicative of the possible powerful uses of 2000 census data, once it is fully released in 2002. (For census data release schedules, see http://factfinder.census.gov/home/en/releaseschedule.html.) ArcIMS also can be used to create business location point maps showing which of 40 Standard Industrial Classifications (SICs) or seven groupings a user would like to see maps for, with interactive capabilities to show either the name or address of each mapped facility.

Another aspect of interaction in this dynamic environment is that user feedback can be solicited, collected, and archived in databases on the server to improve the usability, quality, and accuracy of the information presented.

LAYOUT OF THE *ENVISIONING NEIGHBORHOODS* WEB SITE

Using the frames ability of HTML, we have created the user interface with a single menu for the entire site on the left margin of the screen. The materials that can be easily accessed from the menu are listed in Figure 1-8. That list gives general instructions for using the Web site, including optimum hardware and software settings. Overview information and summary reports for this and related projects are provided in Adobe Acrobat (PDF format). A general discussion of the TOD concept is provided, along with information of the Envisioning Neighborhoods project. These documents represent PowerPoint files that were modified slightly before being converted to Adobe Acrobat files. This format enhances production of hard copies of the documents with a stable, consistent format regardless of particular printer used; vector graphics can be magnified in Acrobat Reader so the user can examine details without the problem of pixilation. Information then is provided on team members and relevant bibliographic sources pertaining to the project.

Home Page	
Instructions for Use	**TOD Study Sites**
Introduction	**-Regional View**
-Project Overview 9810	-Hayward
Summary 9810	-Redwood City
Summary 2001	-Mountain View
-Why TOD	-Fruitvale
-TOD History	-Campbell
-Envisioning Concepts	-Sacramento
Team Members 9810	
Team Members 2001	-Bike Routes/Crashes
	Time Buffer Maps
Bibliography	
Interactive Mapping	**TOD Related Sites**
-User Generated Maps	**Data Sources**
Acknowledgments	
-Project 9810	
-Project 2001	

Figure 1-9. Home Page and Main Menu of *Envisioning Neighborhoods* Web Site

Following the general project information are reports of specific TOD study sites for the overall region and Hayward, Redwood City, Mountain View, Fruitvale, Campbell, and Sacramento. Each region is examined through a combination of text, photographs, maps, statistics, graphs, Flash animations, and panoramic MPEG video files. Many of the graphics can be magnified at the discretion of the user, because they are presented in a combination of Adobe Acrobat files and HTML pages. Additional topical reports are provided on bicycle routes and crash information, along with time buffer maps.

Next comes a discussion of interactive mapping, with user-generated maps produced on a map server that are based on the ArcIMS application from ESRI. To illustrate this powerful tool, a series of screen dumps produced by this application can be examined as thumbnail images with accompanying text descriptions, each of which can be activated (clicked on) to display a full-scale version of the particular graphic.

After the interactive mapping section of the Web site is a list of more than 110 hyperlinks to TOD-related sites that provide additional information to the user beyond this particular Web site. The user can access a list of agencies and organizations that have provided data for this project.

The menu ends with acknowledgement documents pertaining to the previous and current Envisioning studies.

NEW FEATURES IN PROJECT 2001 TO ENVISION NEIGHBORHOODS

This project improves upon the local transportation facilities data developed for the previous *Envisioning* project (MTI Report 01-15) by using Arc View Network Analyst software to help estimate travel times to transit centers from surrounding areas and estimates the resident population within travel time zones using 2000 Census counts for city blocks. Bicycle route maps and bicycle accident locations have been added to the detailed neighborhood profiles. The West Oakland BART vicinity has been added because of its TOD potential and the availability of many Internet-based data for Oakland, including crime statistics. The report suggests data sets that communities may wish to use to facilitate TOD developments.

For each of the five San Francisco Bay Area study areas envisioned in the previous *Envisioning* study, only the new bicycle and/or crime maps will be shown, along with a link to Web sites related to the site. The West Oakland study area will have a few summary pages shown in addition to the bike and crime maps, as it was not envisioned in the previous project.

BICYCLE INFORMATION

Bicycle Route and Crash Location Maps

Exploring patterns of bicycle usage is difficult, laborious, and expensive. Unlike motor vehicle-based roadway volume counts or gate-based parking surveys, there are few reliable mechanical or incidental means of collecting bicyclist data.

Until Congress passed the landmark transportation legislation, the Intermodal Surface Transportation Efficiency Act (ISTEA), in 1991 (see http://www.fhwa.dot.gov/environment/bikeped/BP-Broch.htm), there were no federal incentives for states or municipalities to quantify bicycle patterns on a regular basis.

The 1990 U.S. Census "Journey to Work" Data

A limited amount of data about individuals who reported that they bicycled to work in March 1990 is available at http://www.census.gov/population/socdemo/journey/usmode90.txt, but these data do not accommodate those commuters who use more than one means of transportation to access work. Thus commuters who ride their bike from their residence to a transit stop and then continue their journey on one or more other transit modes, might not have listed the bicycle as the "the one used for most of the distance" when asked on the 1990 U.S. Census Questionnaire.
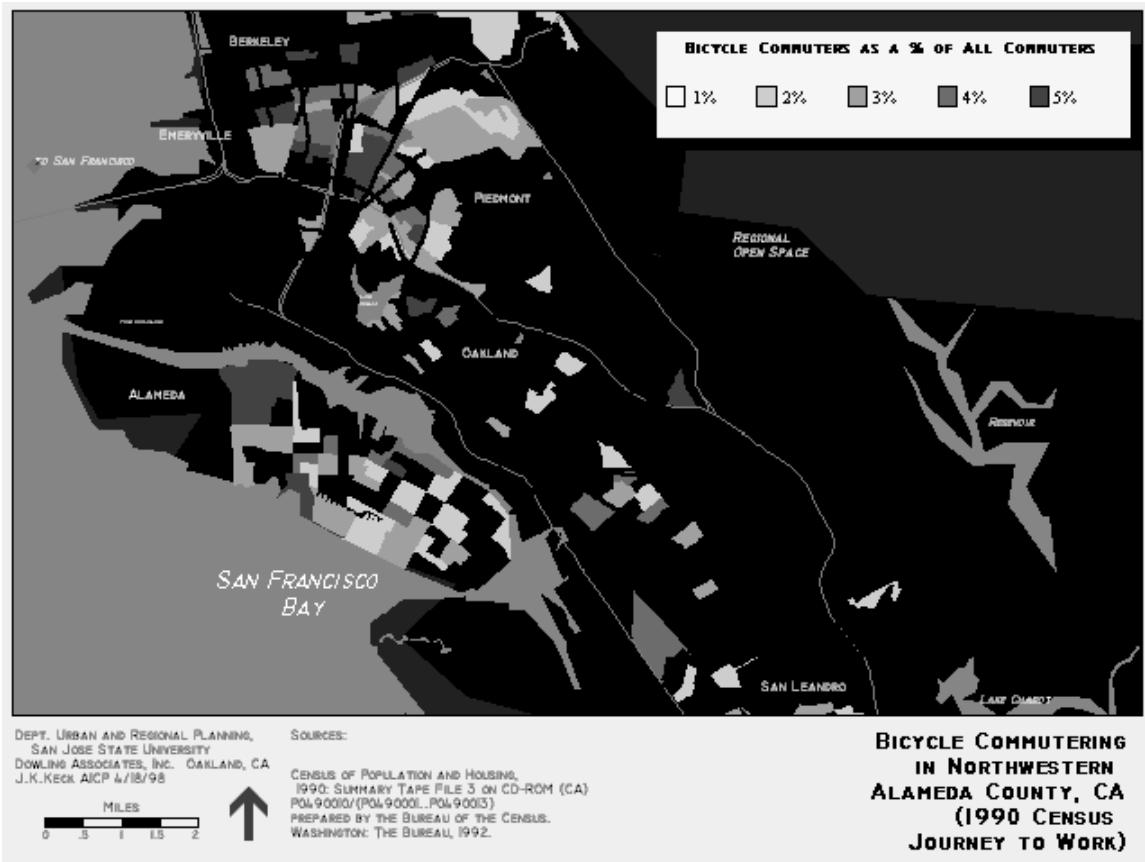
Figure 2-1. U.S. Census-Based Patterns of Bicycle Usage in the City of Oakland

Figure 2-1 illustrates how the U.S. Census Journey to Work data depicts bicycle usage in the City of Oakland and surrounding communities. Based on this map, one might conclude that there are relatively few cyclists in East Oakland and West Oakland, and that most cyclists are concentrated in North Oakland.

Using Bicycle Crash Data to Identify Patterns of Bicycle Use

Many states maintain computer databases of traffic accident records. State officials frequently use these records to monitor statewide safety efforts such as those designed to curb drunk driving. In California, local county and municipal officials use these annual and quarterly summaries to identify trends and safety concerns at particular locations.

Links to traffic incident reporting data include the following:

•   Nationwide Professional Organization—http://www.traffic-records.org/

- California—http://www.chp.ca.gov/html/switrs1999.html

- Texas—http://www.txdps.state.tx.us/administration/driver_licensing_control/arb.htm

- New Hampshire—http://www.clip.unh.edu/

- New Jersey—http://www.state.nj.us/lps/hts/traffic.htm - records

Bicycle accident data, when viewed at an annual or quarterly level time period, may not reveal patterns or trends to the same degree as motor-vehicle accidents for the same interval might.
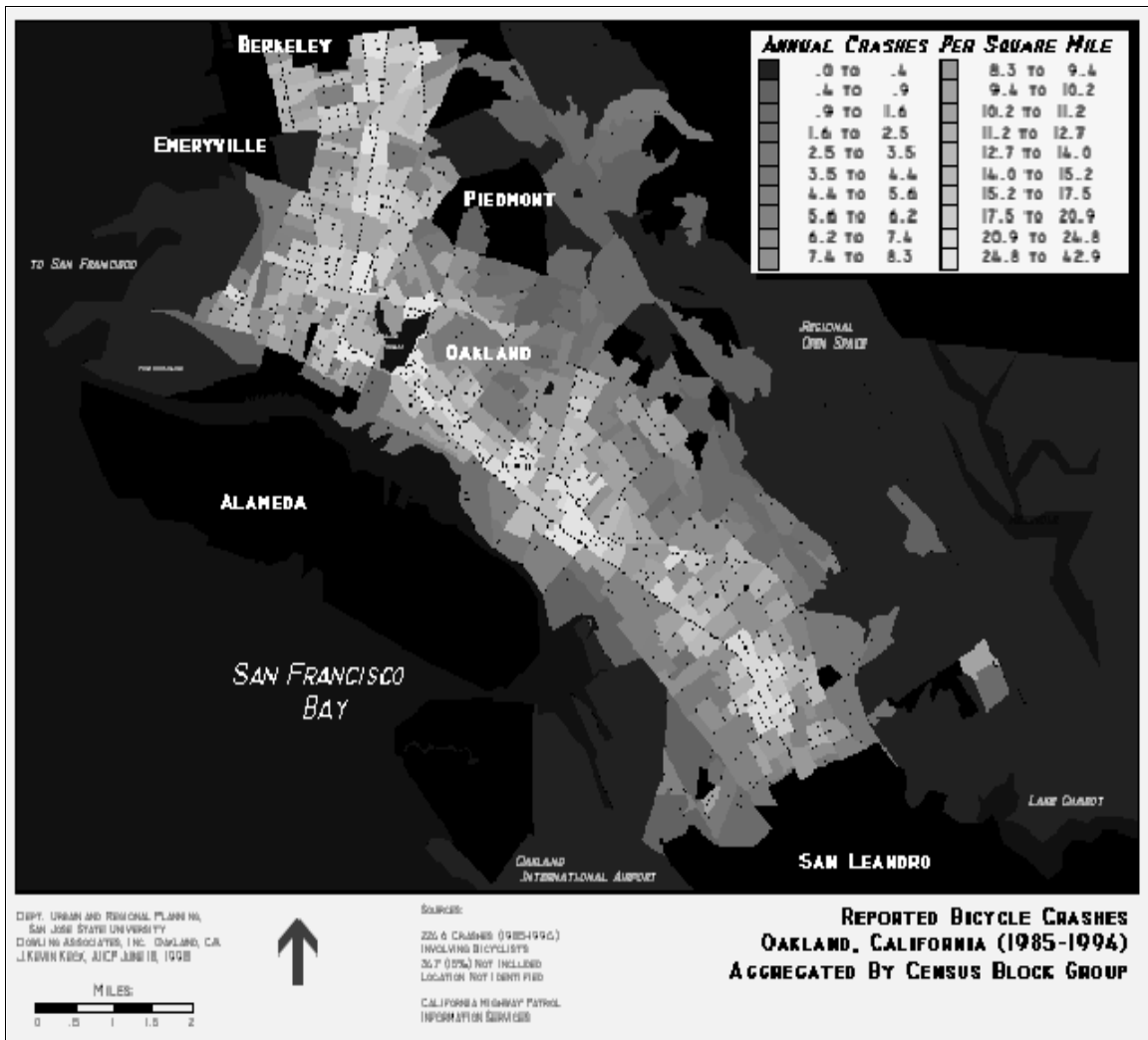

Figure 2-2. Crash-Data-Based Patterns of Bicycle Usage in the City of Oakland

Figure 2-2 takes the same U.S. Census block groups and associates these spatial units with the number of bicycle crashes reported between 1985 and 1994 in the City of Oakland. This map indicates that the incidence of bicycle crashes is distributed fairly evenly throughout Oakland. Unsurprisingly, there is a marked decrease in the crash density as one ascends the Oakland Hills in the northeast of Oakland.

Bicycle Crash Maps

The bicycle "crash maps" (Figure 2-3) produced for the MTC Regional Bike Plan and this transit-oriented development project demonstrate how bicycle crash data can help planners better understand bicycle circulation patterns. The purpose of these maps is not to identify, in and of themselves, any particular hazard or specific dangerous condition, but rather to portray those patterns of bicycle usage in the vicinity of transit stations that might otherwise go unnoticed.

These bicycle crash maps are ill-suited to microanalysis for several reasons:

- All crashes have been repositioned to the nearest major intersection.
- All crashes have been give equal weight, regardless of the incident's severity or the number of injured parties.
- The actual street names have, in some instances, been modified to aid in the geocoding process.
- About 14 percent of the total number of bicycle accidents reported in the MTC region were not geocoded.
- There was no discrimination as to who was at fault.

Accidents involving alcohol or impairment of any kind were not categorically excluded.
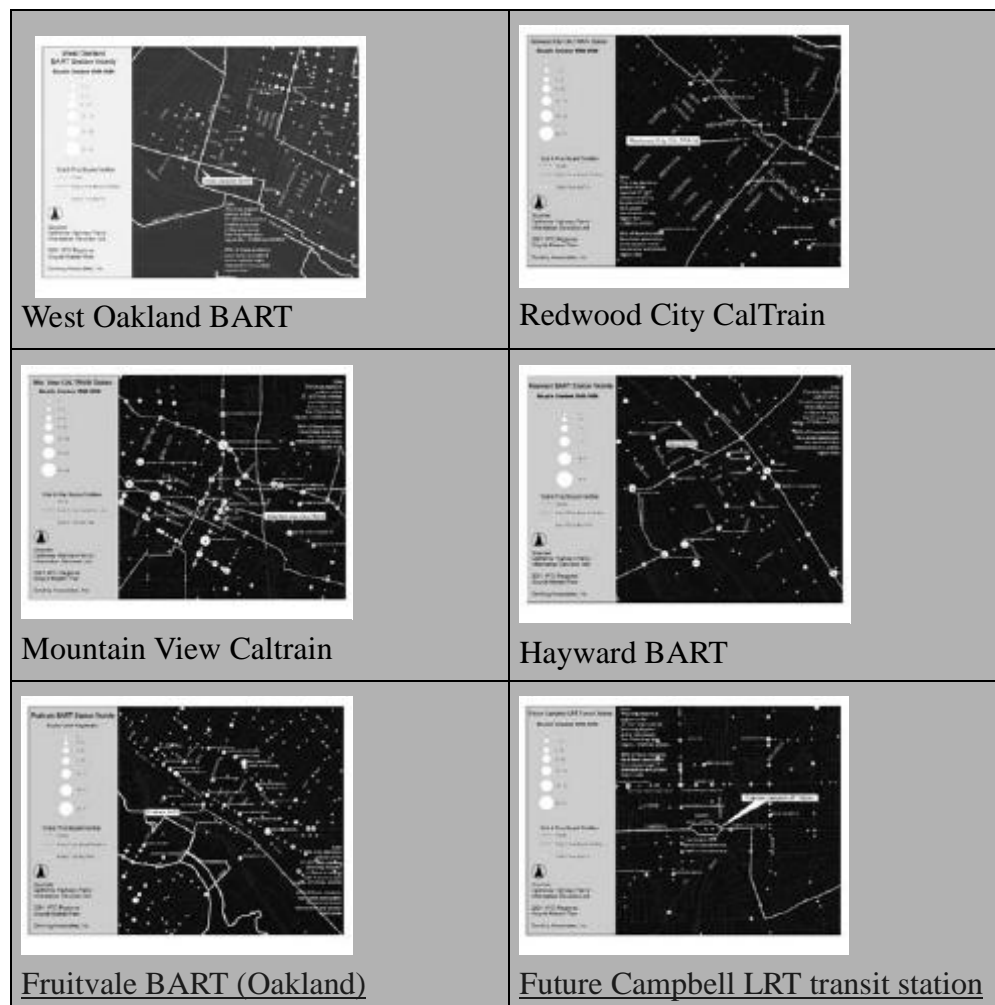
West Oakland BART	Redwood City CalTrain
Mountain View Caltrain	Hayward BART
Fruitvale BART (Oakland)	Future Campbell LRT transit station

Figure 2-3. Study-Area Bicycle Crashes

Bicycle Routes

The crash maps also display a preliminary inventory of existing and proposed bicycle facilities, and the identifiable portions of the region's Bay Trail network. These facilities, generally those appearing in municipal and countywide general plans, are being inventoried and identified on a regional basis by the MTC. Because of new federal funding sources for bicycle projects and a new effort to create a "seamless transportation system" (http://www.fhwa.dot.gov/environment/bikeped/BP-Guid.htm) that includes pedestrians and bicyclists, there are strong financial incentives to link bicycle facilities with transit facilities. In the San Francisco Bay Area, there are additional incentives related to air quality issues. The Bay Area Air Quality Management District

maintains a Transportation Fund for Clean Air (TFCA). This fund is designed to reduce air pollution from motor vehicles by funding cost-effective transportation projects and programs designed to reduce motor vehicle travel and vehicle emissions. Information about Bay Area Air Quality Management District initiatives is available at the following sites:

- http://www.baaqmd.gov/planning/plntrns/tfcapage.htm

- http://www.baaqmd.gov/planning/plntrns/bikeaq.html

Macroanalysis Level—the Hub and Spoke

These maps are designed to provide guidance to planners and engineers and help focus efforts for a more detailed analysis of the key bicycle circulation patterns surrounding these transit hubs. The analysis of bicycle circulation in the vicinity of a transit station may require a new hub-and-spoke configuration that, although common to Napster and the deregulated airline industry, is not typically applied or addressed at the street level to bicycle facility planning.

These bicycle maps may demonstrate that a new type of bicycle facility is warranted in the vicinity of transit facilities. A new, nonpoint, nonlinear approach to bicycle facility design may improve safety and better meet regional air-quality and local community amenity needs. In most cases illustrated, there are at least four bike route legs radiating from the general vicinity of the transit station. In some instances, these four legs may not be enough to serve existing or planned residences. In other cases, particularly those along the Caltrain corridor, the transit line itself can act as a barrier, which can serve (for better or worse) to concentrate access to the major arterials in the vicinity of the station.

POPULATION WITHIN TRAVEL TIMES OF TRANSIT CENTERS USING CENSUS 2000 DATA

These maps were produced with ArcView 3.2 and its Network Analyst extension; both software programs are from ESRI. Roads, streets, and population symbology were added to base maps that had been modified to show distance rings from chosen stations. These distance rings represent the time needed to cover the selected distances. The maps then were exported into Microsoft's PowerPoint program. Population data came from year 2000 U.S. Census population, STF 1 Census Blocks.
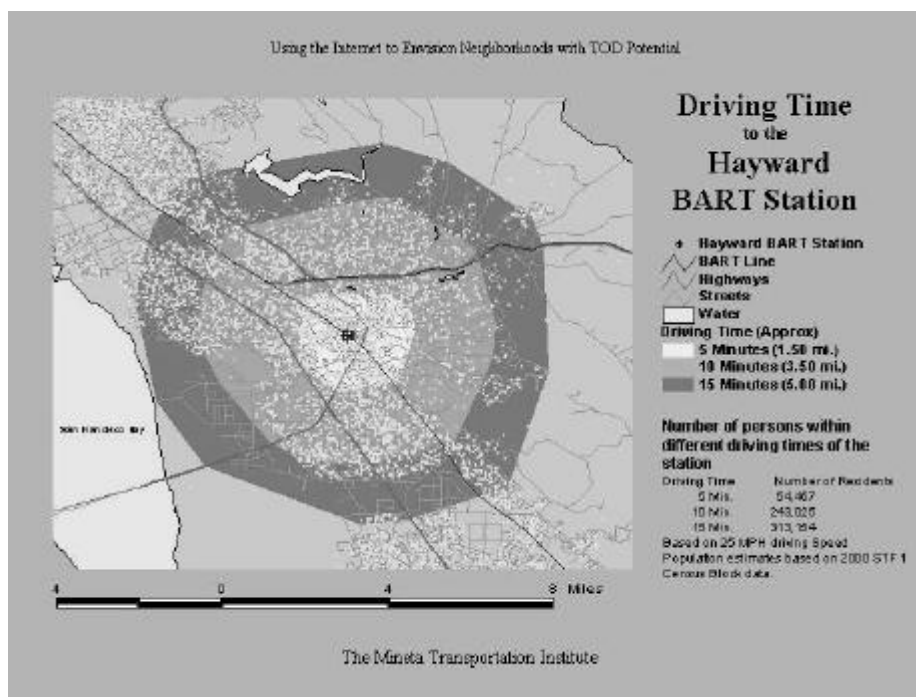
Figure 2-4. Hayward Driving

At this scale the distance bands are also concentric, showing how well the station fits into the fabric of Hayward's streets. Population shows concentrations along BART and highways.
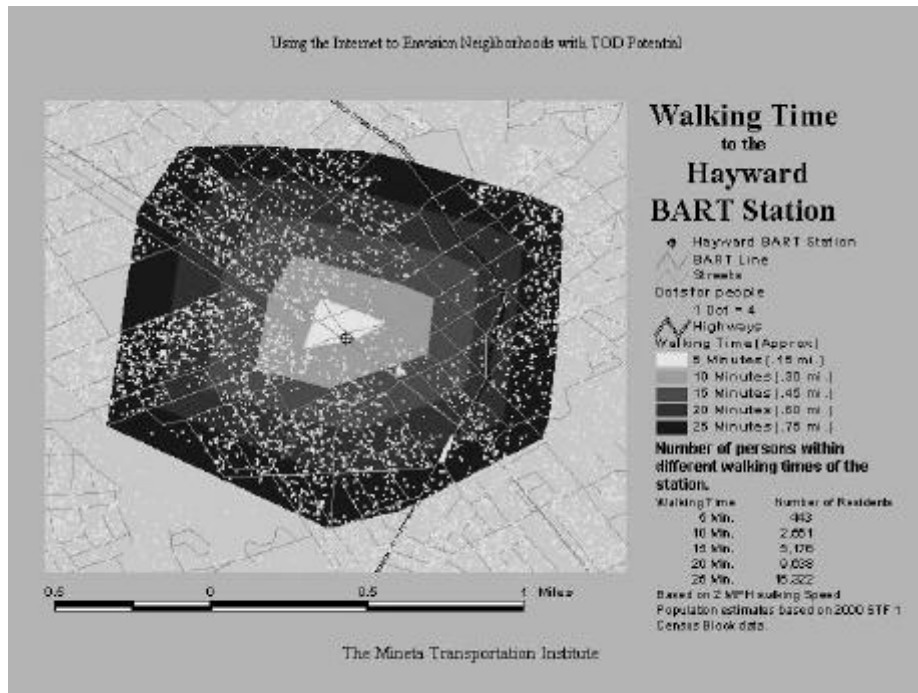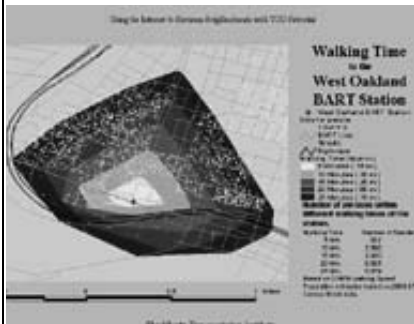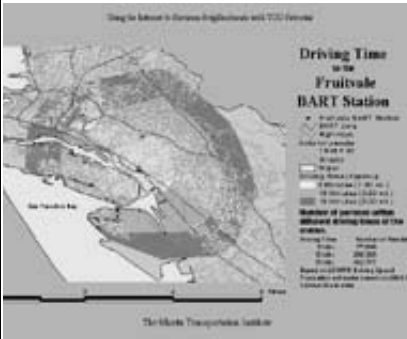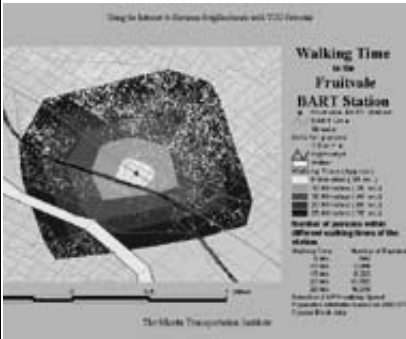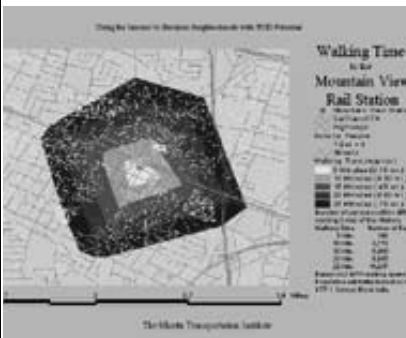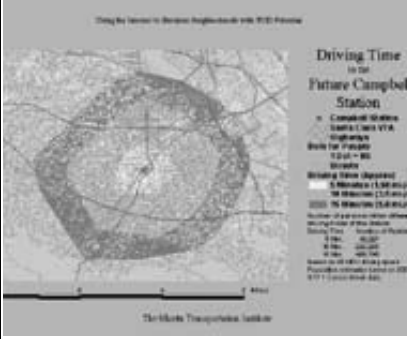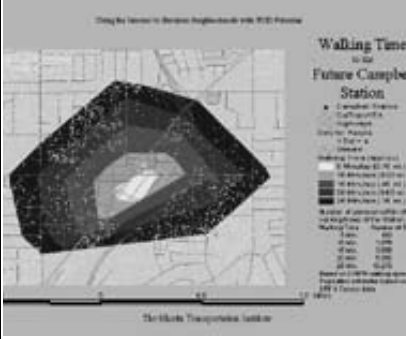
Figure 2-5. Hayward Walking

The generally concentric distance bands show good access to the station from all quarters except the southeast. Population also surrounds the station in a unified manner, suggesting it is well placed for maximum usage. In the year 2000, population density within a five-minute walking distance of the station showed few people living in the area. This also reflects the great possibilities for mixed-use infill redevelopment and TOD potential.

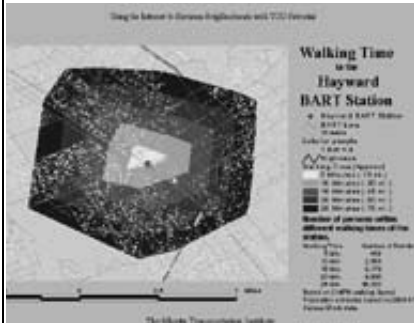| Driving Time Buffers		Walking Time Buffers
	Hayward Hayward Walking The concentric distance bands show good access to the station from all quarters. Population surrounds the station in a unified manner, suggesting it is well placed for maximum usage. Hayward Driving At this scale the distance bands are also concentric, showing how well the station fits into the fabric of Hayward's streets. Population shows concentrations along BART and highways.	
	West Oakland West Oakland Walking The pyramidal shape of the distance bands indicates that few streets cross the rail lines in this area. Population shows a profound bisecting across the rail and highway lines and many large blanks near the station. West Oakland Driving This scale more clearly shows the nature of the area and BART coverage. Population is nearly completely to the north and east.	

Driving Time Buffers		**Walking Time Buffers**
	Fruitvale Fruitvale Walking Walking distances are squared off because of incomplete grid pattern near the station and only one road across a water barrier. Low population near the station may show TOD potential. Fruitvale Driving At this scale, distance bands still show results from restricted movement across the Alameda Canal water barrier. Southwest to northeast population variances, which are bisected along rail and highway lines, are more visible.	
	Mountain View Mountain View Walking Fairly symmetrical distance band shows a good transportation fabric. Population coverage is uniform, except for two channels that are the commercial areas. This could show potential for mixed-use infill. Mountain View Driving At this scale, the effects of geography show up as streets come to an end at the edge of the San Francisco Bay in the north and in hills to the south. Population also shows the restraints imposed by geography.	
	Campbell Campbell Walking Incomplete street grid across the highway elongates the distance banding. Low population near the station begs further inquiry. Campbell Driving This scale shows the future Campbell station to have more uniform coverage at driving distances. Population numbers soar at these distances.	
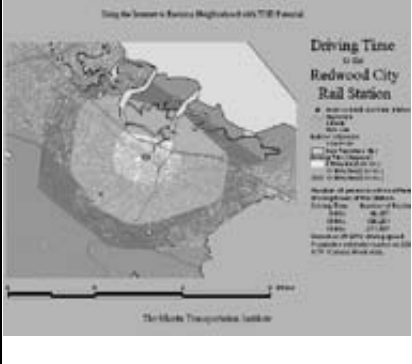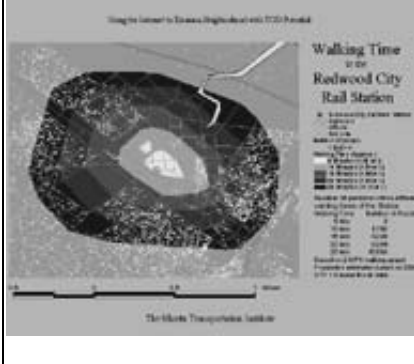
Driving Time Buffers		Walking Time Buffers
	Redwood City Redwood City Walking At walking scale, the distance bands are fairly symmetrical. What stands out is the lack of population close to the station. Redwood City Driving This map is much like the driving distance time map of Mountain View for the same geographical reasons. Population dispersion is nearly the same as Mountain View.	

Figure 2-6. Travel Distance Maps

CRIME MAPS FOR OAKLAND

CrimeWatch is a tool that was built originally for the Oakland Police Department in their efforts to analyze and detect crime patterns in different areas of the city. The Oakland Police Department has been using this tool since 1998, and they soon saw how CrimeWatch could help the public. The idea was that each person could be a crime analyst for his or her own neighborhood. This Web site could be very useful in statistical studies of future TOD projects.
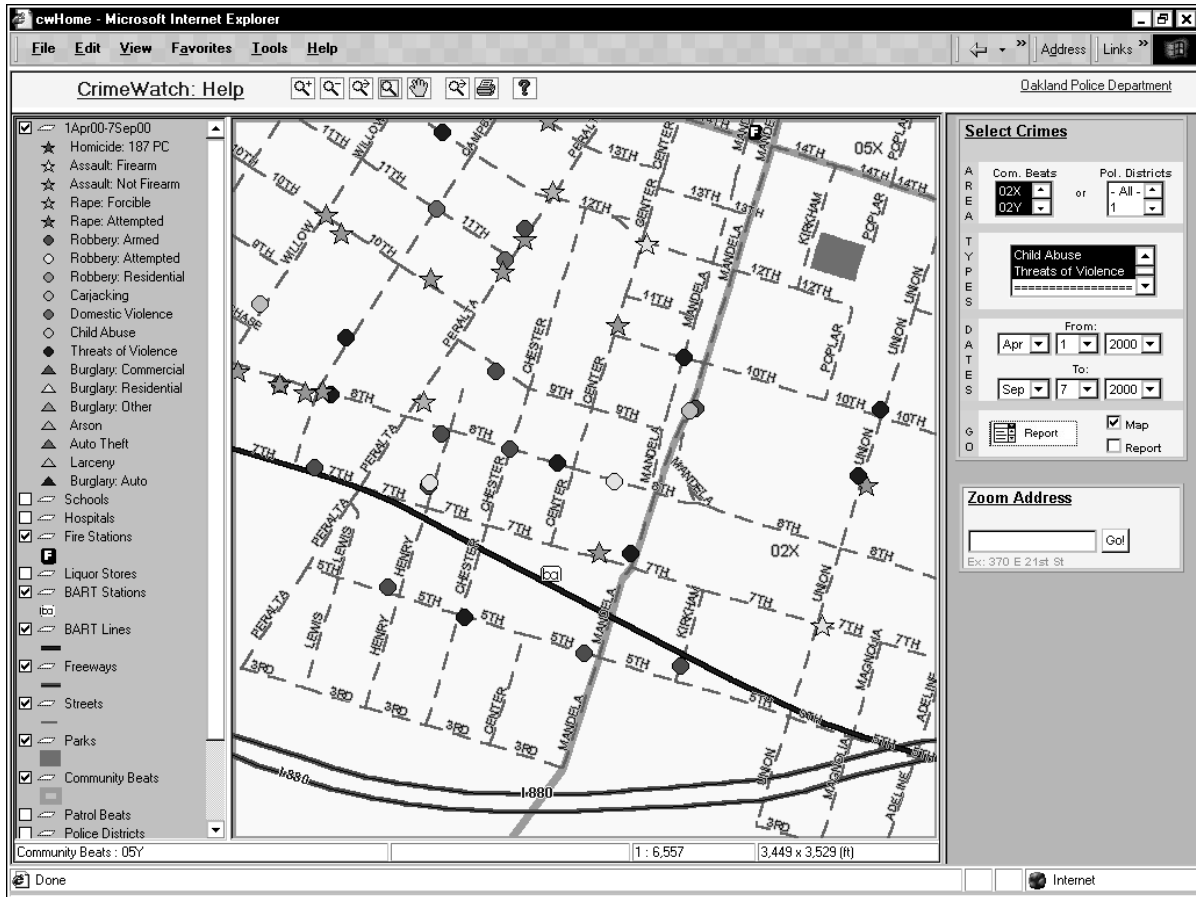
Figure 2-7. West Oakland Screen Shot From Oaklandnet.com CrimeWatch Web Site

Figure 2-8. Screen Shots from the Fruitvale CrimeWatch Site

APPENDIX A: INSTRUCTIONS FOR WEB SITE USE

Your Internet Connection Capacity			Website Use
Narrow Band Dial-up Telephone Modem		32K or Slower	Forget Internet, use CD-ROM *
		56K	Limited Internet (see Via 56K Modem)
Broadband	DSL	>128K	Access Acceptable Via Internet (see Via Broadband or CD-ROM)
	Cable		
	T-1		

* To simulate Web site access using the CD-ROM and your computer without actually using the Internet, place the CD-ROM in your CD-ROM reader and point your computer's browser (Microsoft Internet Explorer 4.0 or comparable) at the Index HTML file in the MTIZ001_Etodp Website" folder and open the file. Click on the underlined white text in the frame that appears with the Home Page. More than 25 separate Web-enabled files can be accessed in this manner.

	Via 56K Modem	Via Broadband or CD-ROM

Home Page	**Home Page**
Instructions for Use	**Instructions for Use**
Introduction	**Introduction**
-Project Overview 9810	**-Project Overview 9810**
Summary 9810	Summary 9810
Summary 2001	Summary 2001
-Why TOD	-Why TOD
-TOD History	-TOD History
-Envisioning Concepts	-Envisioning Concepts
Team Members 9810	Team Members 9810
Team Members 2001	Team Members 2001
Bibliography	Bibliography
TOD Study Sites	**TOD Study Sites**
-Regional View	**-Regional View**
-Hayward	**-Hayward**
-Redwood City	**-Redwood City**
-Mountain View	**-Mountain View**
-Fruitvale	**-Fruitvale**
-Campbell	**-Campbell**
-Sacramento	**-Sacramento**
-West Oakland	
-Bike Routes/Crashes	-Bike Routes/Crashes
-Time Buffer Maps	Time Buffer Maps
Interactive Mapping	**Interactive Mapping**
-User Generated Maps	**-User Generated Maps**
TOD Related Sites	**TOD Related Sites**
Data Sources	**Data Sources**
Acknowledgments	**Acknowledgments**
-Project 9810	**-Project 9810**
-Project 2001	**-Project 2001**

Adobe Acrobat Reader (4.0 or 5.0 free download at www.adobe.com) is needed to view most presentations in this Web site.

The left-side menu bar can be used to access all the files; use navigation buttons for moving within the files. 3-D buttons indicate links to other screens.

ACRONYMS AND ABBREVIATIONS

ABAG	Association of Bay Area Governments
BART	Bay Area Rapid Transit
Caltrans	California Department of Transportation
DOT	Department of Transportation
ESRI	Environmental Systems Research Institute
HTML	Hypertext Markup Language
ISTEA	Intermodal Surface Transportation Efficiency Act
LRT	Light-Rail Transit
MAUP	modifiable areal unit problem
MTC	Metropolitan Transportation Commission
PDF	Portable Document Format (Adobe Acrobat format)
SIC	Standard Industrial Classification
TFCA	Transportation Fund for Clean Air

BIBLIOGRAPHY

INTERNET

Flanders, Vincent, and Michael Wills. *Web Pages That Suck—Learn Good Design by Looking at Bad Design*. San Francisco: Sybex, 1998. www.webpagesthatsuck.com

Greene, R.W. *Open Access—GIS in e-Government*. Redlands, CA: ESRI Press, 2001.

Harder, Christian. *Serving Maps on the Internet—Geographic Information on the World Wide Web*. Redlands, CA: Environmental Systems Research Institute, Inc., 1998.

Lowe, Jonathan W. "Looking Good Online—Designing an Effective GIS Web Site." Geo Info Systems, October 1999, p.36-44 www.giswebsite.com/geoinfo/page1.htm

Lynch, Patrick, and Sarah Horton. *Web Style Guide—Basic Design Principles for Creating Web Sites.* New Haven, CN: Yale University Press, 1999. www.info.med.yale.edu/caim/manual

Pandey, Shilpam, Jon Harbor, and Bernard Engel. *Internet-Based Geographic Information Systems and Decision-Support Tools*. Park Ridge, IL: The Urban and Regional Information Systems Association (URISA), 2000.

Shiffer, Michael J. "Interactive Multimedia Planning Support: Moving From Stand-Alone Systems to the World Wide Web." *Proceedings of the Fourth International Conference on Computers in Urban Planning and Urban Management*, Vol. 2, Ray Wyatt and Hemayet Hossain, eds. Melbourne, Australia: University of Melbourne, 1995, pp. 39-54.

GEOGRAPHIC INFORMATION SYSTEMS

ArcInfo. Redlands, CA: ESRI Press, 2001.

Davis, David E. *GIS for Everyone*. Redlands, CA: ESRI Press, 1999.

Getting to Know Desktop GIS. Redlands, CA: ESRI Press, 1995.

Greene, R.W. *GIS in Public Policy—Using Geographic Information for More Effective Government.* Redlands, CA: ESRI Press, 2000.

Harries, Keith. *Mapping Crime: Principle and Practice*. Washington, D.C.: U.S. Department of Justice, Office of Justice Programs, National Institute of Justice, 1999.

Huxhold, William E. *An Introduction to Urban Geographic Information Systems*. New York: Oxford University Press, 1991.

Lang, Laura. *Transportation GIS*. Redlands, CA: ESRI Press, 1999.

Longley, Paul A., et al. *Geographical Information Systems: Principles, Techniques, Applications, and Management, 2nd Edition*. New York: John Wiley and Sons, Inc., 1999. www.wiley.com/gis 'Links to Big Book I'

_____. *Geographical Information Systems—Systems and Science*. New York: John Wiley and Sons, Inc., 2001.

Mitchell, Andy. *The ESRI Guide to GIS Analysis*, Vol. 1: Geographic Patterns & Relationships, Redlands, CA: ESRI Press, 1999.

_____. *Zeroing In*. Redlands, CA: ESRI Press, 1997.

Odenwalder, Edgar P., III. "GIS Applications Take Center Stage—A New Wave of Innovation Puts Users in Charge, Extending GIS Beyond Its Mapping and Engineering Beginnings." *GIS World*, Vol 11, No. 2, Feb. 1998, pp. 52-55.

O'Looney, John. *Beyond Maps—GIS and Decision Making in Local Government*. Redlands, CA: ESRI Press, 2000.

Openshaw, Stan. "Developing GIS-relevant zone-based spatial analysis methods." Ch. 4 in *Spatial Analysis: Modeling in a GIS Environment*, Edited by Paul Longley and Michael Batty. Cambridge, England: GeoInformation International, LTK, 1996.

Ormsby, Tim, et al. *Getting to Know Arc GIS—Basics of Arc View, ArcEditor, and ArcInfo*. Redlands, CA: ESRI Press, 2001.

Ormsby, Timothy, and Jonell Alvi. *Extending ArcView GIS*. Redlands, CA: ESRI Press, 1999.

Talen, Emily. "Bottom-Up GIS: A New Tool for Individual and Group Expressons in Participatory Planning." *Journal of the American Planning Association*, Vol. 66, No. 3, Summer 2000, pp. 279-294.

Wrigley, Neil, et al. Ch. 2 in *Spatial Analysis: Modeling in a GIS Environment*. Edited by Paul Longley and Michael Batty. Cambridge, England, UK: GeoInformation International, 1996.

Zeiler, Michael. *Modeling Our World: The ESRI Guide to Geodatabase Design*. Redlands, CA: ESRI Press, 1999.

INFORMATION DESIGN AND TECHNOLOGY

Bossard, Earl G. "Spreadsheet Design Guidelines." Ch. 2 in *Spreadsheet Models for Urban and Regional Analysis*, edited by Richard Klosterman, Richard Brail, and Earl Bossard. New Brunswick, NJ: Center for Urban Policy Research, 1993.

_____. "Envisioning Neighborhood Quality of Life: An Organizational Framework for Small Area Analysis, with a Case Study Envisioning Chinese Areas of Alameda County, California, USA." pp. 246-260 in Proceedings of *The First International Conference on*

Quality of Life in Cities, Vol. 2. Singapore: School of Building and Real Estate, National University of Singapore, 1998.

Bossard, Earl, and Tallam, Priya. "Envisioning Neighborhoods: Understanding Areas Using Multiple Replicates of Maps, Graphs, and Photos." pp. 481-492, in *Computers in Urban Planning and Urban Management. Vol. 1*, P.K. Sikdar, S.L. Dhingra, and K.V. Krishna Rao, eds. New Delhi, India: Narosa Publishing House, 1998.

Davenport, Thomas H. *Information Ecology: Mastering the Information and Knowledge Environment*. New York: Oxford University Press, 1997.

Devlin, Keith. *InfoSense—Turning Information into Knowledge*. New York: W.H. Freeman and Company, 1999.

Gates, Bill. *The Road Ahead*. New York: Penguin Books, 1995.

Jacobson, Robert. *Information Design*. Cambridge: The MIT Press, 1999.

Meyers, Dowell. *Analysis with Local Census Data, Portraits of Change*. Boston: Academic Press, 1992.

Mitchell, William J. *City of Bits: Space, Place and the Infobahn.* Cambridge: The MIT Press, 1995.

_____. *E-topia—Urban Life, Jim—But Not As We Know It.* Cambridge: The MIT Press, 1999.

Mulgan, Geoff. *Connexity: How to Live in a Connected World.* London: Chatto and Windus, 1997.

Negroponte, Nicholas. *Being Digital.* New York: Vintage Books, 1995.

Tufte, Edward R. *Envisioning Information*. Cheshire, CT: Graphics Press, 1990.

_____. *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press, 1983.

_____. *Visual Explanations: Images and Quantities, Evidence and Narrative.* Cheshire, CT: Graphics Press, 1997.

PLANNING AND TOD REFERENCES

Association of Bay Area Governments. *Projections 1998* Oakland, CA: ABAG, 1998.

_____. *Projections 2000*. Oakland, CA: ABAG, 2000.

_____. *Theory in Action, Smart Growth Case Studies.* Oakland, CA: ABAG, 2000.

Bauer, Raymond. *Social Indicators*. Cambridge: The MIT Press, 1966.

Batty, Michael. "Digital Planning: Preparing for a Fully Wired World." pp. 13-30 in *Computers in Urban Planning and Urban Management, Keynote Papers*. P.K. Sidar, S.L. Dhingra, and K.V. Krishna Rao, eds. New Delhi, India: Narosa Publishing House, 1998.

Batty, Michael, et al. "Visualizing the City: Communicating Urban Design to Planners and Decision Makers." In *Planning Support Systems—Integrating Geographic Information Systems, Models, and Visualization Tools*. Richard Brail and Richard Klosterman, eds., Redlands, CA: ESRI Press, 2001, Ch. 15.

Beatley, Timothy, and Kristy Manning. *The Ecology of Place*. Covelo CA: Island Press, 1997.

Bernick, Michael, and Robert Cervero. *Transit Villages in the 21st Century*. New York, NY: McGraw-Hill, 1997.

Bossard, Earl G., and Tara Kelly. "Envisioning the Quality of Life and Context for Development in Neighborhoods with Transit Oriented Development Potential." pp. 334-352 in Proceedings of *The Second International Conference On Quality of Life in Cities*, Vol. 2. Singapore: School of Building and Real Estate, National University of Singapore, 2000 (Reproduced as file BK_EQOL.ppt).

Brower, Sidney. *Good Neighborhoods—A Study of In-Town & Suburban Residential Environments*. Westport, CT: Praeger, 1996.

Calthorpe, Peter. *The Next American Metropolis: Ecology, Community, and the American Dream*. New York: Princeton Architectural Press, 1993.

Cervero, Robert. *The Transit Metropolis: A Global Inquiry*. Covelo, CA: Island Press, 1998.

Cervero, Robert. *Transit-Supportive Development in the U.S.* Washington, D.C.: Federal Transit Administration, 1993.

Colman, Steve. *San José State University, URBP 226 Course Reader.* Fall 1999. San José State University Department of Urban and Regional Planning.

Congress for the New Urbanism. *Charter of the New Urbanism*. New York: McGraw-Hill, 2000.

Corbett, Judy, and Michael Corbett. *Designing Sustainable Communities: Learning from Village Homes*. Covelo, CA: Island Press, 2000.

Duany, Andres, Elizabeth Plater-Zyberk, and Jeff Speck. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. New York: North Point Press, 2000.

Federal Transit Administration. *Planning for Transit-Friendly Use: A Handbook for New Jersey Communities*. 1994.

Frank, Lawrence D. "Land Use and Transportation Interaction: Implications on Public Health and Quality of Life." *Journal of Planning Education and Research*, Fall 2000, pp 6-21.

Fulton, William. *Guide to California Planning*. Point Arena, CA: Solano Press, 1999.

Holtzclaw, John. *Using Residential Patterns and Transit to Decrease Auto Dependence and Costs*. San Francisco: Natural Resources Defense Council, 1994.

Katz, Peter. *The New Urbanism—Toward an Architecture of Community*. New York: McGraw-Hill, Inc. 1994.

Kunstler, James Howard. *Home From Nowhere*. New York: Touchstone, 1996.

Lefaver, Scott. *Private Land with Public Partnerships for Transit Based Development*. San Jose, CA: Norman Y. Mineta International Institute for Surface Transportation Policy Studies, 1997.

Lynch, Kevin. *A Theory of Good City Form*. Cambridge: MIT Press, 1981.

Morris, Marya. *Creating Transit-Supportive Land Use Regulations*. Chicago: American Planning Association, 1996.

Parsons Brinckerhoff Quade & Douglas, Inc. *Transit and Urban Form*. Transit Cooperative Research Program Report 16. Washington, D.C.: National Academy Press, 1996.

Partners for Livable Communities. *The Livable City: Revitalizing Urban Communities*. New York: McGraw-Hill, 2000.

Porter, Dougles. *Transit-Focused Development*. Washington, D.C.: National Academy Press, 1997.

Pushkarev, Boris S., and Jefferey M. Zupan. *Public Transportation and Land Use Policy*. Bloomington: Indiana University Press, 1977.

Smith, Wilbur. "Mass Transit for High-Rise, High-Density Living." *Journal of Metropolitan Communities*. Washington, D.C.: National Academy Press, 1997.

Transit Cooperative Research Program. *The Role of Transit in Creating Livable Metropolitan Communities*. Washington, D.C.: National Academy Press, 1997.

_____. *TCRP Report 16: Transit and Urban Form* Vol. 1-2. Washington, D.C.: National Academy Press, 1996.

Untermann, Richard. *Accommodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling*. New York: Van Nostrand Reinhold, 1984.

Van der Ryn, Sim, and Peter Calthorpe. *Sustainable Communities—A New Design Synthesis for Cities, Suburbs, and Towns*. San Francisco, CA: Sierra Club Books, 1986.

1000 Friends of Oregon. *Making the Connections: A Summary of the LUTRAQ Project*. Portland, OR: 1000 Friends of Oregon, 1997.

DATABASE SOURCES–(MTI PROJECT 9810)

San Francisco Bay Area 1990 U.S. Census data
　　　www.census.gov *(*CD-ROMs of STF 3A & 1B data were the main sources used)

Association of Bay Area Governments Projections '98 data
　　　www.bag.org "Services"
　　　www.bag.org "Bay Area Information"

"Bay Area Transit Information" www.bag.org "Local Government"

Internet links to BADGER-based digital ortho photos
　　　http://Badger.parl.com

Internet links to other data

California School data http://great schools.net/gas/find.html

Oakland Crime data http://Oakland net.com "Crime Watch"

ABOUT THE AUTHORS

Team Leader: Earl G. Bossard, AICP

Dr. Bossard is a professor of Urban and Regional Planning at San José State University. He holds B.S. and M.S. degrees in economics from the University of Wisconsin, Milwaukee, and a Ph.D. in City and Regional Planning from Harvard. He has worked extensively on computer applications for urban analysis and planning, with special emphasis on geographic information systems, spreadsheets, and census data. For both this report and the previous *Envisioning* project, Bossard produced the final report and oversaw production of all project components, created envisioning neighborhood concepts, and produced PowerPoint presentations.

Steve Colman, AICP

Steve Colman is an adjunct faculty member of Urban and Regional Planning specializing in transportation planning. He provided technical advice regarding many of the key readings for the literature review. Colman holds a B.A. degree in economics and a M.S. degree in transportation engineering science from the University of California, Berkeley. He is a principal of Dowling Associates with more than 22 years of experience in transportation planning.

Jeff Hobbs

Jeff Hobbs is a geography department student at San José State University, and provided the ArcIMS applications for this project. In the previous *Envisioning* project he provided ArcView database and map production expertise, worked with digital ortho quads, and provided Internet sources of data and programs. Hobbs has worked as a computer applications and mapping specialist for a number of local governments, including the Santa Clara County Planning Department and the city of San Jose.

Kevin Keck, AICP

Kevin Keck is an adjunct faculty member of Urban and Regional Planning specializing in computer applications for urban planners and environmental engineers. He provided the bicycle route and bicycle-crash maps for the six Bay Area study sites, along with the crime maps for Oakland areas in the vicinity of the Fruitvale and West Oakland BART Stations and photos of the West Oakland BART area. These maps are part of an ongoing MTC-sponsored Regional Bicycle Plan he and his firm are working on.

Keck holds a B.A. degree in English Literature from the University of Wisconsin, Madison, and an MUP degree from San José State University. He has worked in transportation planning for 14 years and was a Senior Transportation Planner at Dowling Associates in Oakland. Keck currently is a Transit Planner for the San Francisco Municipal Railway (MUNI).

Donald Reed

Dr. Reed is a Professor of Geology at San José State University and served as this project's Internet Web development advisor, meeting on a weekly basis with Dali Zheng and others during key periods of the Web site development. Reed is a Internet pioneer within the California State University System, having developed some of the first Internet-based courses and leading courses on Web site creation for professors within the system while serving as Internet adoption resource person for the San José State University campus.

Reed holds a Ph.D. degree from the University of California, San Diego, Scripps Institution of Oceanography, and a B.S. degree from the University of California, Santa Cruz.

David Roemer

David Roemer is an Urban and Regional Planning Department graduate student. He used Arc View Network Analyst to produce the innovative new maps and tables of year 2000 populations within various walking and driving travel times of study area transit centers. He also provided the local government Internet links and downloads. Roemer holds a B.A. degree in Geography from San José State University.

Richard Taketa

Dr. Taketa is an Associate Professor of Geography at San José State University. For this project, he provided consultation on ArcIMS implementation and general consultation on GIS and Internet issues. This project used his contributions to the previous Envisioning project regarding ArcView mapping, summarizing data in rings and sectors, and map database design and creation. Taketa holds B.A. and M.A. degrees in Geography from San José State University and a Ph.D. in Geography, specializing in cartography, from the University of Washington.

Dali Zheng

Dali Zheng is a student of Urban and Regional Planning and was responsible for most of the technical work in preparing the Web site. He updated, from the previous *Envisioning* report, the Hayward study and maps showing as embedded bars the numbers of residents and workers near transit stations. In the previous report he pioneered the animated density maps, which he transferred to the Internet for this *Using the Internet to Envision Neighborhoods with Transit-Oriented Potential* project. Zheng has a Bachelors degree from Tongji University in Shanghai, China, and a Master of Civil Engineering degree from Tokyo University.

PREPUBLICATION PEER REVIEW

San José State University, of the California State University system, and the MTI Board of Trustees have agreed upon a peer review process required for all research published by MTI. The purpose of the review process is to ensure that the results presented are based upon a professionally acceptable research protocol.

Research projects begin with the approval of a scope of work by the sponsoring entities, with in-process reviews by the MTI Research Director and the project sponsor. Periodic progress reports are provided to the MTI Research Director and the Research Associates Policy Oversight Committee (RAPOC). Review of the draft research product is conducted by the Research Committee of the Board of Trustees, and may include invited critiques from other professionals in the subject field. The review is based on the professional propriety of the research methodology.