



**MTI**

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

# ***Envisioning Neighborhoods with Transit-Oriented Development Potential***

Mineta Transportation Institute  
San José State University  
San Jose, CA 95192-0219

**MTI Report 01-15**

**Envisioning Neighborhoods with  
Transit-Oriented Development Potential**

**May 2002**

Earl G. Bossard

Jeff Hobbs	Brett Hondorp
Tara Kelly	Scott Plembaeck
Dayana Salazar	Andrea Subotic
Richard Taketa	Tung Tran
Pin-Yuan Wang	Dali Zheng
Steven Colman	

a publication of the

**The Mineta Transportation Institute  
College of Business  
San José State University  
San Jose, CA 95192-0219**

Created by Congress in 1991

## Technical Report Documentation Page

1. Report No. FHWA/CA/OR-2001-25	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Envisioning Neighborhoods with Transit-Oriented Development Potential		5. Report Date May 2002	
		6. Performing Organization Code	
7. Authors Earl G. Bossard		8. Performing Organization Report No. 01-15	
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 <p>The Mineta Transportation Institute (MTI) at San José State University conducted this study to review the issues and implications involved when seeking to Envision Neighborhoods with Transit Oriented Development (TOD) Potential.</p> <p>The Envisioning Neighborhoods with Transit Oriented Development (TOD) Potential 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 successfully integrated into the metropolitan fabric.</p> <p>The primary focus of this project is intra-regional comparisons, focusing on information pertaining to the relative desirability of places within a region. Context matters, so data is best understood in a comparative context. Small multiple replicate maps, charts, and digital images can be used to understand many aspects of places with TOD potential. Place comparisons can be made across space, time, and scale. The study focus is on understanding the neighborhoods surrounding transit centers and their context in terms of the character of areas within walking distance (&lt; 1/2 mile), bicycling distance (&lt; 2 miles) and five-mile driving or transit distance. These ranges of analysis include the areas where residents of possible TODs might work, shop, or prefer to go for services. This project includes a comprehensive case study application envisioning the Hayward BART Station area. Other case studies cover the Fruitvale BART in Oakland, Redwood City and Mountain View CalTrain, Campbell LRT site, and Sacramento's 65th St. Station areas.</p>			
17. Key Words  Statistical analysis; Transit-oriented development; Transportation planning; Urban growth; Urban planning		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 126	22. Price \$20.00

**Copyright © 2002 by MTI  
All rights reserved**

Library of Congress Catalog Card Number: 200195386

To order this publication, please contact the following:

Mineta Transportation Institute  
College of Business BT-550  
San José State University  
San Jose, CA 95192-0219  
Tel (408) 924-7560  
Fax (408) 924-7565  
E-mail: [mti@mti.sjsu.edu](mailto:mti@mti.sjsu.edu)  
<http://transweb.sjsu.edu>

## ACKNOWLEDGEMENTS

The *Envisioning Neighborhoods with Transit-Oriented Development Potential* project team members are all associated with San José State University's Urban and Regional Planning Department (nine members) or Geography Department (three members).

The principal investigator was Earl Bossard. Other team members from the Urban and Regional Planning Department include Mineta Transportation Institute (MTI) Research Associates Dayana Salazar and Steven Colman, and graduate students Tara Kelly, Erin Mayer, Scott Plambaeck, Tung Tran, Pin-Yuan Wang, and Dali Zheng. Team members from the Geography Department include MTI Research Associate Richard Taketa and graduate students Jeff Hobbs and Andrea Subotic.

Institutional support was provided by the Urban and Regional Planning and Geography Departments as well as the Mineta Transportation Institute at San José State University. The planning and community development departments in the cities of Campbell, Hayward, Mountain View, Oakland, Redwood City, and Sacramento all helped provide data and information for this study.

Other contributors to this project include SJSU Masters in Urban Planning graduate Brett Hondorp, who contributed an essay on TOD history, and Geography Department students Shyamala Raveendran, who contributed her project analysis 3-D images of Fruitvale BART area data, and Anthony Jayaprakash, who provided ArcView operational assistance.

The direct sponsor and overseer of this project was the Mineta Transportation Institute. MTI Research Director Trixie Johnson played a major role in overseeing administrative matters as well as providing direction, support, and guidance. The California Department of Transportation and the U.S. Department of Transportation provided the funding for this project via MTI.

We would also like to thank MTI staff including Research and Publications Assistant Sonya Cardenas; Webmasters Barney Murray and Shun Nelson for getting drafts of the work onto the Internet; and Graphics Designers Ben Corrales, Shun Nelson and Cedric Howard and Editorial Associates Robyn Whitlock, Catherine Frazier and Irene Rush for following the project to print and onto CD-ROM.

## TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
<b>CONCEPTS FOR ENVISIONING NEIGHBORHOODS WITH TOD POTENTIAL .....</b>	<b>5</b>
<b>SELECTED PROJECT OVERVIEWS THAT PRESENT KEY     CONCEPTS FOR ENVISIONING NEIGHBORHOODS WITH     TOD POTENTIAL .....</b>	<b>6</b>
Organizational Principles and Framework (Project Overview 6) .	6
Data File Relationships Chart (Project Overview 7) .....	7
A Solution to Urban Analysis Problems in the Digital Era (Project Overview 8) .....	9
Find data .....	10
Filter data .....	10
Transform data .....	10
Model data .....	10
Synthesize data .....	11
An Analysis and Presentation Solution for Envisioning Neighborhoods (Project Overview 9) .....	11
Envisioning Neighborhoods Techniques and Principles (Project Overview 10) .....	13
<b>ENVISIONING NEIGHBORHOOD CONCEPTS .....</b>	<b>13</b>
How Information Visualization Facilitates Understanding (Project Overview 10A) .....	14
Using Information Visualization to Envision Neighborhoods (Project Overview 10B) .....	16
Scales for Envisioning Places (Project Overview 11) .....	25
Project Overviews 12 Through 15 .....	27
Population and Job Densities (Project Overviews 16 & 17) . . .	27
Data Sources, Software, and Techniques Documentation . . .	29
Population and Jobs Within a Half Mile of East Bay BART Stations (Project Overview 18) .....	30
Characteristics .....	30
Possible Applications .....	31
Data Sources, Software, and Techniques Documentation . . . . .	31
What Project Overview 18 Shows .....	32
<b>PROJECT OVERVIEW 19 .....</b>	<b>32</b>
Characteristics .....	32
Possible Applications .....	32

---

SUMMARY OVERVIEW OF STUDY AREAS .....	33
<b>ENVISIONING THE FORTHCOMING DOWNTOWN CAMPBELL LRT STATION TOD POTENTIAL ...</b>	<b>35</b>
<b>ENVISIONING THE FRUITVALE BART STATION VICINITY .....</b>	<b>41</b>
<b>ENVISIONING THE HAYWARD CITY BART STATION VICINITY .....</b>	<b>47</b>
<b>ENVISIONING THE MOUNTAIN VIEW VTA/ CALTRAIN STATION VICINITY .....</b>	<b>55</b>
<b>ENVISIONING THE REDWOOD CITY CALTRAIN STATION VICINITY .....</b>	<b>59</b>
<b>ENVISIONING THE SACRAMENTO 65TH STREET LRT VICINITY .....</b>	<b>63</b>
<b>COUNTY OR REGIONAL CONTEXTS .....</b>	<b>67</b>
REGIONAL DATA .....	67
COUNTY CONTEXT VIEW CHARACTERISTICS .....	70
<b>A. ENVISIONING THE QUALITY OF LIFE AND CONTEXT FOR DEVELOPMENT IN NEIGHBORHOODS WITH TRANSIT-ORIENTED DEVELOPMENT POTENTIAL</b>	
ABSTRACT .....	73
INTRODUCTION .....	74
APPROPRIATE SCALES FOR STUDYING URBAN QOL .....	75
ENVISIONING NEIGHBORHOODS AS A TECHNIQUE FOR ESTIMATING QOL .....	77
CASE STUDY EXAMPLE ENVISIONING THE FRUITVALE BART STATION VICINITY .....	78
SUMMARY PAGE VIEWS ENVISIONING THE FRUITVALE BART STATION AREA .....	81

CONCLUSION .....	91
ACKNOWLEDGMENTS .....	91
REFERENCES .....	91

## **B. HISTORY OF TRANSIT-ORIENTED DEVELOPMENT**

DEFINITION OF TRANSIT-ORIENTED DEVELOPMENT .....	93
BRIEF HISTORY OF TRANSIT-ORIENTED DEVELOPMENT .....	93
MAJOR ELEMENTS OF TRANSIT-ORIENTED DEVELOPMENT .....	94
RELATIONSHIP OF TOD TO NEW URBANISM AND SMART GROWTH .....	96
SPECIFIC FEATURES OF TRANSIT-ORIENTED DEVELOPMENT .....	97
Design Features .....	97
Density Features .....	98
PROXIMITY TO STATIONS .....	100
NOTES .....	101
REFERENCES .....	102

## **C. WHY ENVISION TRANSIT-ORIENTED DEVELOPMENT POTENTIAL WITHIN A NEIGHBORHOOD CONTEXT WITH QUALITY-OF-LIFE MEASURES?**

### **D. OPERATIONS HELP**

OPERATING INSTRUCTIONS AND TECHNICAL NOTES ...	107
System Requirements .....	107
Operating Instructions .....	107
Suggested Paths Through the Envisioning Neighborhoods with TOD Potential Files. ....	108
FEEDBACK REQUEST .....	110
Figure 1-ArcView Extension: SJSU Zone Summary .....	111
Figure 2-ArcView Extension: SJSU Zone Summary 2 .....	112
Figure 3-ArcView Extension: SJSU Zone Summary 3 .....	113



<b>E. PRESENTATION OVERVIEWS.....</b>	<b>115</b>
<b>BIBLIOGRAPHY .....</b>	<b>123</b>
GEOGRAPHIC INFORMATION SYSTEMS .....	123
INFORMATION DESIGN AND TECHNOLOGY .....	124
PLANNING AND TOD REFERENCES .....	125
DATABASE SOURCES .....	127
<b>ACRONYMS AND ABBREVIATIONS .....</b>	<b>129</b>
<b>ABOUT THE AUTHORS .....</b>	<b>131</b>

---

**LIST OF TABLES**

1 Project Overview 6: Organizational Principles and Framework . . . . 7  
2 How Information Visualization Facilitates Understanding . . . . . 15  
3 Using Information Visualization to Envision Neighborhoods . . . . 16  
B-1 Major Elements of Transit-Oriented Development . . . . . 95  
B-2 Minimum Residential Densities for Various Types of Transit  
Services . . . . . 100



## LIST OF FIGURES

1	Project Overview 7: Data File Relationships Chart	8
2	Project Overview 9: Small Multiple Replicas	12
3A	Schema for Envisioning Neighborhoods, Example 1	17
3B	Schema for Envisioning Neighborhoods, Example 2	18
3C	Schema for Envisioning Neighborhoods, Example 3	19
3D	Schema for Envisioning Neighborhoods, Example 4	20
3E	Schema for Envisioning Neighborhoods, Example 5	21
3F	Schema for Envisioning Neighborhoods, Example 6	22
3G	Schema for Envisioning Neighborhoods, Example 7	23
3H	Schema for Envisioning Neighborhoods, Example 8	24
3I	Schema for Envisioning Neighborhoods, Example 9	25
4	Project Overview 11: Scales for Envisioning Places Understanding the Context of TOD Developments; Example: TOD Near the Hayward BART Station	26
5	Population Density, San Francisco Bay Area	28
6	Population, Employed Residents, and Jobs Within 1/2 Mile of East Bay BART Station	30
7	Campbell Summaries 1 and 2	36
8	Campbell Summaries 3 and 4	36
9	Campbell Summaries 5 and 6	37
10	Campbell Summaries 7 and 8	38
11	Fruitvale Summaries 1 and 2	41
12	Fruitvale Summaries 3 and 4	42
13	Fruitvale Summary 5	43
14	Fruitvale Summary 6	44
15	Fruitvale Summaries 9 and 11	45
16	Fruitvale Summaries 7 and 8	45
17	Hayward Summary 1	47
18	Hayward Summaries 2 and 3	49
19	Hayward Summary 4	51
20	Mountain View Summaries 1 and 2	55
21	Mountain View Summary 3	56
22	Mountain View Summaries 4 and 5	57
23	Redwood Summaries 1 and 2	59
24	Redwood City Summaries 3 and 4	60
25	Redwood City Summary 7	61
26	Sacramento Summaries 1 and 2	63
27	Sacramento Summaries 3 and 4	63

28	San Francisco Bay Region for Five TOD Study Areas . . . . .	68
29	Population 2000 and 2020 Rail Transit and TOD Areas . . . . .	69
30	Regional Context of the Fruitvale and Hayward BART Station Areas . . . . .	71
31	Alameda County TOD Study Areas with Highways . . . . .	72
A-1	Organizational Principles and Framework . . . . .	79
A-2	Chart of Data Relationships for Envisioning Neighborhoods with TOD Potential. . . . .	79
A-3	Location Maps for Fruitvale BART Station Vicinity. . . . .	81
A-4	Digital Ortho Photos and Photos for Fruitvale BART Station Vicinity. . . . .	82
A-5a	Stacked Bar Charts and Standard Bar Chart. . . . .	84
A-5b	Stacked Bar Chart and Standard Bar Chart . . . . .	85
A-6a	Population Rings for Fruitvale BART Area. . . . .	86
A-6b	Block Groups Within 1, 2 and 5 miles of Fruitvale BART Station. . . . .	87
A-7a	Housing Units in a Stacked Bar Chart; 7b-Z scores for Fruitvale TOD Areas . . . . .	88
A-8	Fruitvale BART Station Area Year 2000 Profiles . . . . .	89
C-1	CD File: Why_TOD, slide 1 . . . . .	105
D-1	ArcView Extension: SJSU Zone Summary . . . . .	111
D-2	ArcView Extension: SJSU Zone Summary 2. . . . .	112
D-3	ArcView Extension: SJSU Zone Summary 3. . . . .	113

---

## EXECUTIVE SUMMARY

The *Envisioning Neighborhoods with Transit Oriented Development (TOD) Potential* project seeks to introduce planners, developers, and urban analysts to information design techniques and digital computer tools which can be used to undertake and study TOD. A basic premise is that effective TOD requires thoughtful planning to be successfully integrated into the metropolitan fabric.

The primary focus of this project is intra-regional 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 attention. The study focus is on understanding the neighborhoods surrounding transit centers and their context in terms of the character of areas within walking distance (<1/2 mile), bicycling distance (<2 miles), and five-mile driving or transit distance. These ranges of analysis include the areas where residents of possible TODs might work, shop, or prefer to go for services.

Understanding these areas may be important for developers seeking to co-locate 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 BART in Oakland, Redwood City, and Mountain View CalTrain, Campbell LRT site, and Sacramento's 65th St. Station area. Chapter one will explain the relevance of transit-oriented development via detailed tables, charts and maps.

This project is unique in that the graphics are not reproduced within the text, but included on the accompanying CD-ROM. To reproduce the graphics in color is cost-prohibitive, and the full-color interactive graphics are of such high quality that MTI elected to publish this series of studies with the CD-ROM to encourage usability of the publication. Readers and users of this study are encouraged to use the CD-ROM with its enhanced viewability.

The transit centers chosen for the creation of prototype examples are oriented around rail transit stops, with two being at BART (Bay Area Rapid Transit) heavy rail stops in the East Bay region (Hayward, and the Fruitvale stop 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. Two (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 PowerPoint slides are the principal output of this study. These files include full color displays and multiple hyperlinks to facilitate access to related text discussions, video clips and animated time series maps. The hyperlinks with the PowerPoint files enable users to choose and immediately access the levels and areas of analysis they are interested in seeing. 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 PowerPoint file version of the presentation screens available from the CD-ROM or website, as most of the maps and diagrams have been designed for color viewing.

The basic organizational principle for the *Envisioning Neighborhoods Technique* developed by Dr. Bossard can be surmised in the single sentence, "Use small replicate GIS maps, charts, digital images, and tables to facilitate comparisons across space, time, and scale because data is best understood in a comparative context."

This document contains several separate studies which were undertaken by SJSU students under Dr. Bossard's supervision.

The chapter one overview explains the type of data which are available on the PowerPoint presentation, the project overview presentations, as well as rationale for TOD and envisioning neighborhood techniques.

Chapter two includes summary overviews including maps and graphs of the various study areas, including Campbell light rail, Fruitvale BART in Oakland, Hayward BART, Mountain View CalTrain/light rail, Redwood City CalTrain, and the Sacramento 65th Street Station.

Chapter three, “County or Regional Contexts” is a series of maps showing the regional setting for the five TOD study areas in Alameda, San Mateo, and Santa Clara Counties.

Appendix A is the text of Dr. Bossard and Tara Kelly’s presentation *Envisioning the Quality of Life and Context for Development in Neighborhoods with Transit-Oriented Development Potential*, which was presented at the Second International Conference on Quality of Life in Cities, Singapore, March 2000.

Appendix B is a “History of Transit-Oriented Development” prepared by Brett Hondorp.

Appendix C is a complete, turnkey PowerPoint presentation which explains what transit-oriented development is all about. It also links TOD’s connection to the New Urbanism movement and introduces the viewer to the *Envisioning* project from San José State University.

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

- *Windows PC running Microsoft PowerPoint 2000. RealPlayer, Casio Panorama and GIF Animator.*
- 32 MB or more CPU (Sacramento detailed views and Fruitvale views may require 64 MB).
- 200 MB hard disk space
- 17" or larger monitor with XGA resolution (1024 x 780). SVGA resolution (800 x 600 generally okay, but has some graphics problems). XGA resolution (640 x 480) shows most text, but graphics are very poor.





---

## CONCEPTS FOR ENVISIONING NEIGHBORHOODS WITH TOD POTENTIAL

The Envisioning Neighborhoods concepts underlying this project were originally developed for presentations at the conferences on Computers in Urban Planning and Urban Management (CUPUM) held in Bombay, India, in 1997 and Venice, Italy, in 1999; and for the Conference on Quality of Life in Cities, held in Singapore in 1998. They were refined for the Conference on Quality of Life in Cities held in Singapore in 2000.

Additional information on this topic can be found in the papers published in these conference proceedings: Bossard and Tallam (1997), Bossard (1998), Bossard (1999), and Bossard and Kelly (2000). Especially pertinent is the paper “Envisioning the Quality of Life and Context for Development in Neighborhoods with Transit Oriented Development Potential” by Bossard and Kelly, which is reproduced in this paper and is accessible in the digital version by clicking on the “[Envisioning QOL](#)” button in the “Help and Rationale” column in the Main TOD Menu.

The PowerPoint files are the principal output of this study. These files include full-color displays and multiple hyperlinks to facilitate access to related text discussions, video clips, and animated time series map displays. The hyperlinks within the PowerPoint files enable users to choose and immediately access the levels and areas of analysis in which they are interested. This approach has many advantages compared to the linear approach of reading printed text. Reading the printed black-and-white version is most meaningful when also viewing on a computer monitor the color PowerPoint file version of the presentation screens available from the CD-ROM or Web site, as most of the maps and diagrams have been designed for color viewing.

Please refer to CD-ROM file 1\_Introductory Presentation, which is a complete presentation. For more in-depth information, refer to CD-ROM file 0\_TOD\_Main and the multiple files that can be accessed through that gateway file. The 0\_Operating\_Instructions file provides guidance in accessing and using the PowerPoint files.

## **SELECTED PROJECT OVERVIEWS THAT PRESENT KEY CONCEPTS FOR ENVISIONING NEIGHBORHOODS WITH TOD POTENTIAL**

The remaining pages in this chapter discuss, and in many cases also present black-and-white miniatures of, selected project overviews from the digital presentation, which present key concepts for Envisioning Neighborhoods with Transit-Oriented Development (TOD) potential.

### **Organizational Principles and Framework (Project Overview 6)** (O\_TOD\_Main.ppt screen 12)

The basic organizational principle for the Envisioning Neighborhoods technique developed by Professor Bossard is: “Use small replicate GIS maps, charts, digital images, and tables to facilitate comparisons across space, time, and scale because data is best understood in a comparative context.” These principles have been derived, in part, from the works of Edward Tufte, author and publisher of the seminal texts *The Visual Display of Quantitative Information* (1983) and *Envisioning Information* (1990). These principles are the basis of the first two components of the hierarchical Organizational Principles and Framework for Envisioning Neighborhoods with Transit-Oriented Development (TOD) Potential, shown as Project Overview 6 (Table 1). The next two components of the framework (Summary Context Views and Detailed Views) are discussed below.

**Summary Context Views** of a few pages for neighborhoods with TOD potential help planners, developers, or analysts decide whether the place merits further consideration. These summary context views may include maps, charts, and digital images that place the TOD-potential neighborhood in regional context, while presenting images and data suggesting the character of the place. The Hayward Summary Overview, presented in “Envisioning the Hayward City BART Station Vicinity,” beginning on page 47, is the prime example of a summary context view, although each of the other summary views has some distinctive features of merit.

**Detailed Views** provide 10 or more pages/screens per neighborhood case study area to facilitate specific site selection, development, and location decisions regarding TOD development. The Hayward case study presents the most comprehensive set of detailed views, but each of the other case study examples also presents some distinctive features of merit. The detailed views cluster information based on spatial context, with separate files and menus for data

**Table 1: Project Overview 6: Organizational Principles and Framework**

<b>Multiples</b> — <i>Use small replicate maps, charts, images, and tables</i>	
<b>Context Matters</b> — <i>Data is best understood in a comparative context</i>	
<b>Summary Context Views</b> — <i>Facilitate selecting places for further consideration</i>	
<b>Size</b>	1 to 6 pages/screens per neighborhood/place
<b>Maps</b>	Regional/county/city location Neighborhood/place details including census area boundaries Regional/county/city rail transit
<b>Charts</b>	Population/housing mix for neighborhood/place compared to region
<b>Photos/Images</b>	Transit center & vicinity, anchor/landmark properties, typical housing & nonresidential uses, digital orthos
<b>Detailed Views</b> — <i>Facilitate specific site selection, development &amp; location decisions</i>	
<i>Size</i>	10 or more pages/screens per neighborhood
<b>Maps</b>	Travel time access maps from transit center within 5, 10, 15, 20 & 25 minutes walk Travel time access maps via roads within 5 and 15 minutes drive from transit center Population, housing & employment choropleth & dot density maps Business locations within 0.5 and 2 miles of transit centers Zoning, general plan, and land use maps
<b>Charts</b>	Population, housing & employment data for neighborhood and areas located within rings 1/2, 1, 2, 3, 4, and 5 miles of transit center
<b>Photos/Images</b>	Panoramic photos/video pans of transit center and streets emanating from it Existing development in neighborhood/place
<b>Take Action</b> — <i>Apply criteria/standards to understanding based on envisioning</i>	

depicting areas within walking (<0.5 miles), bicycling (< 2 miles), and 5 miles distance of the transit center. The details listed in Figure 1 can be better understood by reviewing the Hayward and other case study materials.

**Data File Relationships Chart (Project Overview 7)**

This chart (shown in Figure 1) outlines an ambitious and comprehensive framework for organizing data for this study. The cloud in the right center of

the chart identifies the process goal, which is “Understanding Transit-Oriented Development Potential of [a] Neighborhood.”

The **Locational Context Maps**, top left in the chart, are a key Summary Context View study area component. They identify the location of neighborhoods in their regional, county, and city context along with principal transit connections, which for our study areas are via rail and light rail transit.

The **Data and Neighborhood Characteristics** features take U.S. census and other area data and present them via stacked bar charts and z-score charts that enable comparison of block group areas averaging 1,000 residents within walking distance of the transit center to their city, county, and state. These charts enable analysts to compare, at several scales, characteristics of the areas around transit centers to surrounding areas. Other data presented for neighborhoods include zoning/land use constraint maps, which may be of particular interest to developers. Local real estate listing, assessment, and market information could also be included in envisioning studies.

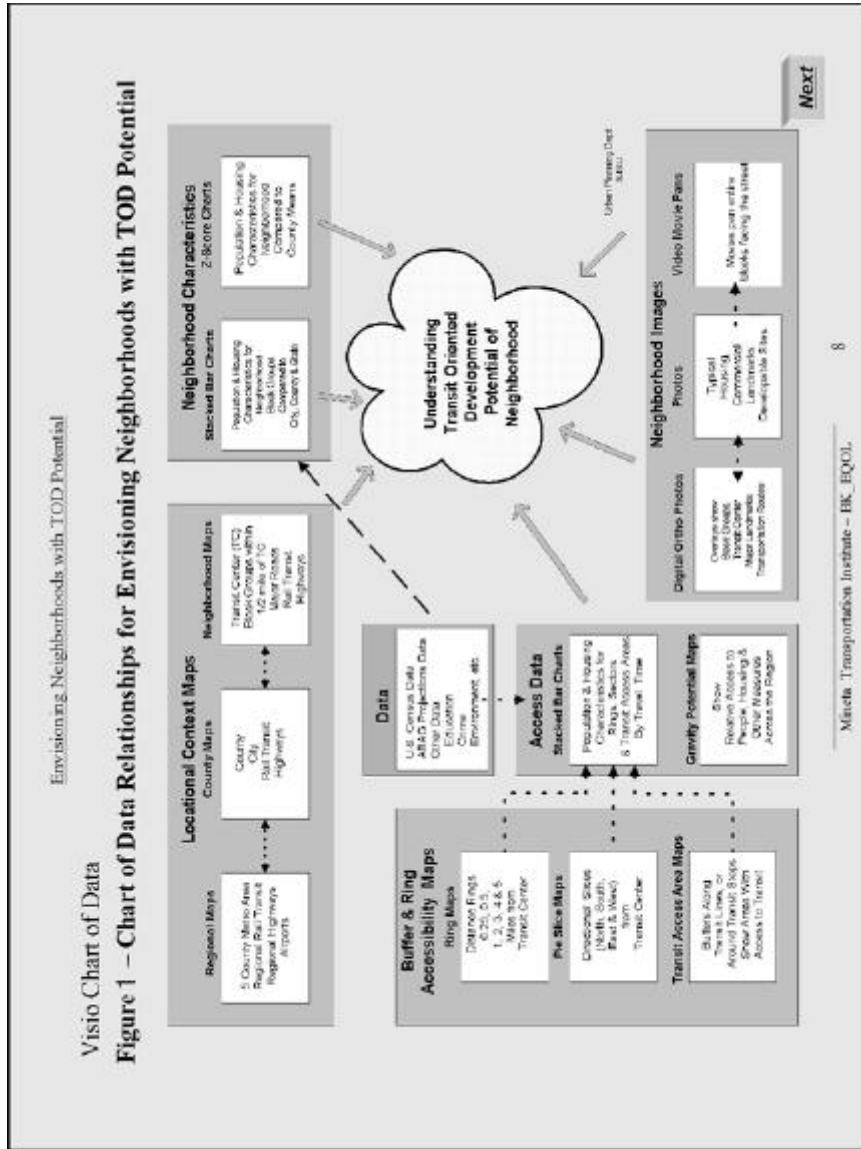
The **Neighborhood Images** information, bottom right in the chart, uses photos, digital ortho adjusted aerial photos, and video pans of neighborhoods to help produce a qualitative (that is, nonquantitative) image of the area.

The **Buffer & Ring Accessibility Maps** and **Access Data**, bottom left in the chart, include access measures that can be developed using geographic information systems (GIS) mapping analysis and various modeling techniques, including the Zone Summary Arc View Extension developed for this project, which produces data needed for ring, pie slice, and buffer maps. This program estimates ring populations from zonal data and helps produce maps and population estimates for areas within various driving and walking distances.

### **A Solution to Urban Analysis Problems in the Digital Era (Project Overview 8)**

Project Overview 8 presents three aspects of solutions to urban analysis problems in the digital data era that have been explored in this project:

1. Use evolving digital information tools and information design principles to **Find, Filter, Transform, Model, and Synthesize** data.



2. Use Envisioning Neighborhoods principles to **Present** the resulting information using a schema that organizes data into small multiples, in a form useful for understanding conditions and making decisions.
3. Take action after applying criteria/standards to understanding based on envisioning.

The use of digital information tools and information design principles to find, filter, transform, model, and synthesize data is discussed below.

### *Find data*

The Internet has fostered a phenomenal increase in the quantity and quality 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 are being developed to search the Internet for relevant data. Batty, 1998, discusses the future of data-finding “agents” that can act digitally for data seekers and search the information for desired data.

### *Filter data*

A major problem with digital information 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—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. The issues of finding and filtering data, which typically costs 15-50 percent of GIS total project costs (Longley, et al., 2001, p. 206) are worthy of detailed study, but that is beyond the scope of this study, which focuses on the data display and analysis part of the envisioning process.

### *Transform data*

Relevant raw data often need to be transformed so that they 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.

### ***Model data***

Transformed data can be input into projection, simulation, and other types of transportation-land use models to estimate relationships and future conditions. This study relies 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 one-half mile of rail stations and transit centers, shown in Project Overview 18 (page 30).

### ***Synthesize data***

A key aspect of the Envisioning Neighborhoods technique is bringing together pieces of data in replicate multiple maps and charts to synthesize data into useful information.

### **An Analysis and Presentation Solution for Envisioning Neighborhoods (Project Overview 9)**

#### **Synthesize neighborhood condition data into small, multiple, replicate map, chart, and digital image displays**

This overview (shown in figure 2) is based on a quotation from Edward Tufte: “Small multiples, whether tabular or pictorial, move to the heart of visual reasoning—to see, distinguish, choose...Their 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.” (Tufte, 1990, 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 2 miles of the Hayward BART Station shown in the bottom left image. Comparisons can be of 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 that 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.

**Small multiples of charts**, such as the multiple stacked bar charts in the bottom central image, enable analysts to compare the relative distributions for



Project Overview 9: Small Multiple Replicas

An Analysis and Presentation Solution  
For Envisioning Neighborhoods:  
Synthesize neighborhood condition data into  
small, multiple, replicate  
map, chart, and digital image displays!

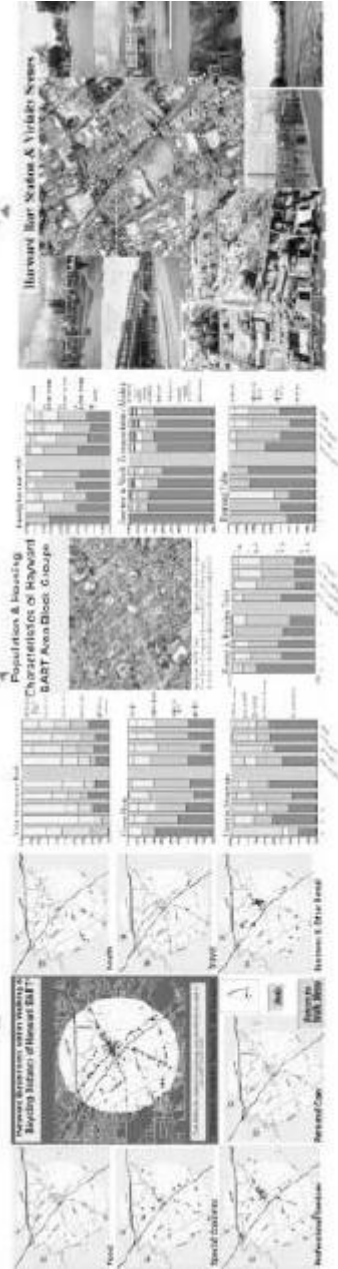


Figure 2. Project Overview 9: Small Multiple Replicas

a number of central data for block groups to the distributions for the city, county, and state. With practice, analysts can use this approach to envision general conditions in TOD areas quickly.

**Small multiple images**, such as the pictures of scenes in the vicinity of the Hayward BART station presented in the bottom right image, provide many qualitative impressions of the character of an area in a limited amount of space.

### **Envisioning Neighborhoods Techniques and Principles (Project Overview 10)**

(Not shown in this printed version.)

The Project Overview 10 slide in the digital presentation succinctly summarizes the Envisioning Neighborhoods principles with four points: Context matters; data is best understood in a comparative context; place data can be compared over space, time, and scale; and small multiples of maps, charts, and digital images are efficient data presentation formats.

The “[Envisioning Neighborhoods Concepts](#)” button on Project Overview 10 links to an extensive presentation developed by Professor Earl Bossard to outline the underlying rationale for the information design, using small multiples of maps, charts, and digital images to facilitate comparisons across space, time, and scale. The presentation cites several books on the subject by Tufte. It has examples and discussions regarding small multiples, comparisons across space, time, and scale, with examples using census data.

### **ENVISIONING NEIGHBORHOOD CONCEPTS**

The Envisioning Neighborhoods technique develops and uses visual representational frameworks of data, called schema, to facilitate understanding and/or decision making in a variety of ways, described in Project Overview 10A, (Table 2 on page 15). The emerging field of information design is rapidly devising better ways to organize and present data (Card, Mackinlay, and Shneiderman, 1999; Jacobson, 1999; Tufte, 1983, 1990, 1997; Davenport, 1997).

One approach to Envisioning Neighborhoods, derived from what *Readings in Information Visualization—Using Vision to Think* (Card, Mackinlay, and Shneiderman, 1999, pp. 10-12) calls knowledge crystallization, is to gather information for some purpose; make sense of it by constructing a representational framework, called a schema; and then package it in a form

suitable for communication or action. A more complete explanation would delineate the following steps:

1. Forage for information regarding the neighborhoods to be studied;
2. Search for a schema, a visual structure of data to represent the neighborhood;
3. Fill the schema with data;
4. Problem-solve working with the schema and determine if the resulting visualization is sufficient to solve the problem; if so, the solution is observed and packaged for communication or action in Step 6;
5. If necessary, search for a new or revised schema that yields a clearer solution, proceeding through Steps 2, 3, and 4;
6. Package the patterns and solutions found into output designed for communication or action.

Project Overview 10B (Table 3 on page 16) provides further detail regarding the schema-based envisioning approach. Project Overview 10C, presented in Figure 3 beginning on page 17, presents nine examples of schema used for Envisioning Neighborhoods.

Envisioning tasks can be “...characterized by the use of large amounts of heterogeneous information, ill-structured problem solving, but a relatively well-defined goal requiring insight into information relative to some purpose.” (Card, et al., 1999).

General envisioning of neighborhoods can use the summary overview schema developed for this project as standard templates; they combine small replicate GIS maps, charts, digital images, and tables. Standard template schema, shown in Project Overview 10C (Figures 3A through 3I, page 17 through page 25), facilitate comparisons of places and choices of places for further study. An in-depth understanding of particular neighborhoods or neighborhood problems often is best achieved by using custom schema that give central positions to the special factors that make the place unique. The detailed view schema in this project contain customized schema. All examples in Figure 3 are from the MTI Project 9810 PowerPoint files. These examples, and others, can be accessed in their home settings from file EN\_Schema.ppt.

**How Information Visualization Facilitates Understanding (Project Overview 10A)**

Table 2 presents ways in which information visualization facilitates understanding.

**Table 2: How Information Visualization Facilitates Understanding**

<p><b>1. Increasing memory and processing resources available to users</b></p>	<p>Human vision combines high spatial resolution and wide aperture in sensing visual environments. Some attributes of visualizations can be processed simultaneously in parallel, unlike text, which must be processed serially. Understanding based on interpreting numerical data is easier than visual perception of maps or charts. Visualizations can expand the working memory available for problem solving by keeping more factors in play. Visualizations can store massive amounts of information in a quickly accessible form (for example, maps and charts).</p>
<p><b>2. Reducing the search for information</b></p>	<p>Visualizations group information used together, reducing search. Visualizations often represent a large amount of data in a small space.</p>
<p><b>3. Using visual representation to enhance the detection of patterns</b></p>	<p>Recognizing information generated by a composite view is easier than recalling information presented in a series of separate views. Visualizations simplify and organize information, supplying higher brain centers with aggregated forms of information through abstraction and selective omission. Visually organizing data by structural relationships, such as space, time, or scale, enhances patterns. Visualizations can enhance value, relationship, and trend patterns.</p>
<p><b>4. Facilitating conclusions via perceptual inference</b></p>	<p>Perceptualizations of information in visual form can be extremely easy for humans. Visualizations can facilitate complex specialized graphical computation.</p>
<p><b>5. Enhancing monitoring by having visualizations draw attention to special circumstances</b></p>	<p>Visualizations can allow for the monitoring of a large number of conditions if the display is organized so that these stand out by appearance or motion.</p>

**Table 2: How Information Visualization Facilitates Understanding (Cont.)**

6. <b>Encoding information in a manipulable medium</b>	Unlike static diagrams, computer-based visualizations allow exploration of a set of parameter values and increase user choice during data review.
Source: Based on Table 1.3 in Card, Mackinlay, and Shneiderman, <i>Readings in Information Visualization</i> (1999) p. 16.	

### Using Information Visualization to Envision Neighborhoods (Project Overview 10B)

Table 3 presents an approximate list for a loosely structured procedure.

**Table 3: Using Information Visualization to Envision Neighborhoods**

Subtasks	Descriptions/Examples
1. <b>Information foraging</b>	Search Internet, CD-ROMs, and other data sources to <b>find</b> data that might indicate TOD potential. <b>Filter</b> out unsuitable data using metadata information.
2. <b>Search for schema</b>	Identify factors needed to understand TOD potential of areas and their most effective transformations. <b>Transform</b> into ranks, shares, means, and standard deviations.
3. <b>Fill schema with data.</b> Residue is significant data that do not fit the schema. To reduce residue, return to Step 2 and improve schema.	Gather and process data for factors identified in Step 2. Produce multiple GIS maps, charts, digital images, and tables. Assemble indices and run <b>models</b> to rate areas. <b>Synthesize</b> into page/screen summary views.
4. <b>Problem-solve and envision using the schema.</b>	Reposition visualization components to better facilitate comparisons. Check values against threshold levels and ranges desired or not desired.
5. <b>Search for a new schema that reduces problem to a simpler form.</b>	Narrow decision to a few neighborhoods with best prospects. Repeat Steps 1 - 4 to produce visualization-detailed components.
6. <b>Package</b> the patterns found and decisions made into an <b>output product</b> , outlining neighborhood conditions or feasible TOD project possibilities.	Create a report regarding what area, if any, was chosen, or what action should be undertaken, for example, what type of TOD project would be most feasible.

**Table 3: Using Information Visualization to Envision Neighborhoods (Cont.)**

Subtasks	Descriptions/Examples
Source: Based on Figure 1.15 in Card, Mackinlay, and Shneiderman, <i>Readings in Information Visualization</i> (1999) p. 10-11.	

1. Location Context for Neighborhood

Show location of potential sites:

- on a block or block face
- in a neighborhood
- within a city/ county/region

Cluster of Maps and DOPs with links to common components at various scales  
 Region or state, county & city, streets & highways within 2 miles, streets within 1/2 mile, and DOPs showing block and parcel details.



Digital version of this schema has links to full screen views of these and smaller components to facilitate context views at many scales.

**Figure 3-A. Schema for Envisioning Neighborhoods, Example 1**

From MTI Project 9810 PowerPoint file H\_Sum.ppt, p. 3.

2. Photos of Typical and Landmark Neighborhood Structures and Scenes

*Photos help to reveal qualitative aspects of places.*

Photos clustered around and linked to a DOP or street map of the area.

Photos can be regular or panorama and can be linked to scrolling pan views.



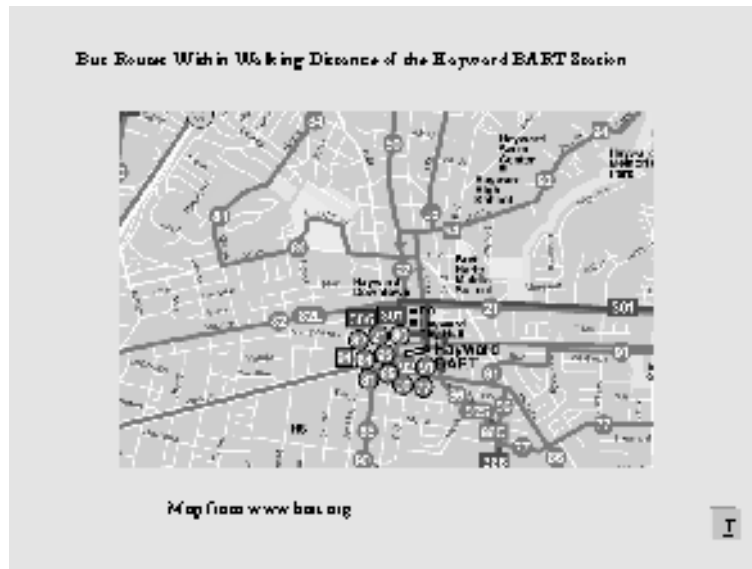
**Figure 3-B. Schema for Envisioning Neighborhoods, Example 2**

From MTI Project 9810 PowerPoint file H\_Sum.ppt, p. 6.

3. Transit Accessibility Characteristics

*These help to identify spatial links between the neighborhood and outside areas.*

Transit center modes, routes, and destinations of area transit shown in tabular or map form (see bus route map on right); or travel times to major centers or attractions such as shown in Redwood City or Mountain View summary presentations.



**Figure 3-C. Schema for Envisioning Neighborhoods, Example 3**

From MTI Project 9810 PowerPoint file H\_busroutes\_www.ppt, p. 1



#### 4. Socioeconomic Conditions

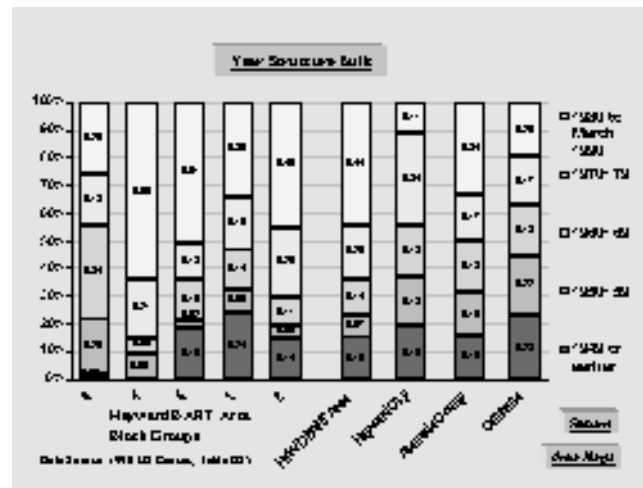
*Stacked bar charts of proportions in neighborhood block groups compared to city, county, state*

Small Multiple Charts facilitate comparison:

- Across space between block groups in neighborhood
- Across scale between entities of different sizes.

Census Data Examples

- Year Structure Built
- Gross Rent
- Units in Structure
- Rooms in Housing Units
- Family Income
- Journey-to-Work Modes
- Housing Values.



*Small multiple charts facilitate comparison among proportions of factors for each Block Group or other entity.*

#### Figure 3-D. Schema for Envisioning Neighborhoods, Example 4

From MTI Project 9810 PowerPoint file H\_Sum.ppt, p. 8

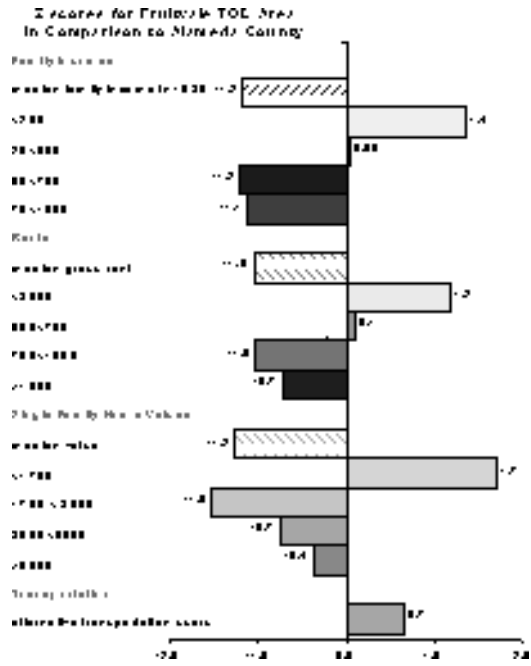
5. Socioeconomic Conditions Compared to Greater Area Norm Conditions

*Standard Deviation z-scores of neighborhood compared to city*

Z-scores of income and housing distribution data displayed as bar charts

Census Data Examples:

- Median Family Income
- 4 Levels of Family Incomes
- Median Gross Rents
- 4 Levels of Gross Rents
- Proportion of Journey-to-Work Trips by Public Transit



*Small multiple bars reveal conditions in the neighborhood relative to the county.*

**Figure 3-E. Schema for Envisioning Neighborhoods, Example 5**

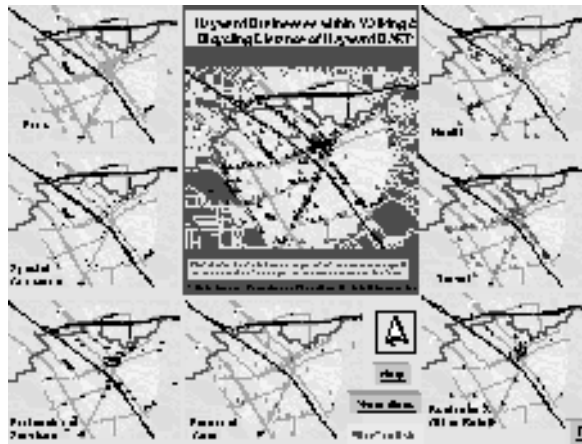
From MTI Project 9810 PowerPoint file f\_sum.ppt, p. 11.

6. Neighborhood and Vicinity  
Business Location Maps

*The digital version of this  
schema leads to 16 full-  
screen 1/2- or 2-mile radius  
area maps.*

*Small multiples facilitate comparison of category patterns*  
Maps showing business locations in neighborhood or within  
2 miles. Categories:

- Food
- Health
- Travel
- Business & Other Retail
- Personal Care
- Professional Services
- Special Concerns
- All of the Above



*Small multiple business location maps can help identify unserved market niches and availability of services for residents and visitors.*

**Figure 3-F. Schema for Envisioning Neighborhoods, Example 6**

From MTI Project 9810 PowerPoint file H\_Walk.ppt, p. 5.

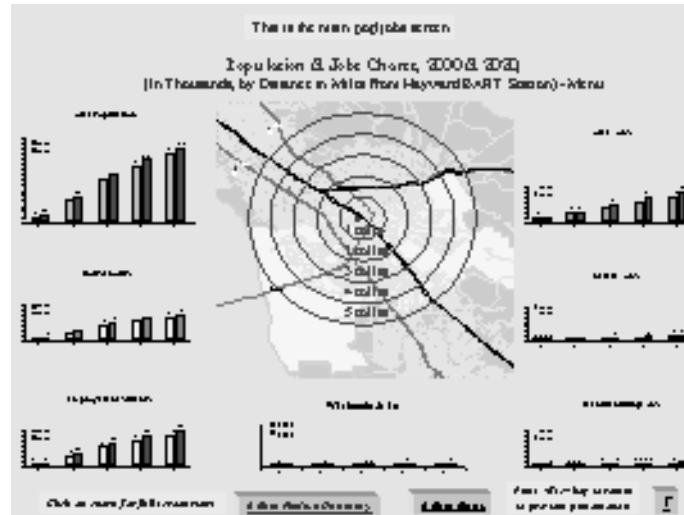
7. Population Density Maps      Shaded choropleth maps with major breaks (changes from red to green) for densities likely to be viable for TOD (>15,000 persons per sq. mile) can be used to indicate areas with TOD potential.  
Digital versions of maps covering a series of years can be animated with red flashes indicating where viability appears.



**Figure 3-G. Schema for Envisioning Neighborhoods, Example 7**

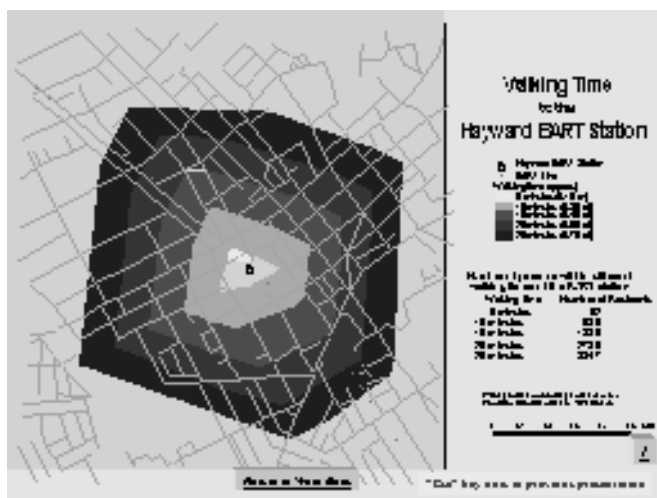
From MTI Project 9810 PowerPoint file 0\_TOD\_Main.ppt, p. 28.

8. Small multiple charts: Charts and tables indicating the number of persons and jobs within various mileages of the transit center can be of interest to businesses with various sizes of market areas. Data for 2000 and 2020 indicate growth expected within various spatial contexts.



**Figure 3-H. Schema for Envisioning Neighborhoods, Example 8**  
From MTI Project 9810 PowerPoint file H\_5MileR.ppt, p. 16.

9. Population residing within various walking and driving times. Maps and tables indicating numbers of persons within 5, 10, 15, 20, and 25 minutes walking time and 5, 10, and 15 minutes of driving time of the neighborhood center. (These maps are a more sophisticated version of the population measures within various airline distances shown in Example 8.)



*Shaded areas show over-the-road travel times to transit center.*

### Figure 3-I. Schema for Envisioning Neighborhoods, Example 9

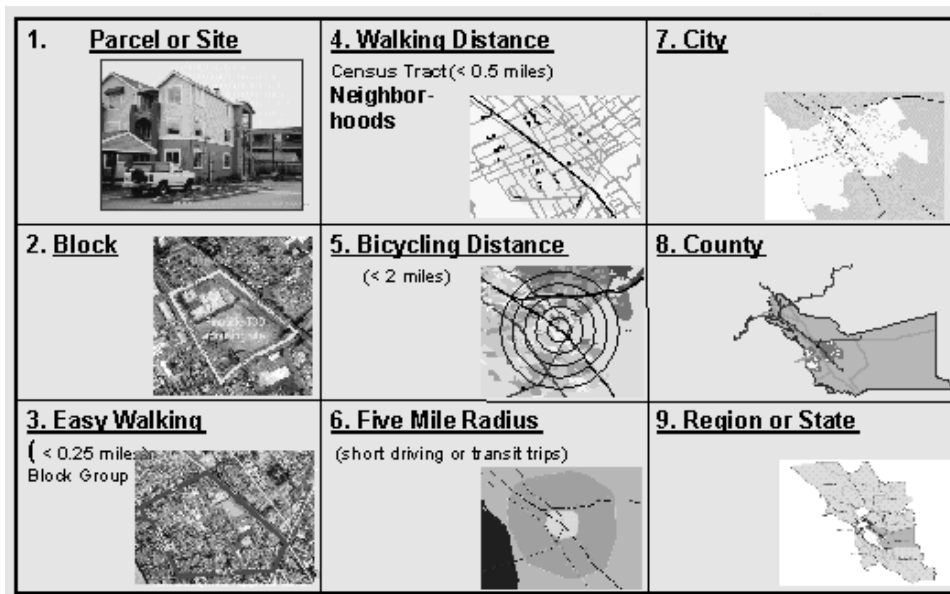
From MTI Project 9810 PowerPoint file H\_Walk.ppt, p. 2.

### Scales for Envisioning Places (Project Overview 11)

**“Reveal the data at several levels of detail, from a broad overview to the fine structure.”** (Tufte, 1983, p.13.)

To understand neighborhood data for a census tract-sized neighborhood of 4,000 persons, compare the distributions within the component block groups to the distributions for the same measure for the census tract, city, county, and state.

A comprehensive set of scales for analyzing and understanding a TOD and its contextual setting must start with the TOD project site and move out through successively larger scales that encompass broader activity patterns (see Figure 4).



**Figure 4. Project Overview 11: Scales for Envisioning Places Understanding the Context of TOD Developments; Example: TOD Near the Hayward BART Station**

Residential TOD analysis could start with the site and its structures and move out to the block or block face; the cluster of blocks within an easy 1/4-mile walking distance, which may encompass one or two census block groups, depending upon the density; and the broader neighborhood within a half-mile walking distance, which may encompass a census tract. The roughly half-mile walking distance is what we perceive as a “neighborhood,” although neighborhoods vary in size.

In this study, these first four scale dimensions generally have been clustered together under the heading “walking distance.” Our fifth dimension is bicycling distance, usually approximated as less than 2 miles. Perhaps it should be called “easy bicycling distance,” as it can be covered in 10 minutes, about the same time as it takes an average walker to cover a half mile. A 5-mile radius is the limit of short driving or transit trips, and also represents the 30-minute threshold for moderate-speed bicycle commuting.

The city, county, and region or state are the largest scales and, depending upon their size and location, may encompass most journeys to work and shopping trips.

CD-ROM file H\_Scales demonstrates scales involved for envisioning places and understanding the context of TOD development.

### **Project Overviews 12 Through 15**

For Project Overviews 12, 13, 14, and 15, see file 0\_TOD\_Main.ppt slides 22 to 27.

### **Population and Job Densities (Project Overviews 16 & 17)**

(Project Overview 17 is a menu for accessing population and job density animations. It is not reproduced in the printed version.)

Population density for the San Francisco Bay Area Region, by census tracts, for the year 2000 with rail transit lines (BART, CalTrain, and VTA light rail), is shown in Project Overview 16 (Figure 5). In the digital presentations, more detailed population density maps are available for portions of the region, including our TOD study areas. Those thematic census tract maps show population and job densities at 5-year intervals between 1990 and 2020. The colored maps have progressively darker shades of green for population densities up to 15,000 persons per square mile, which is a threshold level for density likely to be able to support rail transit. Densities beyond 15,000 persons per square mile are shown in progressively browner shades of red. Animated GIF displays of these maps can alert users to areas that are becoming red or darker red-brown, indicating that these areas are achieving the threshold level of 15,000 persons per square mile, making them likely to be able to support rail transit TOD. Animations were prepared with GIF Animator software, shareware that is downloadable from the Internet with payment expected for use beyond a trial period. Individual maps for each year were pasted into PowerPoint to facilitate separate examination.





**Figure 5. Population Density, San Francisco Bay Area**

The PowerPoint digital version of this report includes population and job density maps for the urbanized areas around San Francisco Bay, including the counties with the five TOD-potential study sites in the Bay Area: the Fruitvale BART Station area in Oakland, the Hayward BART Station area, the Mountain View CalTrain and LRT Station area, the Redwood City CalTrain Station area, and the site of the planned Campbell LRT Station. There are also close-up maps focusing on the Fruitvale BART to Hayward BART area, for Mountain View to Redwood City, and from Mountain View to San Jose and Campbell.

It is possible to scroll up and down through the density maps at 5-year intervals from 1990 to 2020, noting areas where transit-supporting thresholds are expected to be reached.

Figure 5 shows high population densities in San Francisco and along much of the CalTrain route on the Peninsula. While the population densities in the East Bay along the BART lines are usually higher than the surrounding areas, much

of the vicinity along the East Bay BART corridor has only moderate population densities.

These sets of density maps can be used to look for areas close to or over the transit-viability levels, realizing that this data is only ABAG's estimates of what is likely to occur given zoning, land use constraints and patterns, and levels of economic activity that have been forecast. ABAG modelers are not infallible, and future decisions by developers and local governments can result in different patterns emerging than those presented by the maps. Bearing in mind these reservations, areas having, expecting, or adjoining areas above the transit-viability threshold are likely to have good potential for TOD.

### ***Data Sources, Software, and Techniques Documentation***

The Association of Bay Area Governments (ABAG), the regional planning agency for the nine counties surrounding San Francisco Bay, biannually releases estimates of demographic and economic conditions for areas ranging from the region down to census tracts. These projections are based on a host of assumptions and inputs described in detail in ABAG's *Projections 98* report. These inputs include estimates of "...national economic growth conditions, the relative competitiveness of the region's economy, and the ability of the region's land supply to support managed growth" (ABAG, *Projections 98*, p. 2).

Extensive information regarding ABAG's latest Projections data is available at the URL <http://www.abag/overview/pub/p2000/>.

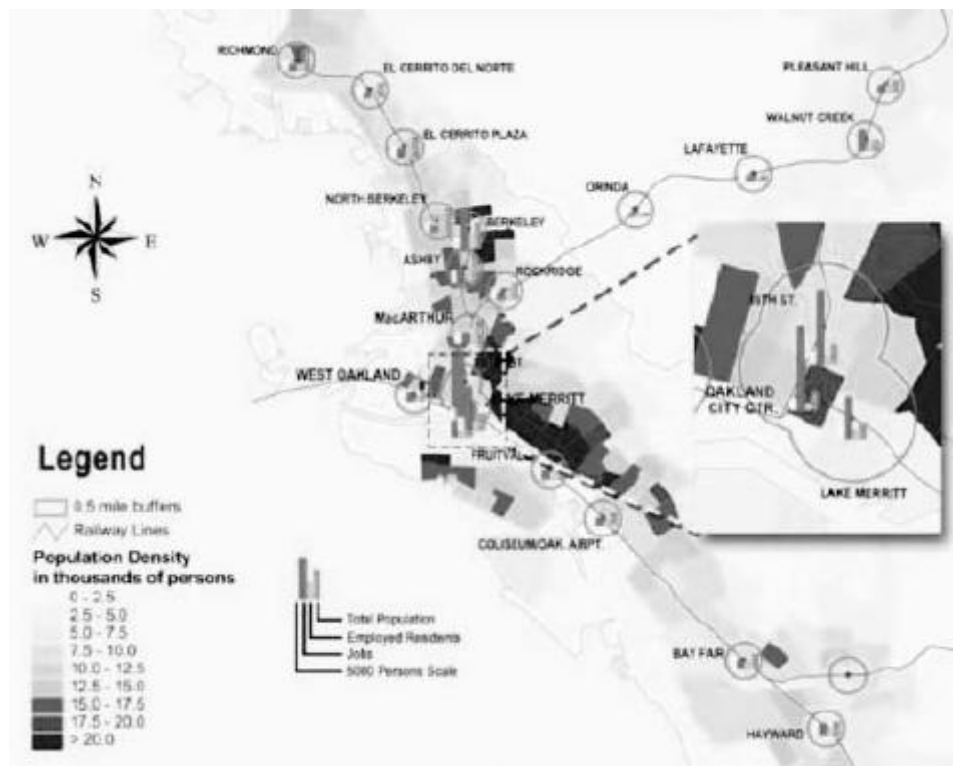
Note that the smaller the area, the lower the probability of the projections actually occurring, with subcounty and especially census tract projections being "...inherently more susceptible to uncertainty." (ABAG, *Projections 98*, p 3.)

These density maps were prepared by dividing the ABAG census tract data by the census tract area within ESRI's Arc View GIS program. Separate maps were prepared at 5-year intervals for the period 1990 to 2020. For the detailed maps showing the job densities of the San Francisco Bay region in 1990, 1995, and 2000, along with projections for 2005 through 2020, see CD-ROM file *sfb\_JD9022LR*. For information about population densities in the Bay Area in 1990, 1995, and 2000, along with projections for 2005 through 2020, see CD-ROM file *SFB\_PD9022LR*.

## Population and Jobs Within a Half Mile of East Bay BART Stations (Project Overview 18)

### *Characteristics*

This view shows the estimated number of residents and jobs within a half mile of East Bay BART stations in 2000, along with census tract population densities.



**Figure 6. Population, Employed Residents, and Jobs Within 1/2 Mile of East Bay BART Station**

The embedded bar charts shown at each BART station site have a scalar bar on the left with a height representing 5,000 residents or jobs. The central bar shows the number of residents and the right bar the number of jobs. If both bars are above the left 5,000 scale, then the sum of more than 10,000 workers or residents indicates likely viable transit support levels for local businesses with at least some pedestrian orientation.

### ***Possible Applications***

The year 2020 estimates could be used to determine which areas not above the threshold level in 2000 are expected to reach the transit-viability threshold level by 2020. Then attention can be given to the years in between and consideration given to site-specific developments that would help supply the transit-viable threshold levels and beyond.

One-mile buffers could be used to estimate population and workers within the extended walking and easy bicycling distance range, and quarter-mile buffers could be used to estimate jobs and population within easy walking distance.

Two-mile radii could be used to estimate data for the moderate bicycling distance area. In Tokyo thousands of bicycles are taken daily to many in-town rail stations, a pattern that could be repeated in California, which has a milder climate, better suited for bicycling.

### **Data Sources, Software, and Techniques Documentation**

Using an Arc View Avenue program script written by Professor Richard Taketa for this project, the proportions of census tract areas inside and outside the half-mile buffers constructed around East Bay BART stations were calculated and used to estimate the proportion of the area of each census tract that was within the walking-distance buffer.

*ABAG Projections 98* census tract data were used. Assuming that population and jobs were uniformly distributed across the census tracts, estimates of the numbers of residents and jobs in all tract areas within each buffer were calculated and summed, yielding estimates of the number of jobs and residents within a half-mile walking distance of each East Bay BART station in 2000.

A circular area a half mile in radius has an area of about three-fourths of a square mile. As 15,000 residents per square mile is a rough threshold for support of good transit service, the levels of residents alone within the buffer areas to support good transit would be 11,250. Assuming that jobs in an area had at least a similar effect on transit viability as residents, a combination of more than 10,000 residents and jobs within the transit half-mile buffer would indicate transit viability. The initial version of this map was constructed in three hours using the *ABAG Projections 98* data, the Arc View GIS mapping program, and the program script by Professor Taketa. The final presentation map was refined with PageMaker software. One difficult task was to enlarge

the downtown Oakland area while keeping the chart bars at the same scale as in the main body of the map.

### **What Project Overview 18 Shows**

Most of the BART station areas from Richmond to Hayward are close to the viable-transit threshold, with the Berkeley and downtown Oakland station areas well above the threshold level. However, outside of central Oakland and Berkeley, only the area north of the Fruitvale BART station indicates sufficient residential density to support strong transit.

## **PROJECT OVERVIEW 19**

### **Characteristics**

This view presents a table outlining types of criteria, standards, or norms that could be applied to envisioning measurements before undertaking an action. Each criteria, standard, or norm is linked to at least one possible application as an indication of some of the ways in which the Envisioning Neighborhoods outputs of small multiple replicate maps, charts, images, and tables could be effectively used to take action regarding neighborhoods or places.

### ***Possible Applications***

Taking action with regard to neighborhoods or places could entail simply deciding that the neighborhood did or did not merit further consideration or study.

Direct actions could include developers deciding to seek a site in the area, governments deciding to declare the area a place with high TOD potential within which special benefits and programs would be available, or prospective tenants (both commercial and residential) deciding to relocate within the area.

The application of criteria, standards, or norms to Envisioning Neighborhoods output can be undertaken in several ways, depending on circumstances. If only a single necessary and sufficient condition were present, such as to whether or not an area has been classified, an indication of whether that condition has been satisfied should be given central prominence in the Envisioning Neighborhoods summary view.

While Envisioning Neighborhoods summary views can be customized for particular applications, in many instances they will be fairly generic. In many cases, however, the criteria, standards, or norms for actions will vary and will be specific to the circumstances and perspectives of the actor. For this reason, this project has emphasized preparation of the generic envisioning views; however, the specific criteria standards can be invaluable in facilitating development when these standards are incorporated into the analysis, in many cases as overlays to the envisioning screens.

### **SUMMARY OVERVIEW OF STUDY AREAS**

The transit centers chosen for creating prototype examples are oriented around rail transit stops, with two being at BART heavy rail stops in the East Bay region (Hayward, and the Fruitvale stop 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 stop and the 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 were farm market centers during their formative years. The Redwood City and Mountain View centers 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, with from half a million to more than a million residents. See Appendix B, “History of Transit-Oriented Development, for additional details.



## **ENVISIONING THE FORTHCOMING DOWNTOWN CAMPBELL LRT STATION TOD POTENTIAL**

Campbell is a city of approximately 38,000 people seven miles southwest of downtown San Jose, in Santa Clara County, California. This study, prepared by Scott Plambaeck, concentrates on the future downtown Campbell light rail station (see CD-ROM file C\_Sum for a complete PowerPoint presentation). The extension of the VTA light rail line from downtown San Jose to downtown Campbell, known as the Vasona Line, is expected to be completed in 2004.

The three block groups in downtown Campbell are studied and compared to Santa Clara County and the state of California. The future downtown Campbell station will be located in an area with low population density, as downtown Campbell is mainly a commercial center of small shops and restaurants. The ethnic balance of the downtown Campbell block groups is mainly white, contrasting greatly with Santa Clara County and the state of California as a whole.

This study lists seven types of businesses within walking and bicycling distance of downtown Campbell. Block group information also is provided, showing the number of Hispanics in the downtown area and the population density of the downtown Campbell vicinity. Features mapped include flood plains and downtown area restaurants.

This overview only suggests the procedures that could be used for envisioning. A full envisioning would require more data, with the 2000 census undoubtedly offering a wealth of additional information. The Campbell maps included in this publication were created using 1990 data from the U.S. Census Bureau.

Campbell's downtown core is enjoying a revival as coffee shops, restaurants, and small businesses thrive in this unique and charming downtown. New housing has been built within a quarter mile of the station site and more is planned. The downtown station will be close to several well-established neighborhoods.



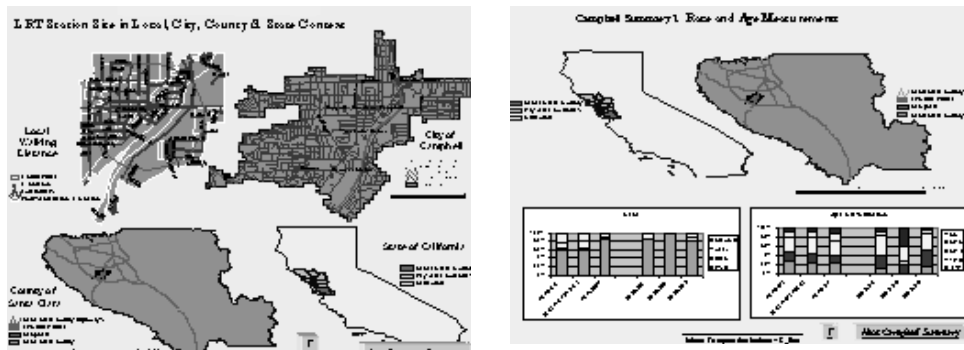


Figure 1. Campbell Summaries 1 and 2

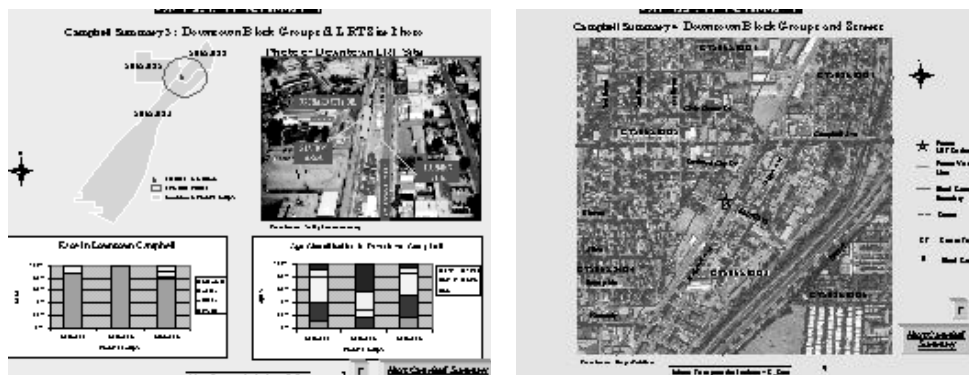


Figure 2. Campbell Summaries 3 and 4

The PowerPoint presentation includes the following information:

Campbell Summary 1 (Figure 1, left side) shows downtown Campbell from a local, city, county, and state view. The **local walking** view shows the future downtown Campbell LRT station and the half-mile vicinity around the station. This station is the focus of the Campbell study, and the map identifies all the local streets within a half-mile of downtown Campbell as well as the downtown block groups. The **city** view shows the entire city of Campbell and the planned LRT stations of the Vasona LRT line. The line, expected to be finished by December 2004, will connect Campbell to the Guadalupe LRT line in downtown San Jose and thousands of jobs in north San Jose, Milpitas, Santa Clara, Sunnyvale, and Mountain View. All the streets of Campbell are shown in the city view, but only the major streets are identified.

The **county** view shows the city of Campbell as it relates to the entire county and shows the county’s highways. Campbell, primarily a bedroom community,

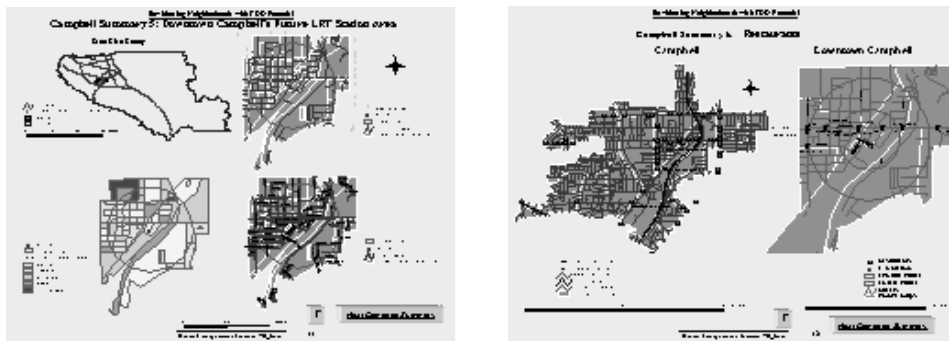
is a mature suburb, located 7 miles southwest of downtown San Jose. The **state** view shows the nine Bay Area counties within the state of California. Santa Clara County is shown in green in the digital color version of Campbell Summary 1.

Campbell Summaries 2, 3, and 4 (Figure 1, right side and Figure 2) show **age**, **race** and **ethnic background**. They compare ethnic breakdowns in the state of California, Santa Clara County, and the city of Campbell, and compare them to the three downtown Campbell block groups. They also detail the census block groups via a digital ortho photo (DOP) of Campbell obtained from the Web site [www.badger.parl.com](http://www.badger.parl.com). Major streets and the location of the future LRT station and VTA Vasona LRT line are included.

Campbell has a larger percentage of whites than Santa Clara County or the state. Block Group 3 in Census Tract 5056.02 is almost 100 percent white, an infrequent situation the Bay Area. Agewise, the three downtown block groups have a lower population than the city, county, or state of those under 19, but a larger percentage of those in the 19-29 range. Block Group 2 in Census Tract 5065.02 has a large population of those aged 30 to 49. Block Group 3 has the most extreme numbers, with a high percentage of those 65 and over and virtually no population under age 19.

Looking at age is important for TOD for several reasons. Seniors tend to ride transit more than other age groups, and it is important to determine the needs of the prime working-age population, ages 18 to 64.

Campbell Summary 5, *Downtown Campbell's Future LRT Station Area*, shows Campbell within Santa Clara County and the highways within the county (Figure 3, left side). The map on the top right shows the restaurants within a



**Figure 3. Campbell Summaries 5 and 6**

half mile of the future LRT station. The restaurants are represented by blue dots. The bottom map presents the density per square kilometer measured at the block level. Blocks with the highest densities tend to be further from the station but within walking distance. Sufficient density is essential in supporting TOD.

The lower right map shows the blocks and the local streets of downtown Campbell and the location of the future downtown Campbell station. The half-mile buffer indicates neighborhoods within walking distance of the station.

Campbell Summary 6, *Campbell's Restaurants*, goes into more detail regarding restaurants in Campbell (Figure 3, right side). Using the data from *Powerfinder Phone Disc 98, Info USA.com, Inc.*, two maps were created showing restaurants in the entire city of Campbell and restaurants within one-half mile of the future downtown LRT station. These maps show that most of the restaurants in Campbell are clustered near downtown. The **city-level** map shows that many of the restaurants in Campbell will be served by the Vasona LRT line.

The second, more detailed, map provides the names of the downtown restaurants. Restaurants are a popular destination for people, and locating stations near restaurants and other entertainment facilities is important in attracting people to ride transit.

Campbell Summary 7, *Flood Zones*, maps the 100-year flood zones in Campbell used to determine building sites (Figure 4, left side). It includes a citywide map of Campbell, and a map showing flood zones near the downtown station and population block density per square mile in Campbell.

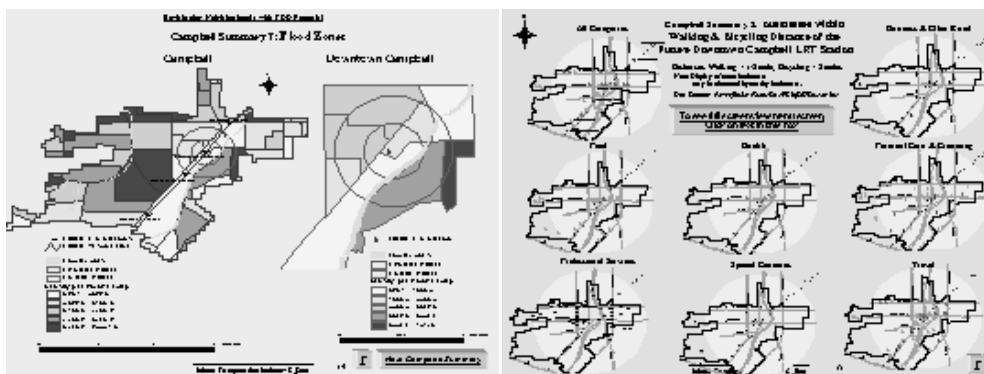


Figure 4. Campbell Summaries 7 and 8

Campbell Summary 8, *Businesses Within Walking and Biking Distance*, is a series of eight interactive maps broken into seven broad categories (Figure 4, right side). The digital version of Campbell Summary 8 provides access to 16 full-screen maps at one-half or two-mile levels. The one-half-mile maps show the walking distance from the future downtown Campbell station.

Including the location and types of businesses is essential in studying sites suitable for TOD. In addition to building mass transit near housing, mass transit needs to go places that people want and need to go to. The Pruneyard Shopping Center, a major shopping center in Campbell, is shown on the map. Although the Pruneyard is outside the half-mile circle, it is less than 1 mile from the downtown station site and is a major retail and employment center in Campbell.

Two miles is considered the biking distance from the future downtown station. Since Campbell is geographically small, portions of San Jose are included in the bicycling distance map. Much of the Vasona Line, which will connect Campbell to downtown San Jose, is shown.

The seven business categories shown in Campbell Summary 8 comprise the following types of businesses:

- **Business and other retail**, including book, copy, gift, and photo finishing shops, along with variety and video stores.
- **Food**, including bakeries, candy and nut shops, coffee and tea shops, grocers, restaurants, and health foods.
- **Health**, including dentists, drugstores, hospitals within 2 and 5 miles, nursing homes, and physicians.
- **Professional services**, including accountants, banks, insurance agents, and attorneys.
- **Personal care and grooming**, consisting of barbers, beauty salons, child care, nursery schools, dry cleaners, laundromats, nail salons, and physical fitness facilities.
- **Special concerns**—businesses that could cause problems—includes bars, gunsmiths, liquor stores, and pawnbrokers.
- **Travel**, including auto repair, auto rental, bike repair, service stations, motel and hotels, and travel agents.

Additional information on Campbell's TOD potential can be found in the following CD-ROM files:

C\_Bus\_Maps includes information on Campbell's businesses within walking and bicycling distance of the future downtown Campbell LRT station, and specific information regarding the seven business categories located within one-half and 2 miles from the LRT station.

C\_DriveTime includes information on population residing within 5 and 15 minutes driving times of the future Campbell LRT station.

C\_Pop\_Housing&Hispanics contains information about Campbell's Households, Hispanic Population and Block Group Z-Scores, Hispanic Household Population Density per Sq. Mile and Block Group Proportions, and Hispanics 0.25 and 0.5 Miles From the Future LRT Station, using 1990 data.

C\_WalkingTime includes information regarding population residing within 5 to 25 minutes walking time of the Campbell LRT station.

C\_Zon&LU includes land use and zoning information for the area around the Campbell LRT station.

## ENVISIONING THE FRUITVALE BART STATION VICINITY

This chapter presents work concerning the neighborhood surrounding the Fruitvale BART station in Oakland, California. The station area is the site of a mixed-use transit village being built on an existing parking lot by The Unity Council, a nonprofit community development corporation. This \$50 million multiuse project began construction in 2000.

This overview provides techniques that could be used to provide information to potential developers, who could use it to reach decisions as to whether this area has potential for them. Some of the information presented here might also be used in detailed presentations provided to facilitate choice of specific sites and choice of the scale and nature of possible developments. This presentation, which is oriented toward planners and developers, can be modified and used by persons considering renting or buying a residence or business site in the area. The Fruitvale BART PowerPoint presentation file is f\_sum. Tara Kelly was the Fruitvale BART Station area research leader responsible for producing the materials for this area. The information is presented and described below.

Fruitvale Summary 1, *Fruitvale BART Locational Contexts*, places the Fruitvale BART station within its spatial context, showing the 10-block groups surrounding the station, the city of Oakland, and the five nearest counties in surrounding San Francisco Bay (Figure 1, left side). The digital data files for the areas were provided by ESRI, and the BART transit line shapes were provided by the Association of Bay Area Governments (ABAG).

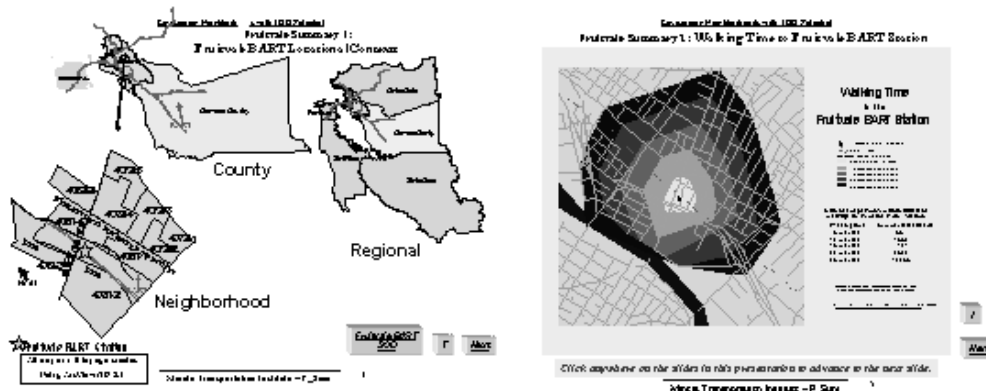


Figure 1. Fruitvale Summaries 1 and 2

Fruitvale Summary 2, *Walking Time to Fruitvale BART*, shows the areas within 5, 10, 15, 20, and 25 minutes walking time, at a pace averaging 2 miles an hour following local roads (Figure 1, right side). This digital view also presents the number of residents within these walking times. Walking time maps will be of particular interest to parties concerned with developing or operating businesses relying, at least in part, on customers residing within walking distance.

U.S. Census block data were used for the population estimates, with ESRI's *Network Analyst Extension to ArcView GIS* used to determine the walking times areas. The digital streets file from ESRI was used to simulate the roads network.

This map, based on 1990 census data, estimates that 554 persons reside within 5 minutes walking distance of the transit center; 1,537 persons live within 10 minutes; and so forth out to 10,763 persons residing within 25 minutes walking distance. This is sufficient density to provide strong support for public transit.

Fruitvale Summary 3, *Census Tract Block Groups*, is a digital ortho photograph (DOP) that was corrected to represent on-the-ground relationships and can be used interchangeably with maps (Figure 2, left side). DOPs are ideal for site analysis work, but should be used with a higher resolution than those provided for free on the Internet. The U.S. Geological Survey DOP was downloaded from <http://bard.wr.usgs./bard/cog/sanfrancisco/oaklandeast/sw.cog>.

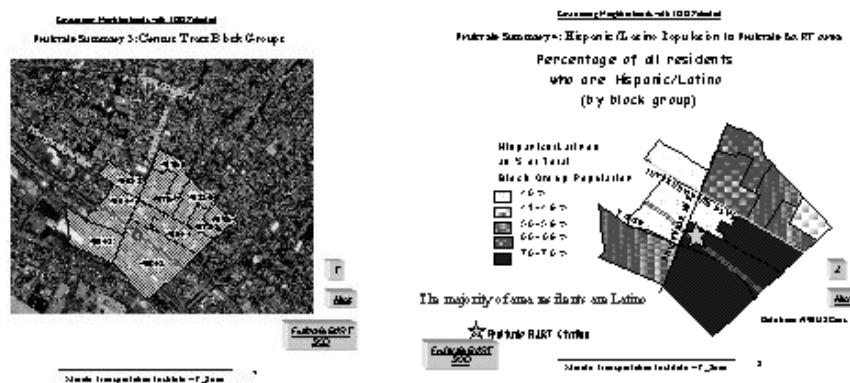


Figure 2. Fruitvale Summaries 3 and 4

Fruitvale Summary 4, *Hispanic/Latino Population in Fruitvale BART Area*, is a choropleth map that was created in Arc View using 1990 census data (Figure 2, right side). This map depicts the proportion of each block group's population that is Hispanic (the predominant racial/ethnic group living in this area). The lowest block group was 40 percent Hispanic and the highest was 70-86 percent Hispanic.

Fruitvale Summary 5, *Fruitvale Block Group Data*, includes data from the 1990 census that compares the block groups within the study area to each other and to increasingly larger-scale areas of which they are a part. Bar charts depicting family income, age of residents, and family types are included in this file (Figure 3).

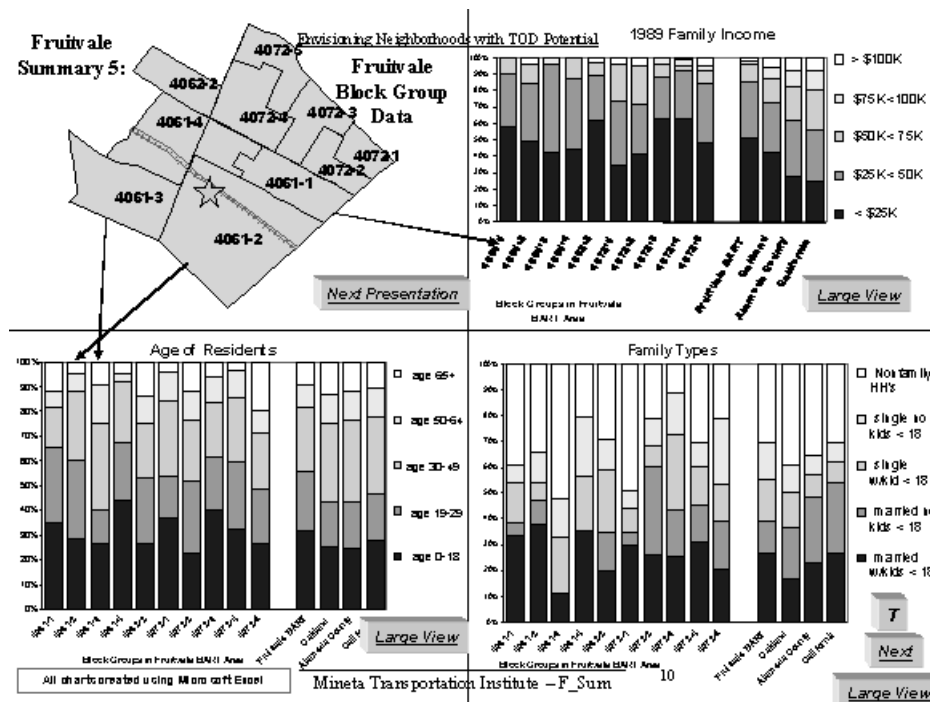


Figure 3. Fruitvale Summary 5

Fruitvale Summary 6, *Fruitvale Area Z-Scores*, includes further breakdowns of family incomes, median gross rents, single-family home values, and transportation via z-scores (standard deviations from county means) and a stacked bar chart showing proportions of housing structures with certain numbers of units (Figure 4). In Block Groups 4072-2 and 4072-1, most



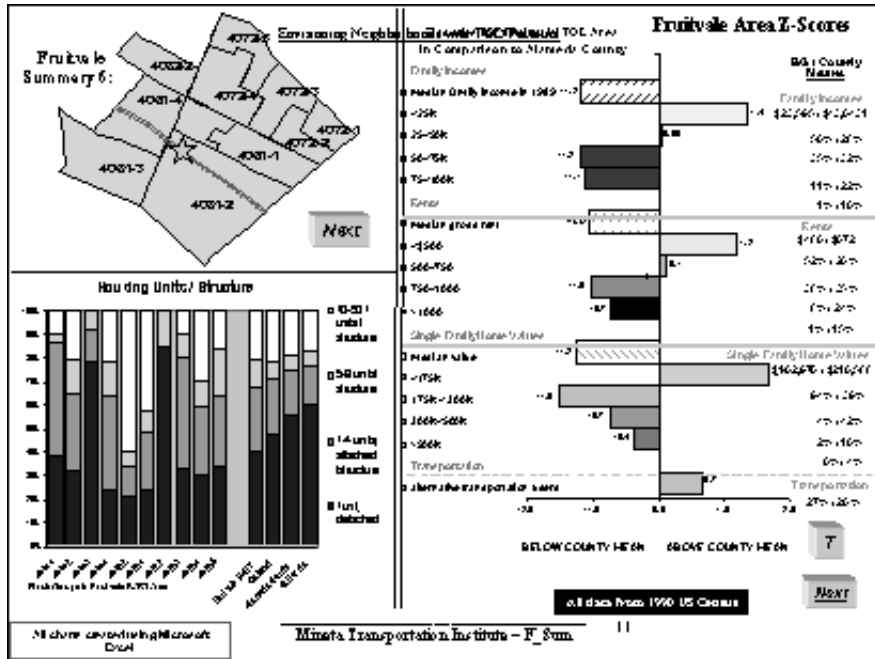


Figure 4. Fruitvale Summary 6

buildings have 10 or more units. On the other hand, most of the structures in Block Groups 4061-3 and 4072-2 are single-family detached homes.

Several census data categories were chosen and z-scores calculated for the entire 10-block group area to show how it compares to the county. As can be seen, this area is lower income, has lower housing prices and rents, and has a higher percentage of public transit users than the county as a whole.

Fruitvale Summary 7, *Area Transit*, illustrates the areas of public transportation lines around the vicinity of the Fruitvale BART station (Figure 5, left side). Public transportation plays a major role in this area, with the Fruitvale station acting as a major transit center with a dozen Alameda-Contra Costa County (AC) Transit District buses stopping in front of the station. The 82 and 82L bus lines, which travel along International Boulevard, carry more than 22,000 passengers each day—almost equal to the number of automobiles that travel on this road (26,000 per day). AC Transit’s second-busiest line is the 40/40L, which runs along Foothill Boulevard. In addition, BART attracts riders from all over, including the Oakland Hills and Alameda.

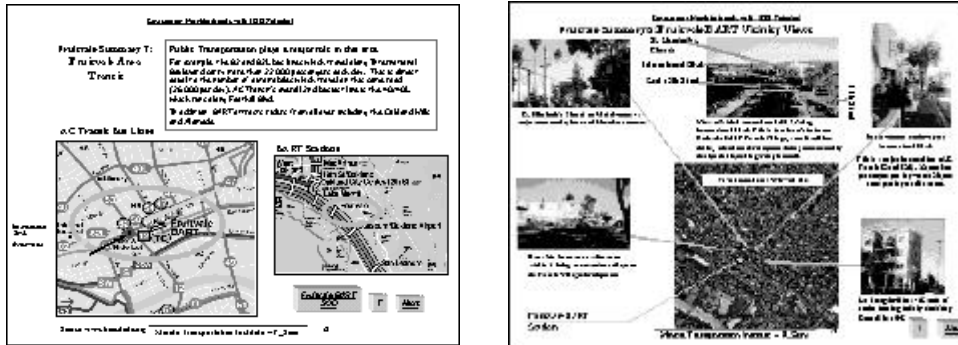


Figure 5. Fruitvale Summaries 7 and 8

Fruitvale Summary 8, *BART Vicinity Views*, shows city and neighborhood structures near the Fruitvale BART station, including St. Elizabeth’s Church, International Boulevard, and Las Bougainvilleas (Figure 5, right side).

Fruitvale Summary 9, *Video Menu*, in the digital version accesses digital video pan movie clips taken of entire blockfronts of the area (Figure 6, left side). It includes views from the BART platform toward 34th Avenue and International Boulevard, and 35th Avenue toward Fruitvale Avenue. The video pan shows underutilized land of the current surface parking lot, on which a mixed-use transit village will be built.

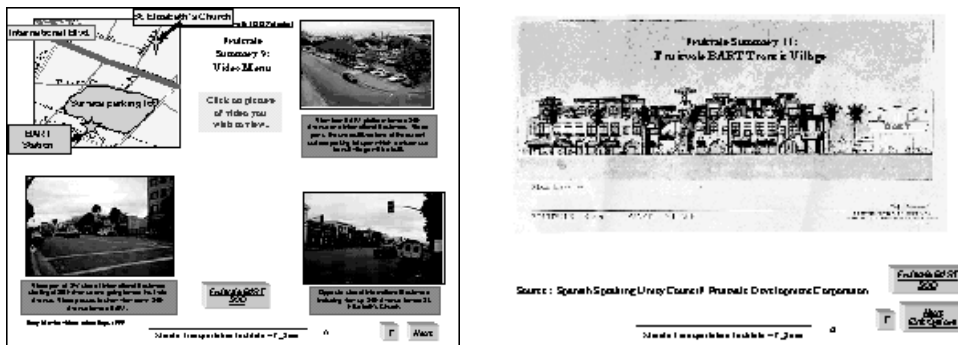


Figure 6. Fruitvale Summaries 9 and 11

Fruitvale Summary 10, *Potential Future Development Sites in Fruitvale BART Vicinity*, is not presented here. It can be viewed as screen 16 on CD-ROM file f\_sum.ppt.

Fruitvale Summary 11, *BART Transit Village*, shows the architectural rendering of the exterior appearance of the Fruitvale Transit Village (Figure 6, right side). New development will include public service facilities, including a low-cost health clinic, library, senior center, subsidized child care, and a computer teaching/learning center; ground-floor retail shops and offices; and 47 housing units on upper floors. In the first phase, 20 percent of the housing units will have below-market rents. In the second phase, additional affordable housing will be built on the adjacent parking lot, with existing displaced parking spaces being moved to a new multilevel parking structure.

One major goal of the Fruitvale Transit Village project is to recapture lands underutilized as surface parking lots and redevelop that land to bring a variety of uses within close proximity to public transportation. It is hoped that this redevelopment will provide easy access to the public while encouraging transit use. Other goals of the project are to generate jobs for community residents and to capture sales revenue from the thousands of BART riders who travel from outside the immediate area, often transferring to and from the 12 local bus lines feeding this station. Project sponsors are also attracting resources to rehabilitate existing housing in the area for resale for low-income families, improve the streets and sidewalks, provide additional housing (especially affordable units), create a new center for local artists, and bring in new commercial development that complements existing businesses.

Additional information on the Fruitvale BART area can be found on the following CD-ROM files:

F\_3D\_access\_F8 has information regarding the Fruitvale BART Station area profiles, including maps about street and accessibility profiles and physical terrain.

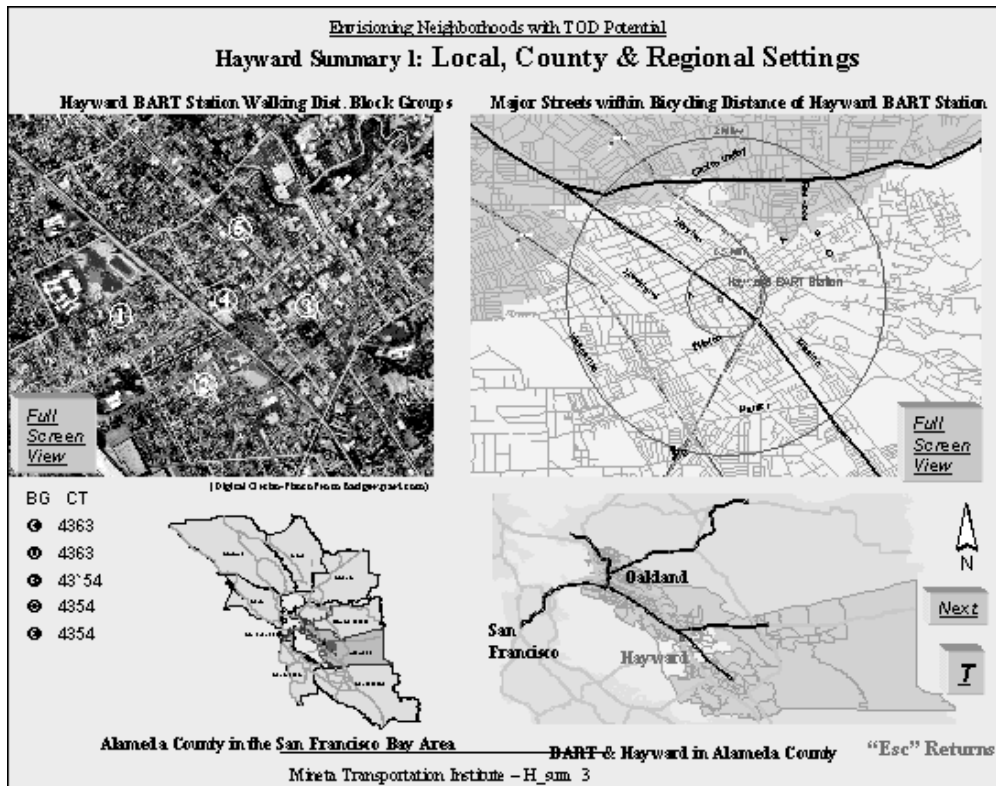
F\_bikeD has demographic information on the Fruitvale area's most common businesses, area services, school maps, public school ratings, number of students, violent crimes statistics, and maps.

F\_LU&ZON is a land-use diagram of the city of Oakland and gives zoning information of the walking-distance vicinity of the Fruitvale BART station.

F\_Vicin4\_videos are shots of the vicinity of the Fruitvale BART station, which were taken in September 1999.

## ENVISIONING THE HAYWARD CITY BART STATION VICINITY

The summary PowerPoint presentation on the Hayward BART Station is available on CD-ROM file H\_sum. Earl Bossard and Dali Zheng were joint project leaders responsible for developing the Hayward BART Station vicinity materials.



**Figure 1. Hayward Summary 1**

*Hayward Summary 1 (Figure 17)* displays four components that provide locational context for the Hayward BART Station vicinity. A digital ortho photograph (DOP) provides context for the area within walking distance of the Hayward BART station, while maps place this area within contexts of scale ranging from 2-mile bicycling distance to the nine-county region. The *Major Streets Within Bicycling Distance of the Hayward BART Station* map shows major streets, freeways, and BART lines within the 2-mile bicycling distance. The *Alameda County in the San Francisco Bay Area* map presents the county

within the context of the nine Association of Bay Area Government counties. The *BART & Hayward in Alameda County* map shows rail connections within the context of the city of Hayward and counties of Alameda and San Francisco.

The summary views can help planners, developers, and analysts decide whether a place merits further consideration for TOD or other development. This view helps to establish the spatial context of the study area in the region and may be of most interest to those not familiar with the area.

The DOP was downloaded from the Internet, using a site specific to the SF Bay region. The U.S. Geological Survey provides DOPs on a national basis. Because of advances in technology, several commercial vendors offer satellite-sourced DOPs at prices far lower than for the custom photographs taken from airplanes, which were the norm until recently.

The street map is derived from the commercially available *Streets* CD-ROM provided by ESRI, Inc. The county boundary maps are derived from the maps available from ESRI or other providers. They are derivatives of the TIGER maps developed for the 1990 U.S. Census. At the scale shown, only the names of the major arterials and highways are displayed.

The DOP with outlines of the block groups within a one-half-mile walking distance of the Hayward BART station indicates that the area is developed with a grid of tree-lined streets, crossed by major streets and rail lines. One problem with the DOP used for this example is that it was taken several years previous and does not show TOD projects constructed during 1998-99 near the Hayward BART station.

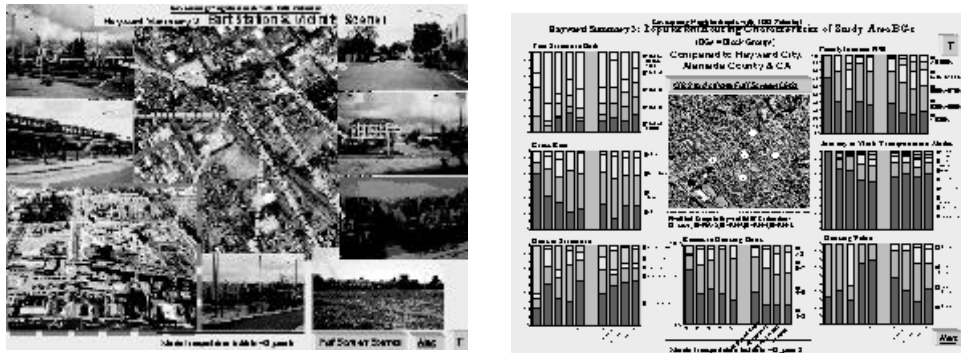
The *Major Streets Within Bicycling Distance of Hayward BART Station* map shows two Interstate Highways passing within 2 miles of the BART station, I-880 (from San Jose to Oakland) and I-580 (from near Stockton to Oakland). Hayward is shown to be just south of a BART junction.

The *BART & Hayward in Alameda County* map shows that Hayward is on the main BART line running along the eastern side of San Francisco Bay to Oakland and San Francisco. Hayward is the county seat and is fairly central within Alameda County.

The *Alameda County in the San Francisco Bay Area* map shows Alameda County to occupy much of the East Bay, east of San Francisco and north of

Santa Clara. This places Hayward within 30 miles of Oakland, San Jose, and Palo Alto, and less than an hour's BART ride from downtown San Francisco.

Hayward Summary 2, *BART Station and Vicinity Scenes*, presents photographs of eight scenes from the area referenced to the DOP (Figure 2, left side). These scenes can provide a quick qualitative feel for the nature of the area, providing a sense of the scale, age, and style of existing and proposed developments.



**Figure 2. Hayward Summaries 2 and 3**

The photos show that the BART station is elevated, with a busy set of feeder buses stopping between the station and city hall. Most of the existing downtown development consists of buildings one or two stories in height. Existing and planned TOD development in the vicinity of the BART station tend to be two to three stories in height.

Several vacant sites with TOD potential are in the vicinity, shown in the air photo in the bottom left of the view. More details are provided about existing and proposed TOD projects in this area in the detailed views for Hayward.

Hayward Summary 3, *Population/Housing Characteristics of Study Area Block Groups*, presents seven sets of stacked bar charts showing census data for the five block groups within walking distance of the BART station (Figure 2, right side). Data for increasingly larger areas are also shown, starting with the average for this area, and proceeding out to the city, county, and state. Each chart presents comparisons across space among the area block groups and across scale between these block groups and their larger city, county, and state entity.

Census data presented include the year the structure was built, gross rent, units in structure, rooms in housing units, family income, journey-to-work modes, and housing values. Analysts can compare block groups in the area and decide which, if any, have characteristics favoring what they wish to develop. Area characteristics can be used to determine what types of TOD might be most suitable for the area.

The comparisons across scale data will facilitate placing the area in context, while helping to understand local characteristics.

A comparison of the seven sets of stacked bar charts for five block groups within walking distance of the Hayward BART station reveals a surprising number of differences. In all block groups, 20 to 60 percent of the housing was built between 1980 and 1990; in three, about 20 percent of the housing was built before 1949. In terms of gross rents, Block Group 3 had far more low-rent housing (70 percent) than any of the others, which had 20 to 40 percent.

In Block Group 3, 60 percent of the buildings have 10 to 50 units, but three other block groups had less than 10 percent of their units in such large structures. The charts for rooms in housing units tell a similar story, with Block Group 3 having far more small (< four rooms) housing units.

As might be expected from its high proportions of low rents, small housing units, and multiple housing unit structures, Block Group 1 has far more lower-income families. The journey-to-work transportation mode data for Block Group 3 is surprising in that it has the highest percentage of workers who drive alone to work.

Comparison of the four right stacked bars in each set of charts reveals how the walking distance area (leftmost of the four right side bars) compares to its city (Hayward), county (Alameda), and the state of California.

Starting with the housing values in the bottom right set of bars, it is clear that this area has a considerably higher share of low-value housing units, and a much smaller share of high-value housing, than the county or state. Both this area and the city of Hayward have an insignificant share of high-value housing (>\$500K). This area also has a greater share of the two lower-family-income groups and a lesser share of the higher-income groups than do the county or state. These charts help define the housing markets in this area and in the city of Hayward in context with the larger county market.

Hayward Summary 4, *Population Density, Population and Jobs, Businesses*, presents three types of figures—a choropleth population density map of the area in the vicinity of the station; a street map of the area within walking distance with point locations for seven categories of businesses; and a pair of bar charts showing population and employment estimates from 2000 and 2020 for areas from 1 to 5 miles out from the station (Figure 3).

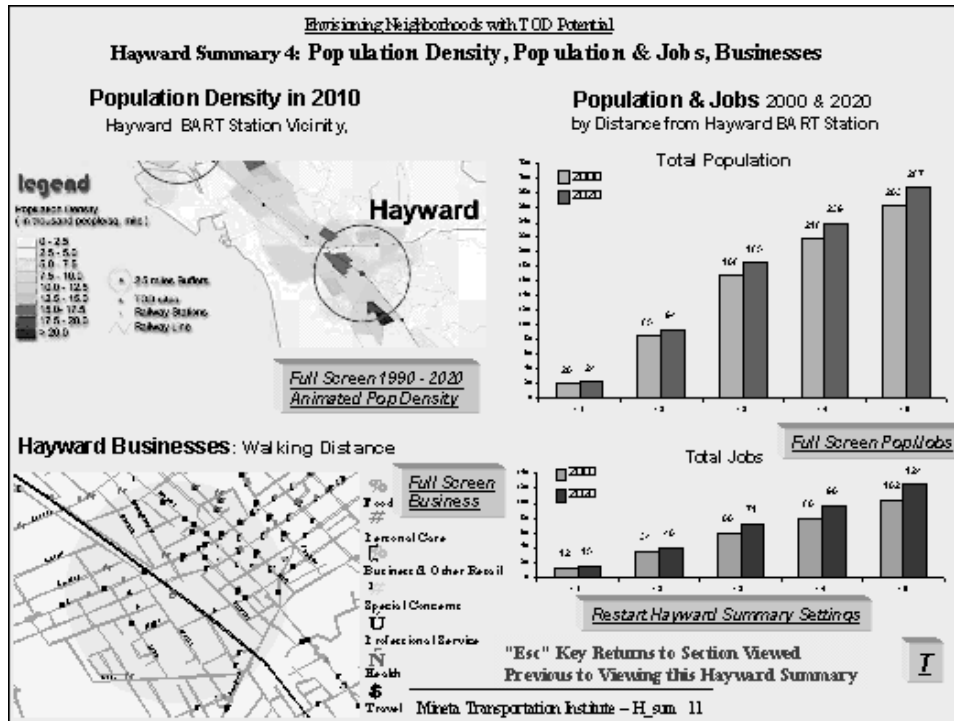


Figure 3. Hayward Summary 4

Population density is a key determinant of transit viability and the likely success of TOD projects, so population density data will be of great interest to TOD developers. The animated population maps for the period 1990 to 2020 by 5-year intervals, found in the digital version, could be of considerable interest to many developers.

The side-by-side bars of population and employment totals from 1 to 5 miles out from the Hayward BART station could be of interest to commercial developers wishing to appeal to various broader or narrower markets. Potential developers of a grocery store may be interested in the residents within 1 mile, while developers of a specialty store may consider the area



within 5 miles. The digital version of *Hayward Summary 4* has links to seven full-page screens with estimates of population and jobs in 2000 and 2020.

The *Businesses Within Walking Distance* maps could be of interest to commercial developers who want to know the business mix of the area and investigate possible market niches. The business maps can also inform potential residents of the services and shopping opportunities within the vicinity. The digital version of *Hayward Summary 4* has links to 16 business maps either within walking or bicycling distance.

In terms of population density, the 2010 map reveals some, but not extensive, areas with sufficient density to support viable transit.

The ring data charts indicate only moderate population growth is expected in the next 20 years for the areas within 2 miles of the transit center, but that more than 20 percent employment growth (102,000 to 124,000) can be expected over that period in the area within 5 miles of the transit center.

The business maps show a heavy concentration of activity east of the transit center, which could be expected in this downtown area of a city of 140,000. A and Mission Streets have considerable strip commercial developments.

Additional information regarding the Hayward TOD potential are located on the following CD-ROM files:

H\_5MileR shows the 5-mile radius population and job charts, race and ethnic population maps, residents within 5- and 15-minute drives of the transit center, and population density data.

H\_Bike has maps of Hayward, showing seven business types within bicycling distance of the Hayward BART station and population percentages of the various ethnic groups residing within bicycling distance of the station.

H\_busroutes\_www is a map of bus routes near the Hayward BART station, taken from the ABAG/MTC Web site.

H\_DOP includes DOPs of the various block groups in the Hayward BART Station vicinity.

H\_DOP\_5mile\_JPG is a DOP of the city of Hayward and vicinity.

H\_F\_PD9022 gives population density information regarding the Hayward area, using ABAG estimates for 1990, 1995, 2000, 2005, 2010, 2015, and 2020.

H\_TOD\_specs has additional information regarding the Hayward BART station vicinity, including specifications for redevelopment sites.

H\_W\_Scene has photographic scenes of the area around the Hayward BART station, including links to video clips, moving panorama views, and still panorama views.

H\_Walk includes maps detailing population within various walking times to the Hayward BART station; businesses within walking distance of the BART station; land use and zoning information for the walking-distance vicinity of the BART station; and bar graphs for population and housing characteristics, family incomes, rents, housing values, and population percentages.

H\_Zoning\_LU contains land use and zoning information for the walking-distance vicinity of the Hayward BART Station.



## ENVISIONING THE MOUNTAIN VIEW VTA/CALTRAIN STATION VICINITY

Downtown Mountain View has perhaps the strongest TOD potential of any of the six areas examined in this study. The downtown Mountain View Transit Center not only has a station on the busy direct CalTrain line between San Francisco and San Jose, but also is the north terminal station for the Santa Clara County VTA LRT line, which passes many high-tech job sites on its way to downtown San Jose and then on to the Blossom Valley area of southern San Jose.

The Mountain View summary overview digital presentation consists of five screens, four of which were prepared by Tung Tran in the fall of 1999, and a fifth prepared by Pin-Yuan Wang during the summer and fall of 2000. The complete PowerPoint presentation can be found on CD-ROM file m\_sum. A brief synopsis of the project follows.

Mountain View Summary 1, *Travel Times from Transit Center*, contains three maps placing the transit center in spatial context within the San Francisco Bay region and Santa Clara County, and showing the travel times via CalTrain from Mountain View to stations from San Francisco to Gilroy (Figure 1, left side). A photo shows the station site before completion of the CalTrain and LRT stations in December 1999.

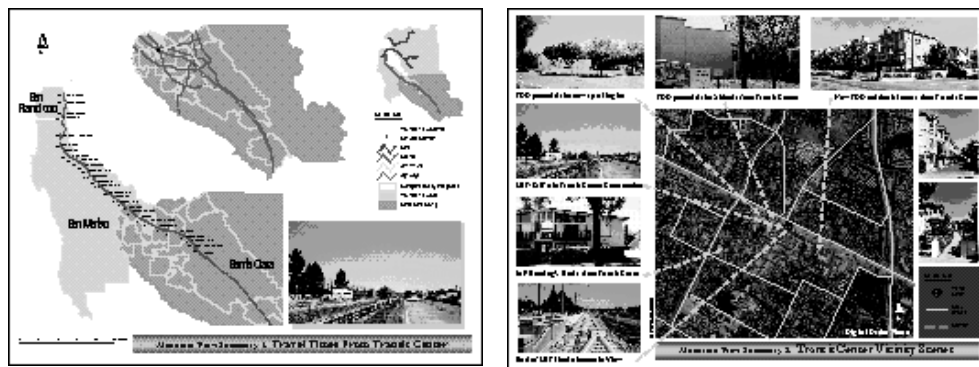


Figure 1. Mountain View Summaries 1 and 2

Mountain View Summary 2, *Transit Center Vicinity Scenes*, contains eight photos of downtown Mountain View and a digital ortho photo (DOP) overlaid

with block group boundaries and references to locations of photographed areas. (Figure 1, right side)

Mountain View Summary 3, *Housing Mix and Five-Mile Radius Stats*, presents four sets of charts showing the cumulative numbers of residents, households, employed residents, and jobs at distances from 1 to 5 miles from the transit center, along with a DOP showing downtown area block groups and housing statistics for these block groups and larger areas (Figure 2).

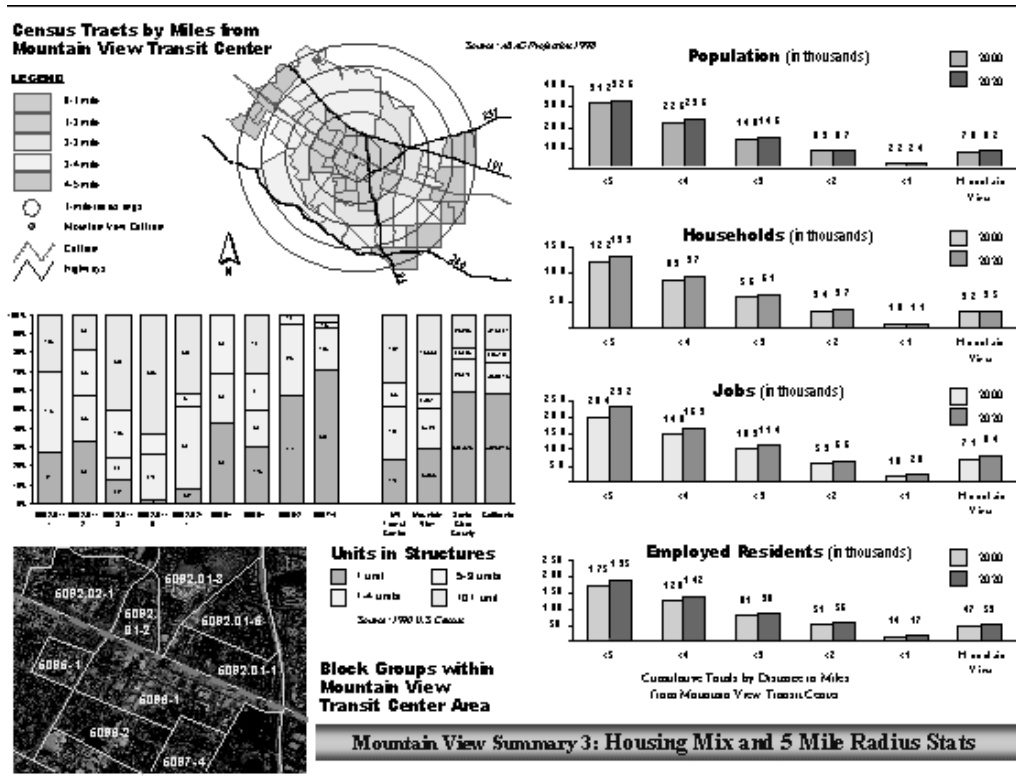


Figure 2. Mountain View Summary 3

Mountain View Summary 4, *Housing and Population Stats for Walk Area*, presents six sets of charts of census data for the nine area block groups and the city, county, and state (Figure 3, left side).

Mountain View Summary 5, *Businesses Within Walking and Bicycling Distance of Transit Center*, presents eight maps showing seven categories of businesses within one-half and two miles of the transit center (Figure 3, right





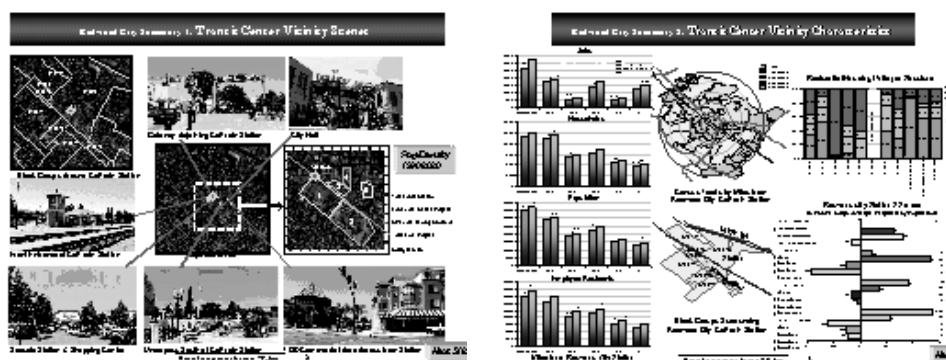
## ENVISIONING THE REDWOOD CITY CALTRAIN STATION VICINITY

Downtown Redwood City has strong TOD potential. The downtown Redwood City transit center not only has a station on the busy direct CalTrain line between San Francisco and San Jose, but also has bus bays that service nearby high-tech job sites and residential neighborhoods. The Redwood City presentations consist of seven screens prepared by Pin-Yuan Wang, including three screens linked via thumbnail photos to a total of 12 short videos.

The CD-ROM file SM\_Setting is a map of the San Francisco Bay that details Redwood City's location in the region.

The complete PowerPoint presentation for Envisioning the Redwood City CalTrain Station Vicinity is located on CD-ROM file R\_Sum. The contents of this presentation follow.

Redwood City Summary 1, *Transit Center Vicinity Scenes*, contains five photos and three digital ortho photos (DOPs) of scenes in the vicinity of the transit center, along with the boundaries of the eight block groups within one-half mile of the CalTrain Station (Figure 1, left side).



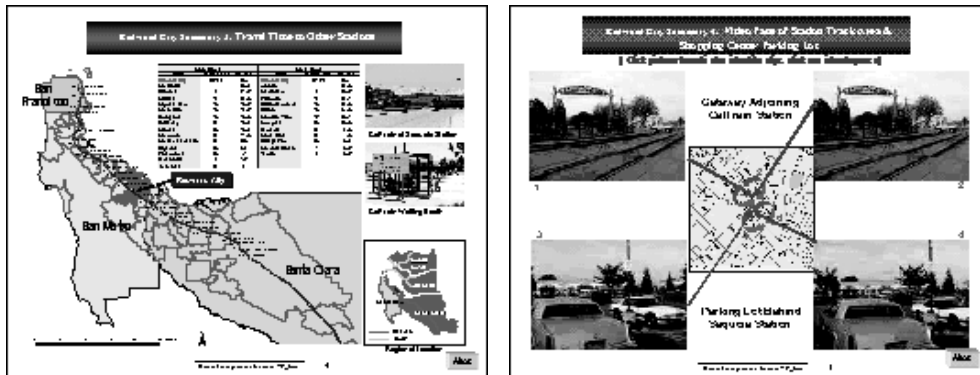
**Figure 1. Redwood Summaries 1 and 2**

Redwood City Summary 2, *Transit Center Vicinity Characteristics*, includes four sets of charts showing the number of residents, households, employed residents, and jobs from 1 to 5 miles from the transit center, along with a map showing downtown area block groups and larger areas (Figure 1, right side). Another chart shows z-scores for 15 census measures for the average of the



eight area block groups, allowing comparison of the area to Redwood City, San Mateo County, and the state of California.

Redwood City Summary 3, *Travel Time to Other Stations*, shows the travel times via CalTrain from Redwood City to stations from San Francisco to Gilroy, using both a map and table (Figure 2, left side).



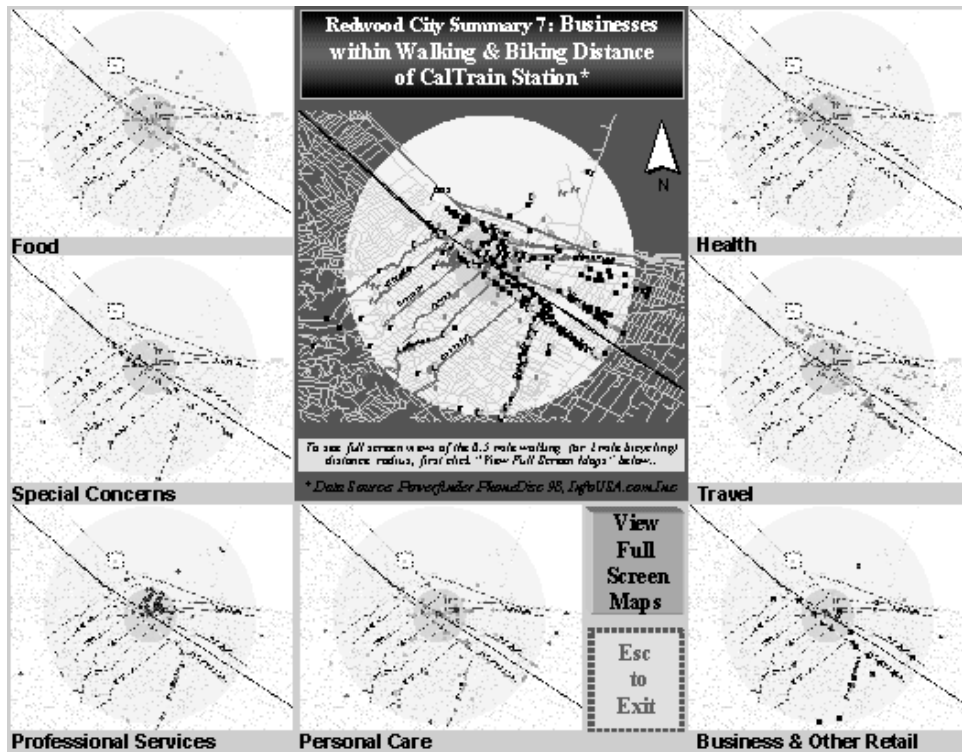
**Figure 2. Redwood City Summaries 3 and 4**

Redwood City Summary 4, *Video Pans of Station Track Area and Shopping Center Parking Lot*, presents four thumbnail photos that, in the digital version, are linked to short video pans of the area (Figure 2, right side).

Redwood City Summary 5, *More Station Area Video Pans*, includes a dramatic short video of the approach of a CalTrain, including crossing sounds. (No miniature shown in printed report; this video is included in the digital version.)

Redwood City Summary 6, *Video Pans of Bus Facility and Area South of Station*, includes two video pans of the Franklin redevelopment site, which will offer residential TOD sites with good access to shopping, downtown businesses and services, and the transit center. (No miniature shown in printed report; videos are available only in the digital version.)

Redwood City Summary 7, *Businesses Within Walking and Bicycling Distance of Transit Center*, are maps showing seven categories of businesses within 2 miles of the transit center (Figure 3). These maps are linked to 16 full-screen views of those business locations, showing details for areas within one-half or 2 miles.



**Figure 3. Redwood City Summary 7**

Additional information about the TOD potential in Redwood City can be found in the following CD-ROM files:

R\_Zon&DOP includes zoning information for the area within walking distance of the Redwood City Transit Center.

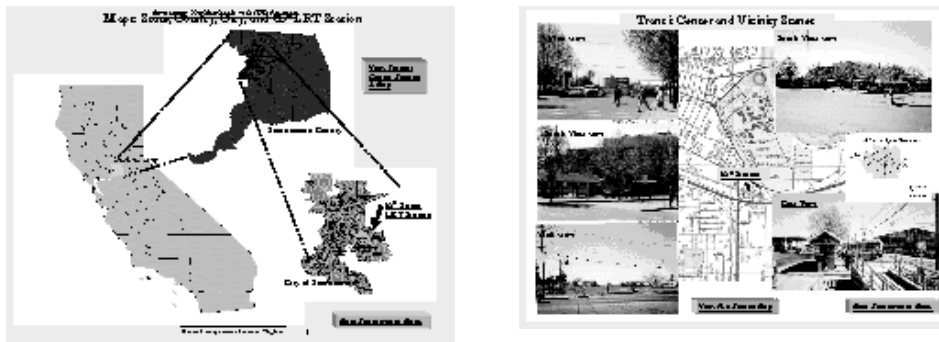
R\_MV\_PD9022 has maps showing population density by census tracts from Redwood City to Mountain View from 1990 through 2020 at 5-year intervals.



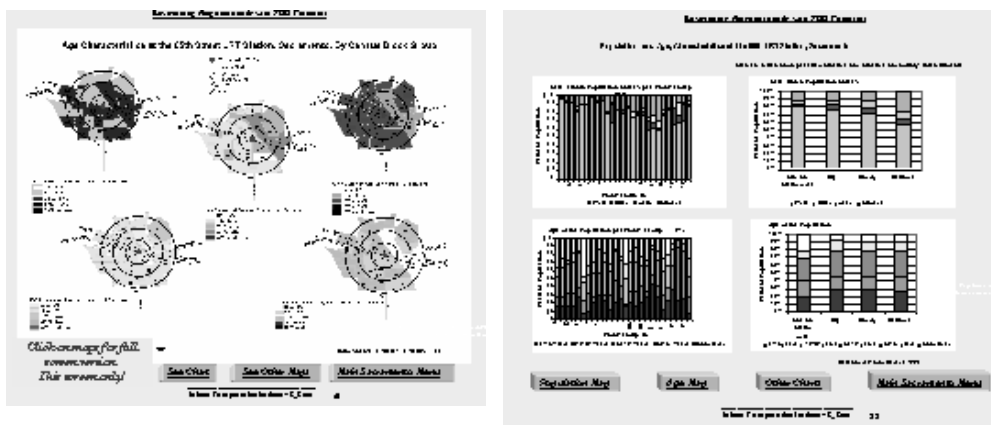
## ENVISIONING THE SACRAMENTO 65TH STREET LRT VICINITY

The Sacramento 65th Street LRT station area has good TOD potential. This transit center not only has a station on the busy direct LRT line to downtown Sacramento but also has several bus bays that service the nearby California State University, Sacramento, campus and residential neighborhoods.

This summary presentation consists of three sets of maps and charts prepared by Andrea Subotic, including race and ethnic data from the Census 2000 pretest that was undertaken in Sacramento in 1998. It also includes multiple maps of the area at the census block group level. Maps and overviews are shown in Figure 1, and age-related graphs are shown in Figure 2.



**Figure 1. Sacramento Summaries 1 and 2**



**Figure 2. Sacramento Summaries 3 and 4**

Four pages present photo scenes and maps to overview the 65th Street Station vicinity. In the PowerPoint version, the transit center and vicinity scenes have links to three full-page screens of the summary.

The majority of the summary (pages 10-22) provides census maps and charts for the area within 1.5 miles of the transit center. Six sets of small multiple maps provide details of census data on age, family income, rooms in housing units, race/ethnic percentages, and means of transportation to work for block groups.

Stacked bar charts are provided for many of the 1990 census block group data, also including statistics for the city and county of Sacramento and state of California, to place the study area in context.

To view the PowerPoint presentation, select CD-ROM file S\_Sum. The highlights of the file are presented below.

Seven categories of business within 1.5 miles of the 65th Street Transit Center are shown on a full-screen map, *Businesses Within 1.5 Miles of the 65th Street LRT Station in Sacramento*.

*Area Data for 1.5 Mile Radius of the Sacramento 65th LRT Station Population and Housing Characteristics Menu* provides a menu for block group maps, block group charts, and census block maps, all based on 1990 data.

*Maps: State, County, City and 65th LRT Station* place the 65th Street LRT station location in context of state, county, and city (shown in Figure 1).

*Transit Center and Vicinity Scenes* shows photographs of the immediate area around the 65th Street LRT station (shown in Figure 1).

*65th Street LRT Station Area Map* details the location of the LRT station in relationship to the California State University, Sacramento campus.

*65th Street Study Area Block Groups* shows the census boundaries created for the 1990 census. The map also shows light rail routes and major highways.

*Age Characteristics at the 65th Street LRT Station, Sacramento by Census Block Group* breaks down age demographics of the census block groups surrounding the 65th Street LRT Station.

*Age 0-18 Block Group Map, 65th Street Station Area* shows the percentage of residents under the age of 18.

*Family Income in 1989 at the 65th Street LRT Station, Sacramento by Census Block Groups* breaks down the income levels of families living near the LRT station.

*Rooms in Housing Units at the 65th Street LRT Station, Sacramento by Census Block Groups* indicates the sizes of housing units near the LRT station.

*Race/Ethnic Percentages at the 65th Street LRT Station, Sacramento by Census Block Groups* shows the race/ethnic breakdown of the neighborhoods surrounding the 65th Street LRT Station.

*Means of Transportation to Work at the 65th Street LRT Station, Sacramento by Census Block Group* summarizes the modes of transportation used by residents near the LRT station.

*Year Structure Built at the 65th Street LRT Station, Sacramento by Census Block Groups* indicates the age of structures standing in the neighborhood around the 65th Street LRT Station.

*Year Structure Built at the 65th Street LRT Station, Sacramento* has bar charts comparing the age of structures near the 65th Street LRT Station to the remainder of Sacramento, Sacramento County, and the state of California.

*Population and Age Characteristics at the 65th Street LRT Station, Sacramento* has bar charts comparing the population and age characteristics of residents near the 65th Street LRT Station to the remainder of Sacramento, Sacramento County, and the state of California (shown in Figure 2).

*Family Income and Means of Transportation at the 65th Street LRT Station, Sacramento* are bar charts comparing family incomes and means of transportation to and from work between the residents near the 65th Street LRT Station and the remainder of Sacramento, Sacramento County, and the state of California.

*Means of Transportation to Work at the 65th LRT Station, Sacramento* is a detailed graph that breaks down mode of transportation by census block group, including carpooling, driving alone, motorcycle, public transportation, and rail.

*Rooms in Housing Units in Structure at the 65th Street LRT Station, Sacramento* is a series of bar charts that break down the number of rooms per structure in the census block groups near the 65th Street LRT Station, and compares the number of rooms to the remainder of Sacramento, Sacramento County, and the state of California.

*Race/Ethnic Percentages at the 65th Street LRT Station, Sacramento by Census Bloc, 1998* has graphs detailing the racial percentages of the neighborhood surrounding the 65th Street LRT Station, using 1998 data.

*Race/Ethnic Percentages at the 65th Street LRT Station, Sacramento by Census Block, 1990* gives the same data as above but using 1990 data.

*Businesses Within 1.5 Miles of the 65th Street LRT Station in Sacramento* is a map with local businesses plotted in relationship to their location of the 65th Street LRT Station.

---

## COUNTY OR REGIONAL CONTEXTS

*Envisioning the Regional Setting for Five TOD Study Areas in the San Francisco Bay Region* presents a series of maps showing the regional setting for the five TOD study areas in Alameda, San Mateo, and Santa Clara counties. The “regional setting” is both broadly and narrowly construed, with the broad view looking at the nine counties constituting the Association of Bay Area Governments (ABAG) region, and the narrow view looking at the five counties nearest the study areas: San Francisco, San Mateo, Santa Clara, Alameda, and Contra Costa.

### REGIONAL DATA

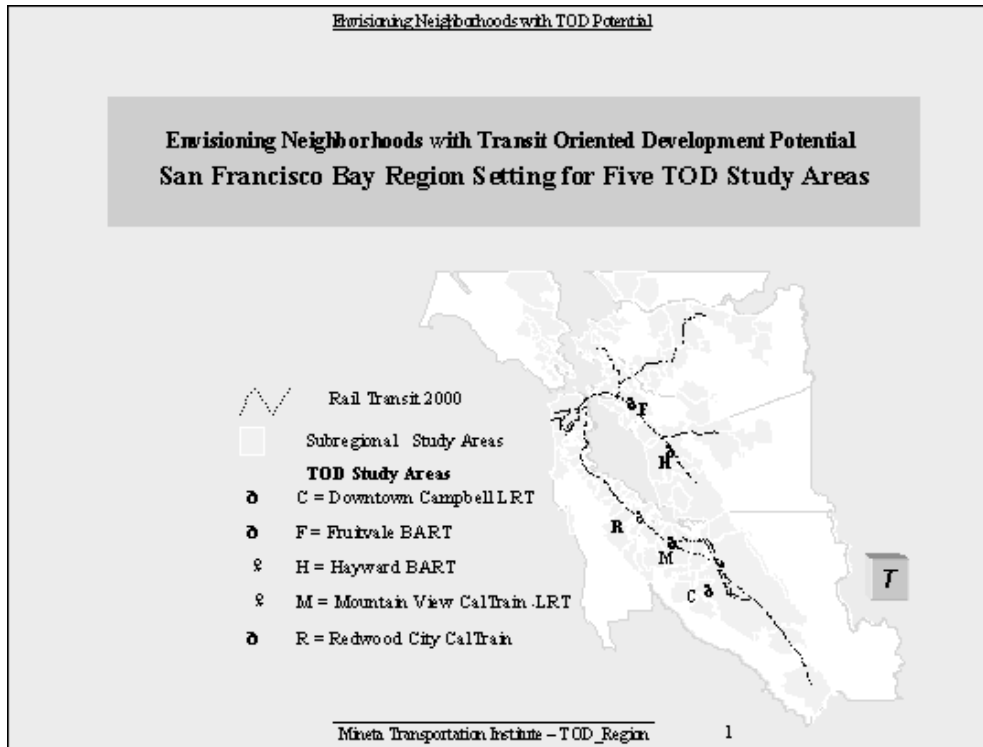
The regional data shown include rail transit routes; county boundaries; highways, commercial airports, and ferry terminals; 2000 and 2020 estimates of population, population density, and housing density; and 1990 census data regarding race, ethnicity, and family incomes.

Understanding the regional setting of areas with TOD potential is important because a significant proportion of activities in this region cross multiple counties, with journey-to-work trips often crossing county boundaries. Potential developers of residential TOD projects need to be aware of where the future residents of their projects may be working. TOD developers also need to be aware of how their project fits in with the general demographic patterns of the region.

All the population and housing estimates for 2000 and 2020 are based on ABAG’s *Projections ’98* census tract data. The 1990 race/ethnicity and family income data source is the U.S. Census, as ABAG does not produce census-tract-level statistics for these measures. Highlights of the CD-ROM file *TOD\_Region* are discussed below. Printed miniatures are shown here only for the *Regional Settings* and *2000/2020 Population* slides.

*Rail Transit and Five TOD Study Areas* (*TOD\_Region*, slide 1) shows that the study areas encircle San Francisco Bay, with Fruitvale, Hayward, Redwood City, and Mountain View having direct rail transit access to San Francisco (see Figure 1.)

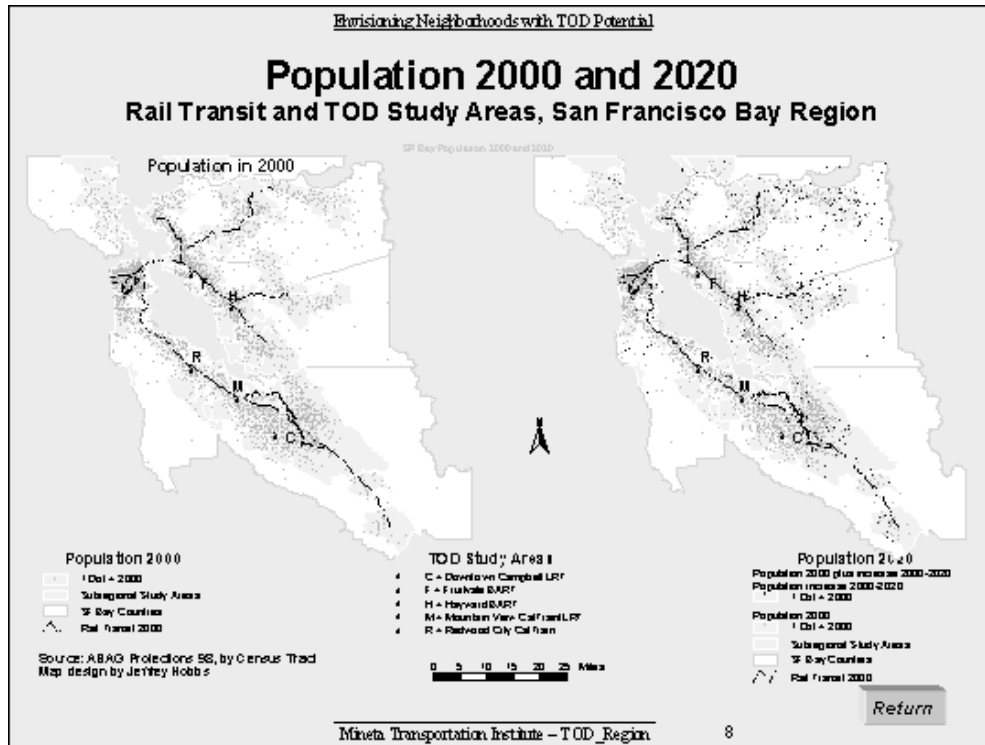




**Figure 1. San Francisco Bay Region for Five TOD Study Areas**

*Highways, International Airports and Ferries* (TOD\_Region, slide 7) shows that Fruitvale has excellent access to the Oakland Airport. (Hayward has good access to the Oakland Airport.) Redwood City and Mountain View have direct access to the San Francisco Airport; Mountain View also has good access to the San Jose Airport. (The VTA Vasona Line extension to Campbell in 2004 [not shown] will connect to a station within a mile of the San Jose Airport.)

*Population 2000 and 2020* (TOD\_Region, slide 8) and *San Francisco Bay Region Population Density* (SFB\_PD9022LR) show that in both 2000 and 2020 the densest population areas will be along the rail transit lines circling San Francisco Bay, with the largest concentrations of high population densities found in San Francisco and from Fruitvale north in Alameda County (this is the city of Oakland). (See Figure 2.)



**Figure 2. Population 2000 and 2020 Rail Transit and TOD Areas**

*San Francisco Bay Region Age Over 64 Population and San Francisco Bay Region Age over 64 Population Density* (TOD\_Region, slides 11-14) show the increasing share and density of elderly population expected in the region during the next 20 years.

*Modal Racial/Ethnic Group* (TOD\_Region, slides 17 -21) show areas where Blacks, Asians, Hispanics, or Whites are the most prevalent group, while other views show details for each of these groups.

*Median Family Income* (TOD\_Region, slide 22) shows modest family incomes in the immediate vicinity of all TOD study areas; however, areas of very high incomes exist near the Redwood City, Mountain View, and Campbell TOD potential study areas.

## COUNTY CONTEXT VIEW CHARACTERISTICS

The Alameda County Settings views present a series of maps for this large urban county, with a population of over a million persons, that place the Fruitvale BART and Hayward BART study sites in countywide context.

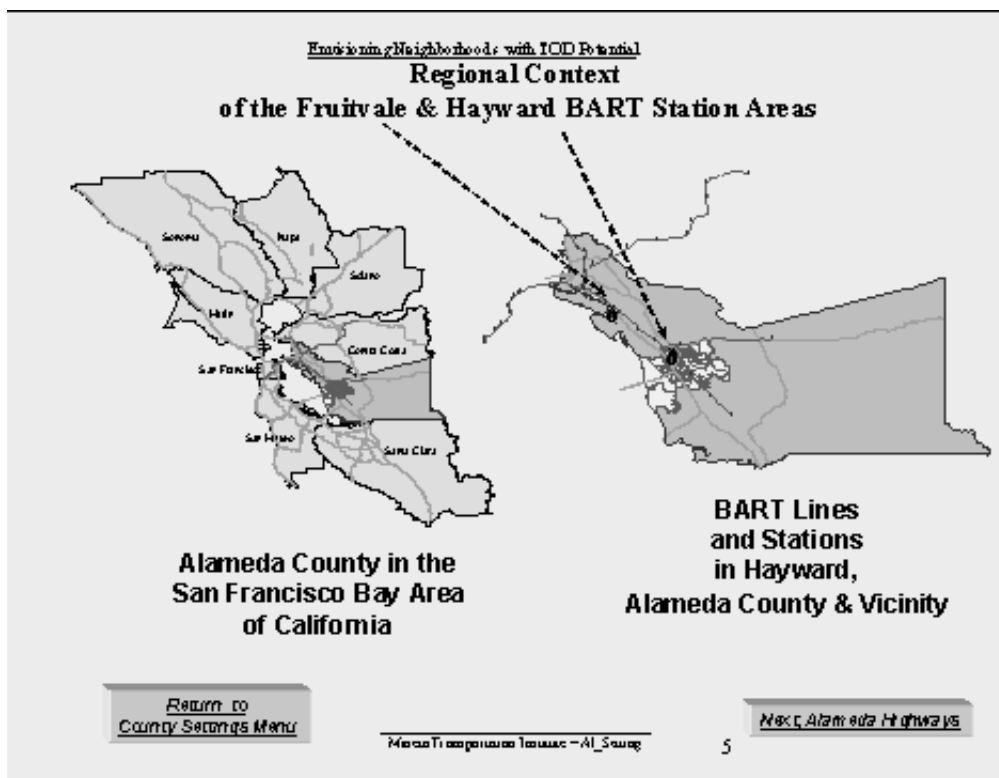
The county data include maps showing rail transit lines, the regional context of the county in the San Francisco Bay region, highways, subregional study areas (mostly cities), job data for census tracts and around BART stations, population and housing densities, and elderly population data, race/ethnic data, and family income data.

The county setting of TOD potential areas is important, because most of the residents in this county work and shop in this county; therefore, TOD developers should understand the county jobs, housing, and demographic patterns.

*Alameda County TOD Study Sites (Al\_Setting, slide 1) and Regional Context of the Fruitvale and Hayward BART Station Areas (Al\_Setting, slide 5) show that both the Fruitvale and Hayward BART Station areas are located in the western part of Alameda County along the BART rail line running from Fremont to Oakland and San Francisco. (Slide 5 is shown in Figure 3.)*

*Alameda County TOD Study Areas with Highways (Al\_Setting, slide 6) shows that both Fruitvale and Hayward are in the I-880 corridor and both are not far from I-580. Hayward also is located on California Highway 92, which crosses the San Francisco Bay to the west going to the job-rich Silicon Valley area (see Figure 4.)*

*Alameda County TOD Study Areas with ABAG Subregional Study Areas (Al\_Setting, slide 7) shows that Fruitvale is in the west central area of Oakland, directly east of the City of Alameda. Hayward BART is in north central Hayward, with the city reaching from the unincorporated hills on the east to the bay on the west.*

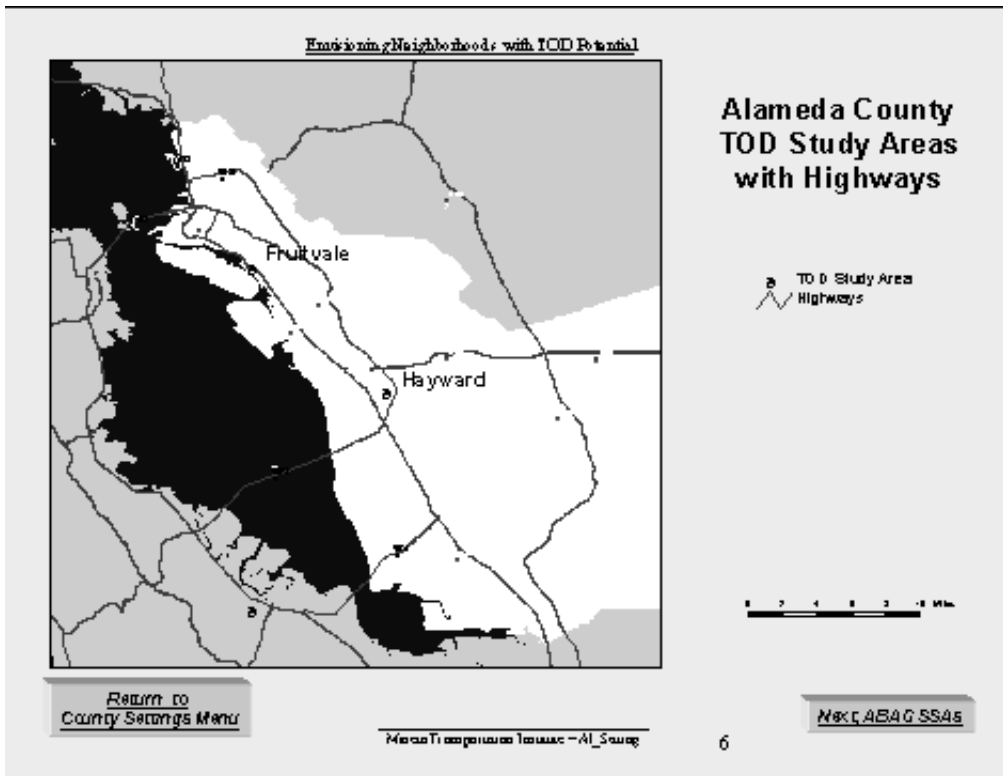


**Figure 3. Regional Context of the Fruitvale and Hayward BART Station Areas**

*Alameda County TOD Study Areas and Jobs in 2000, Job Change 2000-2020* (Al\_Setting, slide 8) shows that Fruitvale is located on the southern edge of the concentration of jobs in central Oakland, which is expected to grow considerably by 2020. Hayward has fewer jobs in its immediate vicinity, both in 2000 and 2020, but is directly west of the large concentration of job growth expected between 2000 and 2020 in the tri-valley area of Dublin and Pleasanton.

*Population & Jobs Within 1/2 Mile of East Bay BART Stations* (Al\_Setting, slide 9) has a great deal of information, which is discussed in detail in the project overview section.

*Population Density* (Al\_Setting, slides 10-11) reveal that although the Fruitvale vicinity has extensive areas with densities sufficient to support viable public transit, the Hayward BART vicinity, even in 2020, is expected to exhibit few census tracts with high densities.



**Figure 4. Alameda County TOD Study Areas with Highways**

*Age Over 64* (Al\_Setting, slides 12-15) show a considerable increase between 2000 and 2020 in tracts with more than 20 percent elderly population, but few of these increasingly elderly tracts are near the BART transit centers.

*Modal Race/Ethnic* (Al\_Setting, slides 18-22), along with the full-page screens for each of the four race/ethnic categories, show that Fruitvale is a predominately Hispanic area, with a large Asian community to its immediate northwest and an even larger Black community to its north, east, and south.

*Family Income* (Al\_Setting, slide 23) shows that Fruitvale is located within the largest low-income concentration in the county, while the Hayward BART vicinity is predominately low-middle income in character.

## **APPENDIX A: ENVISIONING THE QUALITY OF LIFE AND CONTEXT FOR DEVELOPMENT IN NEIGHBORHOODS WITH TRANSIT-ORIENTED DEVELOPMENT POTENTIAL**

### **ABSTRACT**

The digital information revolution had provided an incredibly rich set of digital tools and data that can be utilized for envisioning quality of life in cities. We argue that quality of life (QOL) is a distinctly personal measure for each person, reflecting his or her values and culture, nested in a set of spatial relationships starting with home-related facilities that help satisfy residential needs, and include a hierarchy of neighborhood communities.

We suggest that QOL studies for persons and development sites should explore the context of their locations, looking at data for blocks, using a variety of neighborhood definitions in a regional setting.

This paper takes a second look at using digital tools and data to understand neighborhood conditions explored in ICQOLOC I by Bossard, this time utilizing data tools and sources not readily available only two years ago.

Digital tools explored include increasingly powerful computer hardware, digital cameras and camcorders, global positioning systems (GPS) and robust software to transform and model urban data. Digital data readily available on the Internet and CD-ROM now includes ortho photos, topographic maps, census data, school data, crime data, real estate listings and public transportation route maps and schedules.

The Envisioning Neighborhoods Technique (Bossard, 1998) is used for a case study evaluating the quality of life and context for development in neighborhoods with transit-oriented development potential. Detailed sets of multiple maps, charts and photos present neighborhood conditions, with quantitative aspects shown by multiple maps and charts, and qualitative aspects highlighted in photos, videos and digital ortho photos.

## INTRODUCTION

America is undergoing an urban renaissance, with considerable interest in improving quality of life within its cities. This urban renaissance is accompanied by support within many areas 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 developing in the USA reflecting one residential lifestyle preference which has been neglected under policies which promoted standardized, automobile-oriented, suburban housing tracts (Katz; Van der Ryn and Calthorpe). A key aspect of the New Urbanism movements 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 increasingly 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 conducive to walking, biking, and transit riding” (Bernick and Cervero, p. 73).

Although transit-oriented development has been advocated in the U.S. for years (Bernick and Cervero, Ch.1), it has yet to realize its full potential. The Envisioning Neighborhoods with Transit-Oriented Development project has been undertaken at San José State University under the sponsorship of the Mineta Transportation Institute to develop techniques for regional planning agencies, local governments and developers to screen, analyze, select and promote areas with TOD potential. In order 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.

## **APPROPRIATE SCALES FOR STUDYING URBAN QOL**

What is the appropriate scale for studying urban QOL? While the QOLNET International website points out that there is presently no general agreement on the definition of quality of life, it suggests that nascent urban QOL studies have been generally carried out on the personal and city level (<http://www.qolnet.nus.edu.sg/what.html>).

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 (Lynch, p. 265).

The grain of a mix is fine when like elements, or small clusters of them, such as members of the same economic or ethnic group, are widely dispersed among a variety of different economic or ethnic groups, and coarse when extensive areas of the same group are segregated from extensive areas of other groups. A grain is sharp when the transition from a cluster of like groups to its unlike neighbors is abrupt, and blurred if the transition is gradual. For Lynch, grain is simply a way of making explicit a spatial feature of cities which is often discussed and is variously referred to by such words as segregation, integration, diversity, purity, land-use mix or clustering. "In its many forms, grain is critical to the goodness of a place." (Lynch, p. 266).

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 available grain-related QOL information 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.



If 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, then to understand QOL we must understand the spatial settings of urban components, starting with the smallest possible components (people, households, blocks, etc.) 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 a very important component, especially in urban settings.

While the digital/communications revolution (W. Mitchell) has created vast amounts of personal and household data, this data is generally not uniformly available to researchers and is scattered among survey research firms, geo-marketers, utilities, real estate assessment officials and a wide variety of semi-autonomous public service providers and websites.

Therefore in the USA we usually start urban QOL analysis with readily accessible decennial census data, which provides 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 this 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/medical problems of deprivation, deviance, morbidity, etc., is fraught with considerable ecological fallacy risks and must be viewed as highly suspect (Wrigley, et. al., p. 30).

To this we may add that 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 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, however, a complex topic worthy of a detailed study of its own.

Our conclusion to the question, “What is the appropriate scale for studying urban QOL?” is to strive for a scale that best reflects people’s varied preferences and includes 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**

An innovative technique, called Envisioning Neighborhoods (EN) is being used in the EN TOD project to determine, analyze and promote potential TOD sites. The EN TOD 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).

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 URL <http://www.transweb.sjsu.edu/bossard/census.html>.

The EN TOD project is designing, documenting and applying techniques to envision the quality of life and contextual nature of potential TOD sites, particularly along light and heavy rail corridors in the San Francisco Bay region. Data screening techniques use 1990 census data, but are designed to facilitate use of year 2000 data. Digital ortho photos are being used to find and estimate available developable land. Geographical information systems (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 lines connected 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 to provide contextual relationships of structures, transit facilities and developable sites.

The EN TOD project is developing 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 transit-oriented development potential. The process for using these tools will be explained in a step-by-step manner in the EN TOD project final report to facilitate adoption and emulation by local practitioners.

### **CASE STUDY EXAMPLE ENVISIONING THE FRUITVALE BART STATION VICINITY**

This example focuses on summary page views that envision neighborhoods with TOD potential and detailed neighborhood profiles including sets of maps, charts and digital images. Components of the summary page views and detailed neighborhood profiles are outlined in Figures 1 and 2. The project's summary page views and detailed profiles will be presented in several forms, including hardcopy paper versions, and digital versions distributed via CD-ROM and the Internet.

Reproduction cost constraints result in the paper versions being in black and white, while the digital versions, utilizing advances in digital technology, include color maps, charts, photos, and short video movies.

Envisioning Neighborhoods with TOD Potential

**Figure 1**  
**Organizational Principles & Framework**

**Multiples -** Use small replicate maps, charts & images to facilitate comparisons across space, time & scale (a la E.Tufte)

**Context Matters -** Data is best understood in a comparative context.

**Summary Context Views –** Facilitate selecting places for further consideration

- Size - 1 to 6 pages/screens per neighborhood/place
- Maps - Regional/county/city location; Neighborhood/place details including census area boundaries; Regional/county/city rail transit.
- Charts - Population/housing mix for neighborhood/place compared to region
- Photos/Images - Transit center & vicinity, anchor/landmark properties, typical housing & non-residential uses, digital orthos

**Detailed Views -** Facilitate specific site selection, development & location decisions

- Size - 10 or more page/screens per neighborhood
- Maps - Travel time access maps from transit center within 5, 10, 15, 20 & 25 minutes walk; Travel time access maps via roads within 5 and 15 minutes drive from transit center; Population, housing & employment choropleth & dot density maps; Business locations within 0.5 and 2 miles of transit centers; and Zoning, general plan, and land use maps.
- Charts - Population, housing & employment data for neighborhood and areas located within rings ½, 1, 2, 3, 4, and 5 miles from transit center.
- Photos/Images - Panoramic photos /video pans of transit center and streets emanating from it. Existing development in neighborhood/place

**Note: Later versions of this figure include a new line: “Take Action... based on Envisioning”**

**Next**

Mineta Transportation Institute – BK\_EQOL 7

Figure 1-(CD File; Bk\_EQOL, Slide 7)

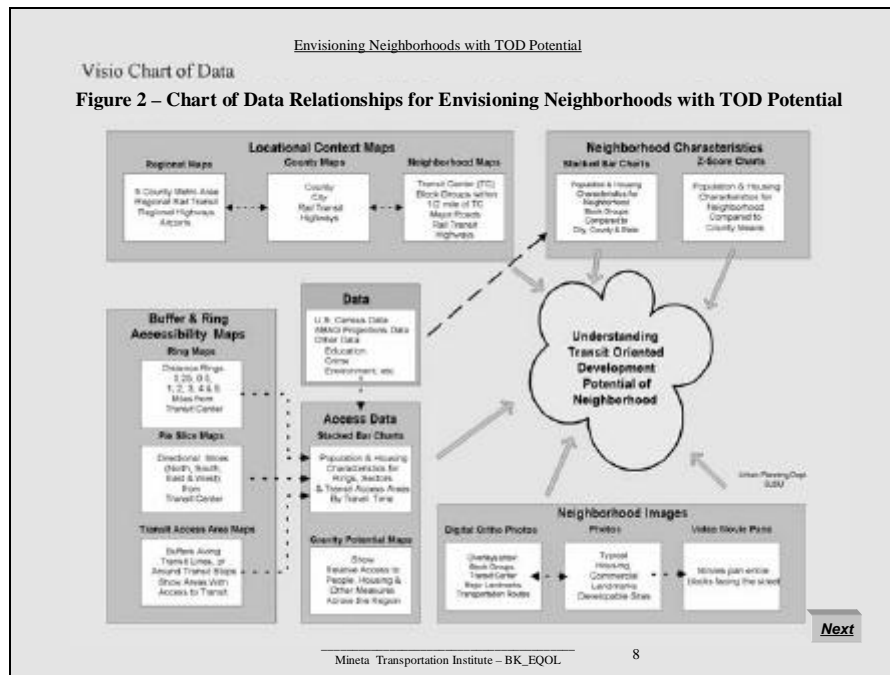


Figure 2-(CD file: BK\_EQOL, slide 8)

Presented here is preliminary work on the neighborhood surrounding the Fruitvale BART (Bay Area Rapid Transit) station in Oakland, California, USA. The station area is the site of a mixed-use transit village being built on an existing parking lot by a non-profit community development corporation named The Unity Council. This \$50 million multi-use project began construction in 1999. New development will include public service facilities (low-cost health clinic, library, senior center, subsidized child care, and a computer/teaching learning center), ground floor retail shops, offices, and 47 housing units on upper floors. In this first phase, 20 percent of the housing units will have below-market rents. In the second phase, additional affordable housing will be built on the adjacent parking lot with existing displaced parking spaces being moved to a new multi-level parking structure.

One major goal of this project is to recapture lands underutilized as surface parking and redevelop that land to bring a variety of uses within close proximity of public transportation. It is hoped that this redevelopment will provide easy access to the public while encouraging transit use. Other goals of the Fruitvale Transit Village project are to generate jobs for community residents and to capture sales revenue from the thousands of BART riders who travel from outside the immediate area, often transferring to and from the 12 local bus lines feeding this station. Project sponsors are also attracting resources to rehabilitate existing housing in the area for resale to low-income families, improve the streets and sidewalks, provide additional housing (especially affordable units), create a new center for local artists, and bring in new commercial development which complements existing businesses. (Bernick and Cervero devote four pages to “Transit Village Redevelopment: The Case of Oakland’s Fruitvale District,” pp. 207-210.)

The preliminary materials in this paper present a work in progress towards the development of summary materials, which could be used by potential developers to reach decisions as to whether or not this area has potential for them. Some of the materials presented here may also be used in detailed materials provided to facilitate choice of specific sites and choice of the scale and nature of possible developments. These materials, which are oriented toward planners and developers, can eventually be modified and used by persons considering renting or buying a residence or business site in the area.

### SUMMARY PAGE VIEWS ENVISIONING THE FRUITVALE BART STATION AREA

Listed below is a description of the tools and techniques that Tara Kelly used in creating Figures 3 and 4:

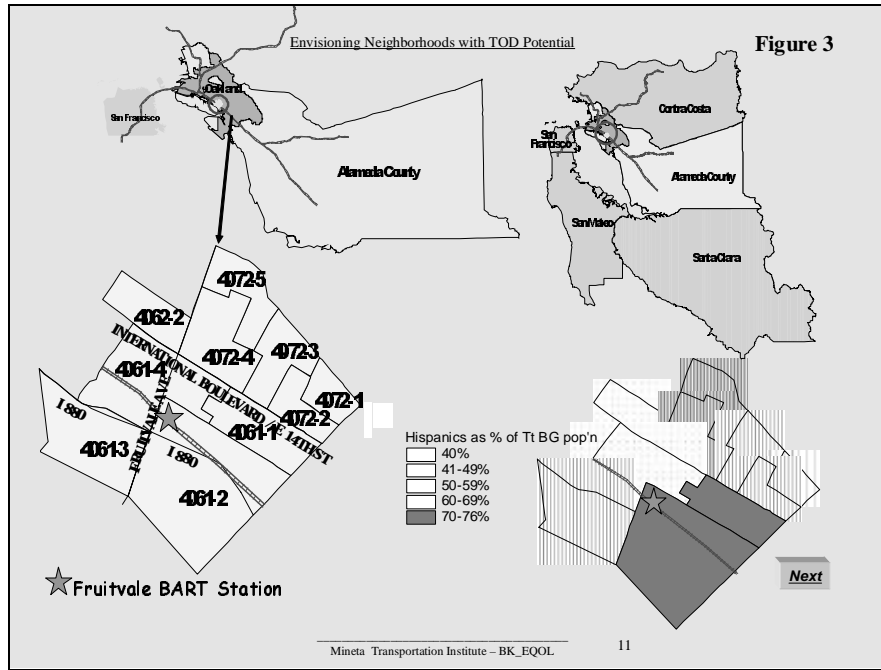
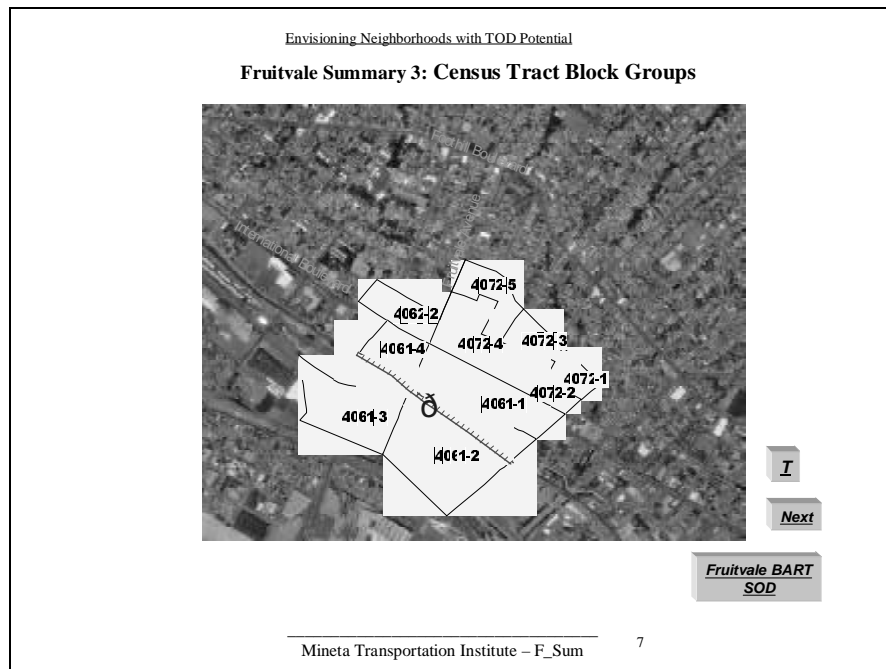


Figure 3- Location Maps for Fruitvale BART Station Vicinity (CD file: BK\_EQOL, slide 11)



**Figure 4-Digital Ortho Photos and Photos for Fruitvale BART Station Vicinity (CD file:F\_Sum, slide 7)**

These maps place the Fruitvale BART Station area within its spatial context, showing the ten block groups surrounding the station, the City of Oakland, and the five nearest counties in the Bay Area region, with a focus on Alameda County, the county the station is within. All of these maps were created in ArcView GIS 3.1 and imported into PowerPoint. Shape files for the areas were provided by ESRI and the BART transit line shape files were provided by the Association of Bay Area Governments (ABAG), the council of governments type organization for the nine-county San Francisco Bay Region. ABAG has a website that provides access to a wide variety of urban QOL data for its region. See URL: <http://www.abag.org>.

The choropleth map in the lower right hand corner was also created in ArcView using 1990 U.S. Census data. This map depicts the proportion of each block group's population that is Hispanic (the predominant racial/ethnic group living in this area). The lowest was 40 percent Hispanic and the highest was 70-76 percent. Figure 1 does not have room to include detailed maps, schedules, and other information regarding public transportation found on the Internet at: [http://www.abag.org/abag/local\\_gov/transit.html](http://www.abag.org/abag/local_gov/transit.html).

*Figure 4-Digital Ortho Photos and Photos for Fruitvale BART Station Vicinity* (CD file:F\_Sum, slide 7). The U.S. Geological Survey digital ortho photo used was downloaded for free from <http://bard.wr.usgs./bard/cog/sanfrancisco/oaklandeast/sw.cog>.

The ortho photograph was edited in Microsoft Word (using the “picture” toolbar functions) down to a smaller area surrounding BART. It was then modified (block group outlines added, etc.) using the Microsoft Word “drawing” function and imported to Microsoft PowerPoint. Because digital ortho photos have been corrected to represent on-the-ground relationships, they can be used interchangeably with maps. Ideally for site analysis work digital orthos with a higher resolution than those provided for free via the Internet should be used.

The other photos were taken with a standard 35mm camera, scanned into the computer and opened in Microsoft Word where they were edited using the “picture” tools. These were then imported into PowerPoint to create the full-page summary pageview presentation.

A new high-tech option, considered for taking photos for the project, but not adopted because of the current \$2,000 cost, would be to use the Kodak DC265 Global Positioning System (GPS) Solution Kit, which enables users to take 1.6 million mega pixel resolution digital pictures, with the latitude and longitude embedded in the digital file to readily identify the location on digital maps and geo-referenced digital ortho photos. (See URL: <http://www.kodak.com/IJS/en/store/catalog/>.)

Digital video pan movie clips were also taken of entire block fronts in the area with a Sony Mavica MVC-FD88 digital camera. The clips, originally stored on a floppy disk in the camera, can be accessed in PowerPoint by clicking on maps or photos in summary pageview presentations that can be accessed from the Internet or via CD-ROM disk. (See CD file: F\_Sum, slide 15.)

Information on the camera is available at URL: <http://www.sel.sony.com/SEL/consumer/dimagin/>.

*Figures 5a and 5b - Stacked Bar Charts and Standard Bar Charts* (CD file: BK\_EQOL, slides 13-14)

The bar charts in these two figures were created using Microsoft Excel and imported into PowerPoint to create the full-page presentations. The stacked bar



charts shown in Figure 5a were created using a template created by Dr. Bossard (Bossard, 1993) that standardized the process for creating charts linked to data tables, which could be changed. This data, from the 1990 U.S. Census, compares the block groups within the study area to each other and to increasingly larger scale areas they are a part of. The standard bar chart shown in Figure 5b was created using Microsoft Excel.

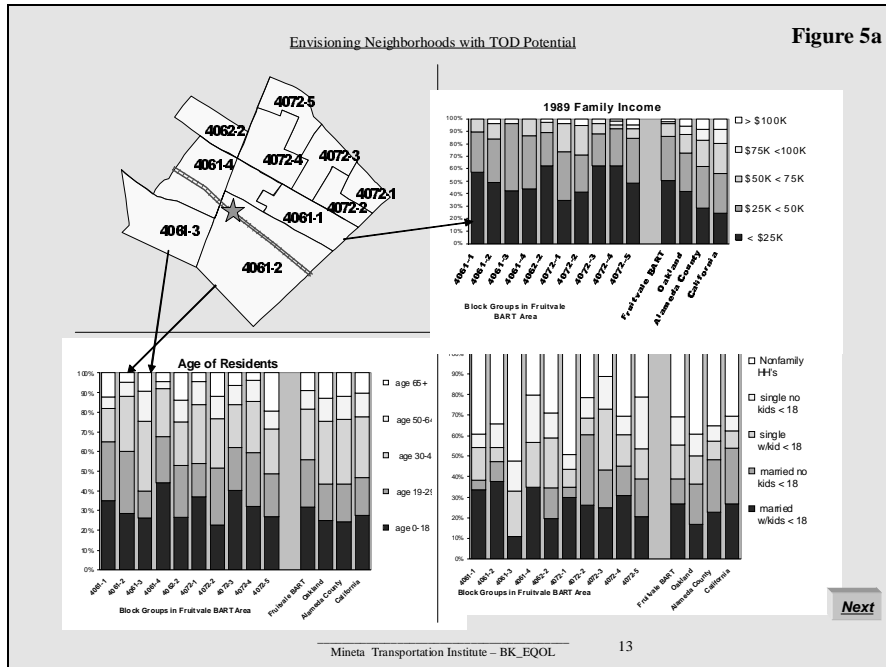
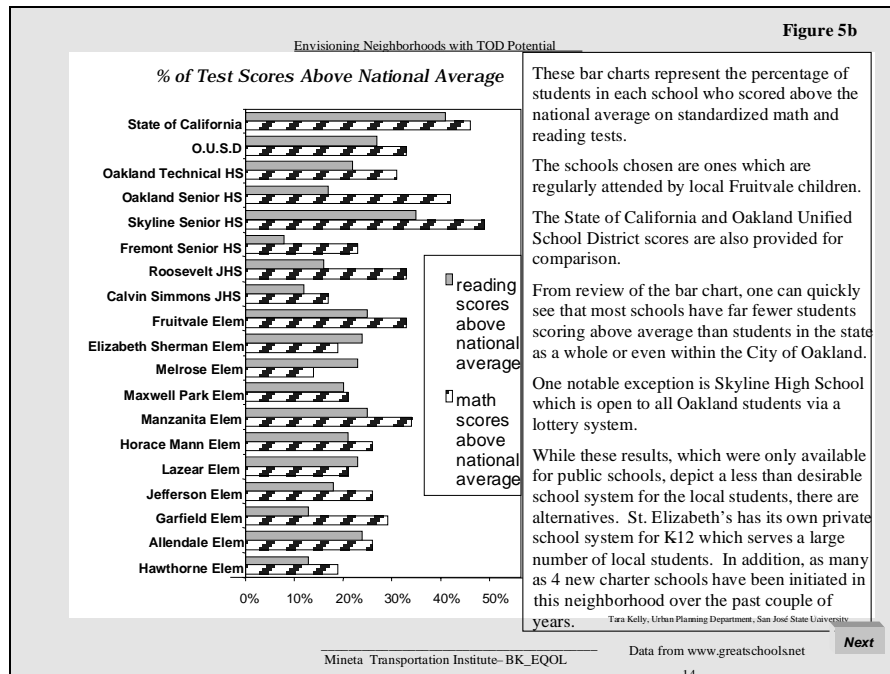


Figure 5a-Stacked Bar Charts and Standard Bar Chart (CD file: BK\_EQOL, slide 13)



**Figure5b - Stacked Bar Chart and Standard Bar Chart (CD file: BK\_EQOL, slide 14)**

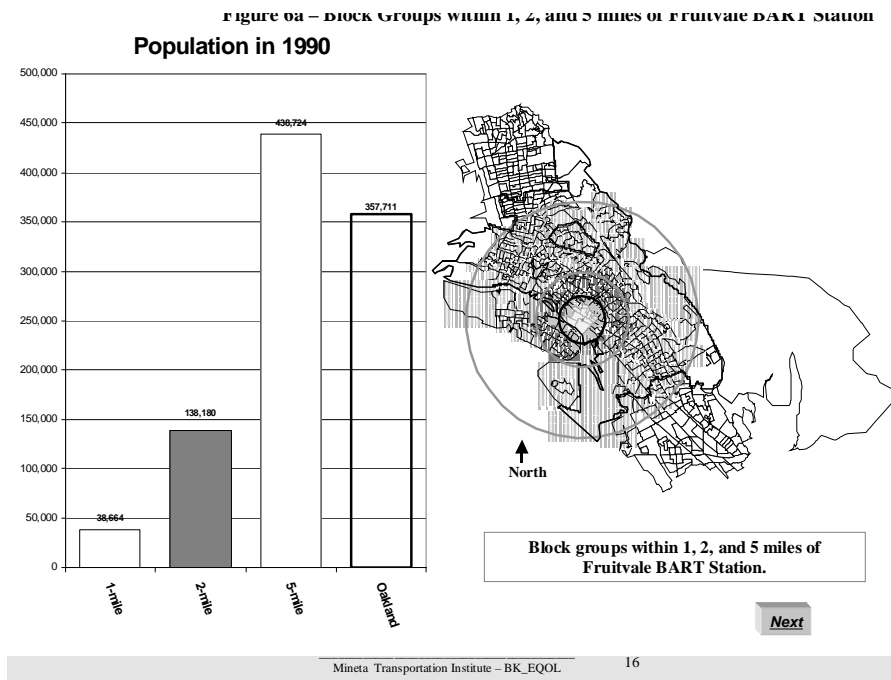
These bar charts represent the percentage of students in each school who scored above the national average on standardized math and reading tests. The schools chosen are ones which are regularly attended by local Fruitvale children.

The state of California and Oakland Unified School District scores are also provided for comparison. From review of the bar chart, one can quickly see that most schools have far fewer students scoring above average than students in the state as a whole or even within the city of Oakland. One notable exception is Skyline High School, which is open to all Oakland students via a lottery system.

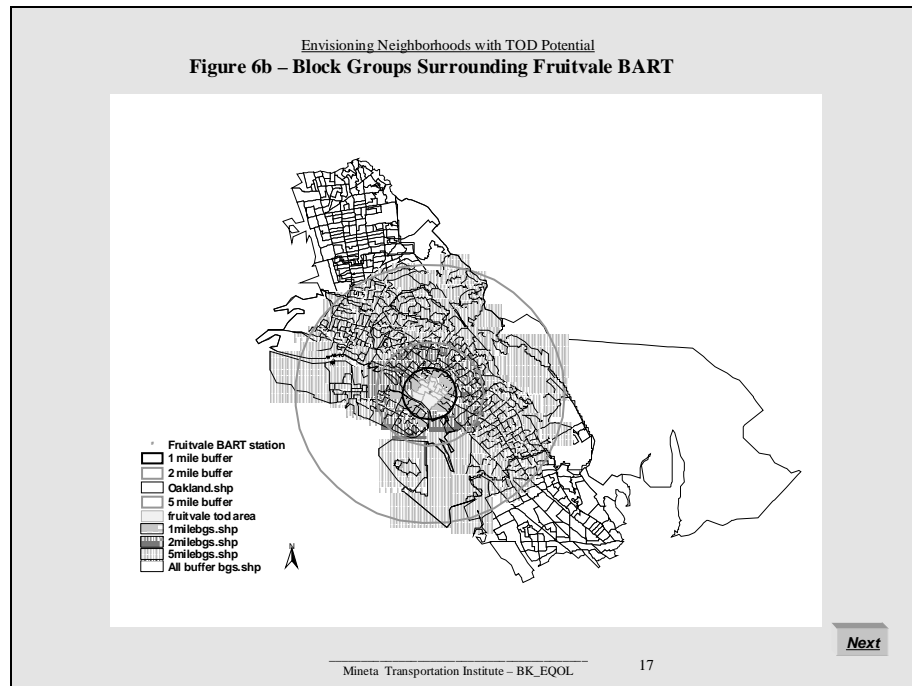
While these results, which were only available for public schools, depict a less than desirable school system for the local students, there are alternatives. St. Elizabeth's has its own private school system for K-12 which serves a large number of local students. In addition, as many as four new charter schools have been initiated in this neighborhood over the past couple of years.

Data is from the website for California's public schools at <http://www.GreatSchools.net>.

An immense amount of social, economic and environmental data regarding crime, real estate and the environment is becoming available on the Internet. Much of this data is well suited to QOL analysis and inclusion in the detailed views to be produced by the EN TOD project. For examples regarding environmental information see <http://sfbay.wr.usgs.gov/>, or <http://www.fema.gov>. For uniform crime report statistics by city see <http://www.ibi.gov/ucr.htm>; for neighborhood and real estate information for the perspective of a person searching for a home see <http://www.realtor.com/FindNeig/>.

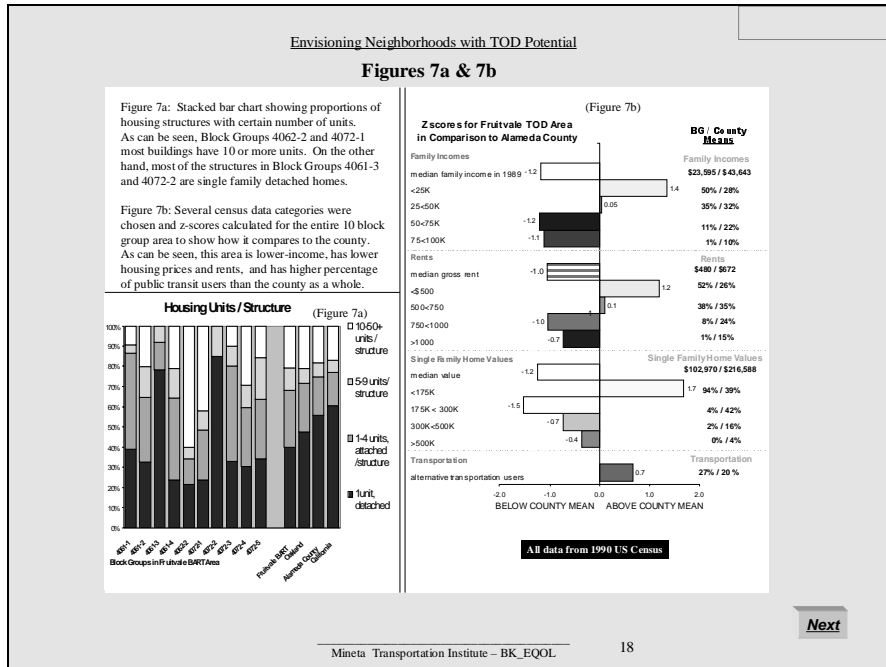


**Figure 6a-Population by Rings for Fruitvale BART Area (CD file: BK\_EQOL. Slide 16)**

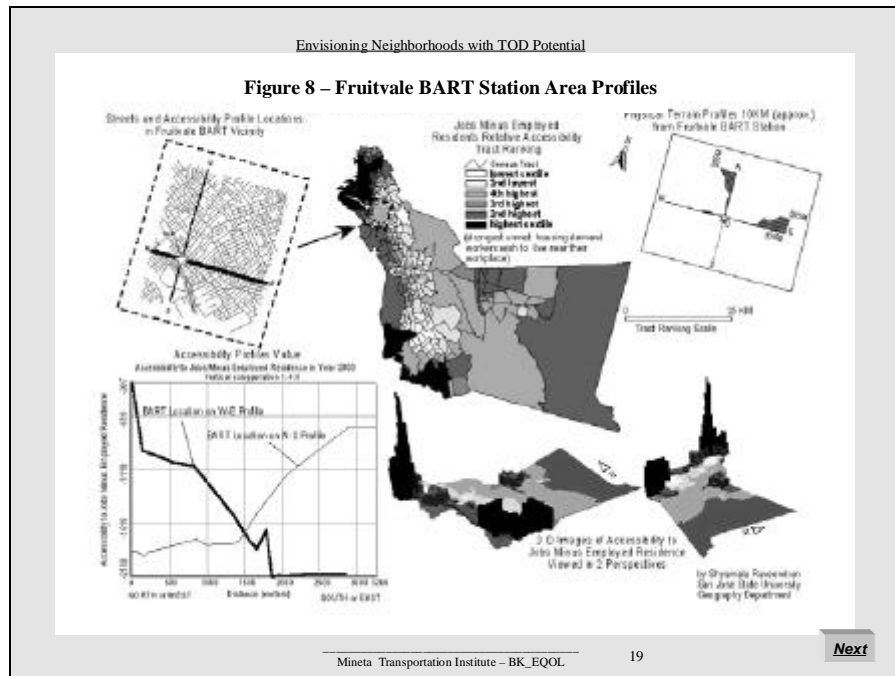


**Figure 6b-Block Groups Within 1, 2 and 5 miles of Fruitvale BART Station (CD file: BK\_EQOL. Slide 17).**

Figures 6a and 6b were created using ArcView software and 1990 U.S. Census data, using a technique for drawing buffer zones at one, two, and five miles from the center point of the station. The rings were then overlaid over the block group maps linked to census data, and data for any block groups within those rings was captured and transferred to *Microsoft Excel* for editing and creating the bar chart. (See Andy Mitchell, “Chapter 5: Finding What’s Inside,” for an explanation regarding overlaying areas and features.)



**Figure 7a-Housing Units in a Stacked Bar Chart; Figure 7b - Z-scores for Fruitvale TOD Areas (CD file: BK\_EQOL, slide 18)**



**Figure 8-Fruitvale BART Station Area Year 2000 Profiles** (CD file: BK\_EQOL, slide 19)

Figure 7a was created in Microsoft Excel using the template created by Dr. Bossard. It provides both comparisons of the ten block groups in the Fruitvale BART area with one another, as well with the entire area, the city, county and the state. Figure 7b was created in Microsoft Excel using data from the 1990 U.S. Census Data. It was then pasted into PowerPoint along with Figure 7a. The column of data showing actual percentage comparisons was inserted as a text box in PowerPoint. These data help place Fruitvale BART area conditions in the context of the million residents of Alameda County.

Figure 7a: Stacked bar chart showing proportions of housing structures with a certain number of units. In Block Groups 4062-2 and 4072-1, most buildings have ten or more units. On the other hand, most of the structures in block groups 4061-3 and 4072-2 are single-family detached homes.

Figure 7b: Several census data categories were chosen and z-scores calculated for the entire ten-block group area to show how it compares to the county. This area is lower-income, has lower housing prices and rents, and has a higher percentage of public transit users than the county as a whole.

Listed below is a description of the innovative tools and techniques that Shyamala Raveendran considered or used in creating Figure 8. Her goal is to demonstrate how a variety of 3-D visualization tools can be used to understand actual and theoretical spatial patterns.

The Accessibility to Jobs Minus Employed Residence 2000 map is based on a gravity spatial interaction model (Bossard, 1998) showing the relative access in the entire county to the difference between the number of workers working and the number of workers living in census tracts. This measure provides an innovative estimate of the relative access to housing demand, where housing demand is based on good access to one's workplace. According to this measure, the darker the areas on the map, the stronger the housing demand. This map was done using ArcView 3.1.

The "Streets and Accessibility@ Profile Locations..." street map, also done with ArcView, shows the location of the Fruitvale BART Station, the streets in its vicinity, and the location of North-South and East-West profiles which were cut through the "3-D Images of Accessibility" described below.

The 3D "Accessibility to JNER2000" maps were done with ArcView - 3D Analyst Extension. The respective 2D themes were converted to 3D themes by using "Accessibility to JUER2000" attribute values as the z-value (height). The maps were then viewed in the "3D Scene" dialogue. Next, they were positioned to a desired perspective. The perspective was then exported as a JPEG image file-hence the image as seen on the layout. These 3-D images show the high potential strength of housing demand in the downtown Oakland area northwest of the station.

The 3D N-S and E-W profiles of Accessibility to Jobs Minus Employed Residents 2000, shown in the bottom left corner of Figure 8, were also done with ArcView-3D Analyst. First, a line was drawn on the 3D thematic map in a "View." Next, the "Profile Line" tool sketched a "Visibility Profile" line graph of the map in a "Layout." These profiles indicate that housing demand is likely to be stronger going north or east from the station area, rather than south or west.

The Physical Terrain Profiles from the Fruitvale BART station, shown in the upper right corner of Figure 8, present profiles of the actual physical terrain within 10 kilometers of the station. These profiles were done using U.S. Geological Survey topographic maps using the TOPO! Version 1.0, a low-cost software used by hikers and bicyclists to plan trips.

The profile images exported from TOPO! were rotated, mirrored, and scaled using mainly Paint Shop Pro 4.00.

Finally, all images and maps were brought into a “Layout” in ArcView.

## **CONCLUSION**

Many communities in the USA are grappling with the notion of how best to meet the desires of their residents whose personal quality of life reflects the sustainable communities movement, which seeks to establish areas that are livable and walkable, and accessible to a great many services and conveniences. Given the factors outlined above, often the ideal setting is a location within close proximity of public transit in an urban setting.

As planning officials, developers and others strive to meet the demand for sustainable communities, they need to equip themselves with the tools to select sites that make sense within their spatial context. The Envisioning Neighborhoods-Transit-Oriented Development (EN TOD) technique, with its myriad methods for analyzing and presenting data in a spatial context, is one such tool.

## **ACKNOWLEDGMENTS**

Acknowledgment is given for support provided by the Mineta Transportation Institute at San José State University, the California Department of Transportation, and U.S. Department of Transportation for this work.

Appreciation is given for contributions to this project by team members Steven Colman, Dayana Salazar, Richard Taketa, Antony R. Jayaprakash, Erin Mayer, Tran V. Tung, and Pin-Yuan Wang, as well as to SJSU Open University student Shyamala Raveendran.

## **REFERENCES**

Included in main report's references.





---

## **APPENDIX B: HISTORY OF TRANSIT-ORIENTED DEVELOPMENT**

**Brett Hondorp**

For the PowerPoint presentation, see CD-ROM file TOD\_History.

### **DEFINITION OF TRANSIT-ORIENTED DEVELOPMENT**

Much has been written about transit-oriented development (TOD) in recent years, and a number of research efforts have provided detailed evaluations of successful TOD projects in such diverse locations as the San Francisco Bay Area, Washington, D.C., Atlanta, and San Diego. In the literature, TOD projects are referred to by a variety of names, including transit-focused development, transit-based development, transit-supportive development, or transit villages. The definition of TOD varies, depending on the researcher. According to Bernick and Cervero, who prefer the term “transit village,” TOD consists of a “compact, mixed-use community, centered around a transit station that, by design, invites residents, workers, and shoppers to drive their cars less and ride mass transit more.”<sup>1</sup> Lefaver describes TOD somewhat broadly as “higher density residential or mixed-use developments built along transportation corridors...i.e., rail and major bus lines as well as freeways.”<sup>2</sup> Porter limits TOD to development “generally within a half a mile of rail transit stations.”<sup>3</sup> This project focuses on TOD near rail or light rail stations.

### **BRIEF HISTORY OF TRANSIT-ORIENTED DEVELOPMENT**

The first transit-oriented development projects in the United States were the railroad and streetcar suburbs of the late 19th and early 20th centuries. The earliest commuter rail lines were powered by steam engines that could achieve high sustained speeds efficiently but were slow to accelerate and decelerate, and thus promoted the development of stations that were several miles apart.<sup>4</sup> In New York City, for example, three commuter railroads—the Hudson River Railroad, Harlem River Valley Railroad, and Long Island Sound Railroad—helped channel population expansion from the five boroughs to outlying suburban townships.<sup>5</sup> Although more common in large East Coast cities, a steam-powered commuter rail service existed in the San Francisco Bay Area in the late 19th century. The San Francisco–San Jose railway began service along the peninsula in 1864 and led to the development of commuter suburbs such as

Burlingame, Redwood City, and San Mateo.<sup>6</sup> Today, CalTrain follows this corridor.

Electric street railways were developed in the late 1880s. Electric streetcars picked up their power from an overhead electrical line (using a “trolley” pole), and used the running rail as a ground.<sup>7</sup> Although electric streetcars could not achieve the top speeds of the steam engines, they were cleaner and quieter, and could start and stop more efficiently, making them useful for interurban as well as commuter service. Construction of electric railway systems typically was privately funded, as developers built rail lines to outlying areas and used the railways to promote their real estate holdings. The first electric streetcar system was the Pacific Electric Railway in Southern California, which at its peak, served 50 communities with 1,164 miles of track and 270 trains a day.<sup>8</sup> In the San Francisco Bay Area, the San Francisco, Oakland & San Jose Railway, more commonly known as the Key System, had developed a vast network of lines in the East Bay by the turn of the century. The extension of the Key System lines into previously undeveloped areas of Berkeley-Oakland Hills led to the rapid settlement of new townships such as Piedmont.<sup>9</sup>

By the early 1900s, electric streetcar systems had emerged in cities throughout the United States, replacing horse-drawn or cable-pulled systems. According to Middleton, “...more than any other development, the electric streetcars contributed to the growth of America’s suburbs.”<sup>10</sup> Population growth followed car lines as middle class households sought to escape crowded, dirty, noisy inner-city living. The success of the early streetcar suburbs was dependent on pedestrian access to transit for connection to downtown jobs and neighborhood services. Typical features of these early transit neighborhoods included a transit depot and public space in the center of the neighborhood, small cottage-type houses, and a street pattern and scale that allowed convenient walking distances to transit.<sup>11</sup>

## **MAJOR ELEMENTS OF TRANSIT-ORIENTED DEVELOPMENT**

Transit-oriented development projects should, at the very least, encourage the use of public transit by locating residential, commercial, or office uses, or a combination of all three, close to a transit node. However, successful TOD involves more than simply placing a transit stop in a residential neighborhood or a business park, or building a mixed-use TOD development next to a transit hub. Transit-oriented development should not only provide transportation options but also improve the “livability” of communities and neighborhoods, while successfully being integrated into the economic pattern of the area. TOD

can create places for community life, be a key force in the revitalization of neighborhoods and center cities, help create new businesses and improve access to job opportunities, and help make communities safer, in part by making them more comfortable and attractive.<sup>12</sup> According to Bernick and Cervero, the hallmarks of transit-oriented development are enhanced mobility and environment, pedestrian friendliness, alternative suburban living and working environments, neighborhood revitalization, public safety, and public celebration.<sup>13</sup>

Table B-1 discusses these elements in detail.

**Table 2-1: Major Elements of Transit-Oriented Development**

<i>Element</i>	<i>Description</i>
Enhanced Mobility and Environment	The major element of TOD is a congregation of housing, jobs, shops, and other activities around transit. In addition to the improved access to these varied land uses, the physical environment is enhanced. For example, TOD is expected to improve air quality, as park-and-ride trips are converted to walk- or bike-and-ride trips.
Pedestrian-Friendliness	TOD involves the development of land use that encourages walking, such as narrow streets with trees, wide sidewalks, an absence of surface parking lots, and large building setbacks. Typical structures are street-oriented, mixed-use buildings that include a blend of residential, retail, and commercial uses.
Alternative Suburban Living	TOD enables people to live in the suburbs without being entirely dependent on the automobile to access the variety of activities and services associated with cities. The pedestrian-friendly scale and design features of transit-oriented development promote social interaction.
Neighborhood Revitalization	TOD can stimulate economic growth in blighted or declining areas served by rail or other transit. Redevelopment agencies can promote transit-oriented development and improve the social and physical infrastructure of neighborhoods, providing needed housing and services to households from a mix of incomes.

**Table 2-1: Major Elements of Transit-Oriented Development (Cont.)**

<i>Element</i>	<i>Description</i>
Public Safety	TOD places a mix of residents, workers, and shopkeepers within a compact area, promoting a continual security presence by the constant activity.
Public Celebration	TOD should include some public open space, such as a park or plaza, that is a gathering place for events such as parades, performances, concerts, or a farmers' market.

Source: Based on Bernick and Cervero, *Transit Villages in the 21<sup>st</sup> Century*

## RELATIONSHIP OF TOD TO NEW URBANISM AND SMART GROWTH

In recent years, both “New Urbanism” and “smart growth” have emerged as buzzwords in the planning profession, and have even gained some recognition in the mainstream media as progressive approaches to solving problems associated with suburban sprawl. Both the New Urbanist and smart growth movements advocate some of the basic elements of transit-oriented development, so it is useful to briefly discuss each here.

New Urbanism, also called “neo-traditional planning,” has been championed over the past two decades by urban designers and architects such as Peter Katz, Andres Duany, Elizabeth Plater-Zyberk, Peter Calthorpe, and Daniel Solomon. These individuals and other promoters of New Urbanism incorporated themselves into an architectural reform movement called the Congress for the New Urbanism.<sup>14</sup> The New Urbanists generally advocate returning to pre-World War II town planning principles, with an emphasis on designs that promote mixed land use, narrow streets laid out in tight grid mesh, decreased setbacks, and reduced parking, among others. Many of the types of design features that make TOD projects successful are the types of features that are included in New Urbanist projects. However, transit is not a required feature of New Urbanist development. Many New Urbanist projects are taking place in suburban or exurban areas, and while they may contain higher densities and more pedestrian-friendly design features, they are not accessible via public transit.<sup>15</sup> Some New Urbanist projects include transit stations; for example, Peter Calthorpe’s “Crossings” project in Mountain View, CA, is situated across from a stop on the CalTrain line.

Smart growth is a somewhat broader and more mainstream movement that draws on many of the principles of New Urbanism. There is no single definition of smart growth, but the common thread is development that revitalizes central cities and older suburbs, supports and enhances public transit, and preserves open spaces and agricultural lands.<sup>16</sup> The underlying premise is that much of the United States' post-World War II suburban development, with its strict separation of land used, low densities, and heavy auto dependency, has contributed to such problems as increased traffic congestion, loss of farmland, and the decline of traditional downtown areas. Smart growth generally calls for higher-density, transit-oriented development, with an emphasis on providing a balanced mix of housing, jobs, and shopping opportunities within a community. The "Ahwahnee Principles," which are often cited as the basic tenets of smart growth, contain many of the elements of successful transit-oriented development. (The New Urbanist architects noted earlier were instrumental in convening the conference at which the Ahwahnee Principles were drawn up.) Key Ahwahnee principles (from the Local Government Commission, Center for Livable Communities Web site) that relate to transit-oriented development are as follows:

- Community size should be designed so that housing, jobs, daily needs, and other activities are within easy walking distance of each other.
- As many activities as possible should be located within easy walking distance of transit stops.
- The location and character of the community should be consistent with a larger transit network.
- Streets, pedestrian paths, and bike paths should contribute to a system of fully connected and interesting routes to all destinations. Their design should encourage pedestrian and bicycle use by being small and spatially defined by buildings, trees, and lighting, and by discouraging high-speed traffic.
- The regional land-use planning structure should be integrated within a larger transportation network built around transit rather than freeways.

## **SPECIFIC FEATURES OF TRANSIT-ORIENTED DEVELOPMENT**

### **Design Features**

In general, transit-oriented development should promote walking and transit riding and discourage automobile use. A common theme of TODs is to create

places that have design features such as landscaped sidewalks, parking in the rear, and retail streetwalls that make walking and transit riding more enjoyable. Some commonly accepted TOD design features, as set forth by Bernick and Cervero, are as follows:<sup>17</sup>

- Continuous and direct physical linkages between major activity centers; siting of buildings and complementary uses to minimize distances to transit stops.
- Streetwalls of ground-floor retail, and varied building heights, textures, and facades, that enhance the walking experience; siting commercial buildings near the edge of sidewalks.
- Integration of major commercial centers with the transit facility.
- Gridlike street patterns that allow many origins and destinations to be connected by foot; avoiding cul-de-sacs, serpentine streets, and other curvilinear arrangements that create circuitous walks and force buses to meander or retrace their paths; direct sight lines to transit stops.
- Minimizing off-street parking supplies—where land costs are high, tucking parking under buildings or placing it in peripheral structures; in other cases, siting parking at the rear of buildings instead of in front.
- Providing such pedestrian amenities as attractive landscaping, continuous and paved sidewalks, street furniture, urban art, screening of parking, building overhangs and weather protection, and safe street crossings.
- Convenient siting of transit shelters, benches, and route information.
- Creating public open spaces and pedestrian plazas that are convenient to transit.

As mentioned above, many of these pedestrian- and transit-friendly features are embodied in the designs of smart growth and New Urbanist projects.

### **Density Features**

High density is another key element of transit-oriented development. If origins and destinations are spread throughout a region, those with access to a car will likely drive rather than take transit.<sup>18</sup> On the other hand, dense, compact TOD places a critical mass of people in a single location, providing the ridership numbers necessary to make transit feasible and efficient. High density offers three benefits to improved transit service: Routes to a relatively large number of points can be offered; the cost per ride of operating transit is reduced when

ridership increases; and increased density allows transit service to be provided more frequently.<sup>19</sup>

A number of research efforts have shown a clear link between increased residential density and increased transit ridership. A widely cited study conducted in 1977 by Pushkarev and Zupan<sup>20</sup> concluded that sufficient rail transit demand requires residential densities averaging 12 units per acre connected to a downtown with at least 50 million square feet of nonresidential uses. That study also noted that residential densities in the range of two to seven units per acre produced only marginal transit use; densities of between seven and thirty units per acre were necessary to sustain significant transit use. With a density increase from seven to thirty dwelling units, transit demand roughly tripled and a sharp reduction in auto travel was noted. A 1984 study by Wilbur Smith found a substantial increase in transit trips when residential densities increased from seven to sixteen units per acre.<sup>21</sup> A 1994 study by Holtzclaw confirmed that residential density is the major explanatory variable in vehicle miles traveled. Holtzclaw found that doubling residential densities resulted in greater transit usage and a 20 to 30 percent reduction in annual household vehicle miles traveled (VMTs).<sup>22</sup>

In general, the population and employment densities needed to support transit are significantly higher than the average densities in most U.S. suburbs.<sup>23</sup> Typical suburban, single-family detached subdivision densities are between one and eight units per acre, with townhouse (single-family attached) densities ranging from eight to twelve units per acre.

Based on the results of the above and other studies, some jurisdictions have adopted minimum density thresholds to be used when evaluating new transit systems or the extension of existing systems. For example, the Denver Rapid Transit District has prepared the *Suburban Mobility Design Manual*, which spells out the relationship of residential density to transit service. According to the manual, densities of seven units per acre can support transit every 30 minutes; 30 units per acre can support transit every 10 minutes; and 50 units per acre can support more bus trips than auto trips.<sup>24</sup>

When analyzing large areas, the minimum residential densities for transit services also can be expressed in terms of population per square mile. In a report published in 1996 by the Transit Cooperative Research Program, Parsons Brinckerhoff Quade & Douglas, Inc., summarized the Pushkarev and Zupan data in terms of minimum residential densities needed for three levels of bus service (minimum, intermediate, and frequent), as well as for light rail and



rapid transit. Using the 1990 average of 2.7 persons per housing unit in California, and 640 acres per square mile, Table 2-2 presents these threshold density levels in terms of persons per square mile. In Figure 5 on page 28, we present thematic population maps with increasing shades of green for the population densities below the approximately 15,000 persons per square mile needed to sustain light rail transit, and increasingly darker shades of red to red-brown for areas with more than 15,000 persons per square mile. Reference to additional such population density maps is provided on page 28 and on slide 30 of the 0\_TOD\_Main.ppt file in the Project Summary 17 menu.

**Table 2-2: Minimum Residential Densities for Various Types of Transit Services**

Transit Service Type	DU/Acre <sup>a</sup>	Persons/ Sq Mile <sup>b</sup>	Map Color 1990-2020
Bus–minimum service	4	6,912	light green
Bus–intermediate service	7	12,096	dark green
Bus–frequent service	15	25,920	darkest red-brown
Light rail	9	15,552	red
Rapid transit	12	20,736	red-brown

a. Pushkarev and Zupan, *Public Transportation and Land Use Policy*, 1977. Reproduced in Transit Cooperative Research Program, Report 16, Transit and Urban Form, Vol. 2, Transportation Research Board, National Research Council, National Academy Press, Washington, D.C., 1996.

b. Persons per square mile transformation of Pushkarev and Zupan densities uses 2.7 persons per housing unit average for California from 1990 Census data and 640 acres per square mile, resulting in a conversion factor of 1,728 from dwelling units per acre to units per mile.

## PROXIMITY TO STATIONS

Most transit trips involve some walking to access stops or stations; therefore, proximity of residences to stations is another important feature of transit-oriented development. According to Bernick and Cervero, “a central premise of transit villages is to concentrate development within one-quarter-mile walking distance of rail stations.”<sup>25</sup> This element is directly related to density; clearly, TOD must place a sufficient number of people within a reasonable walking distance of transit for an increase in ridership to occur.

Research by Untermann on walking behavior in the United States shows that 2,300 feet is the maximum distance people are willing to walk for general purposes.<sup>26</sup> Specific studies on transit proximity and ridership in the Bay Area, Washington, D.C., and Toronto and Edmonton, Canada, indicate that transit ridership generally is the highest within about one-third mile from the station.<sup>27</sup> Trip destination is also an important factor in transit ridership, as is the cost of parking; those commuting to downtown areas (for example, San Francisco) who have to pay for parking are more likely to use transit than those commuting to suburban destinations (for example, Dublin/Pleasanton) where parking is typically free. Overall, however, Bay Area residents living near rail stations were found to be five to seven times more likely to commute by rail transit than the average worker in the city.<sup>28</sup>

## NOTES

1. Michael Bernick and Robert Cervero. *Transit Villages in the 21<sup>st</sup> Century*. New York: McGraw Hill, 1997, p.5.
2. Scott Lafaver. *Private Land with Public Partnerships for Transit Based Development*. San Jose, CA.: Norman Y. Mineta International Institute for Surface Transportation Policy Studies, 1997, p. 2.
3. Douglas Porter. *Transit-Focused Development*. Washington, D.C.: National Academy Press, 1997, p. 1.
4. Steve Colman. *San José State University, URBP 226 Course Reader, Fall 1999*. San José State University Department of Urban and Regional Planning, p. 3-4.
5. Bernick and Cervero, p. 16.
6. Colman. p. 2-4.
7. *ibid.*, p. 2-4.
8. Bernick and Cervero, p. 20.
9. *ibid.*, p. 20
10. W. Middleton. *The Time of the Trolley*. Milwaukee: Kalmbeck Publishing, 1967, p. 44.
11. Robert Cervero. *Transit-Supportive Development in the U.S.* Washington, D.C.: Federal Transit Administration, 1993, p. 4.
12. Transit Cooperative Research Program. *The Role of Transit in Creating Livable Metropolitan Communities*. Washington, D.C.: National Academy Press, 1997, p. 20.
13. Bernick and Cervero, p. 7-11.
14. James Howard Kunster. *Home From Nowhere*. New York: Touchstone, 1996, p. 19.
15. Timothy Beatley and Kristy Manning. *The Ecology of Place*. Covelo, CA.: Island Press, 1997, p. 116.
16. Association of Bay Area Governments. *Theory in Action, Smart Growth Case Studies*. Oakland: ABAG, 2000, p. i.
17. Bernick and Cervero, p. 91-94.
18. *ibid.*, p. 74

19. Morris. *Creating Transit-Supportive Land Use Regulations*. Chicago: American Planning Association, 1996, p. 41.
20. Boris S. Pushkarev and Jeffrey M. Zupan. *Public Transportation and Land Use Policy*. Bloomington: Indiana University Press, 1977, p. 30.
21. Wilbur Smith. "Mass Transit for High-Rise, High-Density Living," *Journal of Transportation Engineering* 110 (6), 1984.
22. John Holtzclaw. *Using Residential Patterns and Transit*.
23. Morris, p. 41.
24. Cervero, p. 50.
25. Bernick and Cervero, p. 121.
26. Richard Untermyer. *Accommodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling*. New York: Van Nostrand Reinhold, 1984.
27. Bernick and Cervero, p. 126.
28. Ibid., p. 122.

## REFERENCES

- Association of Bay Area Governments. *Projections 2000*. Oakland: ABAG, 2000.
- \_\_\_\_\_. *Theory in Action, Smart Growth Case Studies*. Oakland: ABAG, 2000.
- Barbour, Elisa, and Paul G. Lewis. *California Cities and Local Sales Tax*. San Francisco: Public Policy Institute of California, 1999.
- Bay Area Rapid Transit District (BART), San Mateo County Transit District, U.S. Department of Transportation. *BART-SFO Extension, Final Environmental Impact Statement/Final Environmental Impact Report*. June 1996.
- The California Budget Project. *State and Local Government Finance in California: A Primer*. Sacramento: The California Budget Project, 1996.
- Beatty, David F., et.al. *Redevelopment in California*. Point Arena, CA: Solano Press, 1995.
- Beatley, Timothy, and Kristi Manning. *The Ecology of Place*. Covelo, CA.: Island Press, 1997.
- Bernick, Michael, and Robert Cervero. *Transit Villages in the 21<sup>st</sup> Century*. New York: McGraw Hill, 1997.
- Cervero, Robert. *Transit-Supportive Development in the U.S.* Washington, D.C.: Federal Transit Administration, 1993.

City of South San Francisco. *Draft Preliminary Report on the Proposed Second Amendment to the Redevelopment Plan for the El Camino Corridor Redevelopment Project*. December 1999.

\_\_\_\_\_. *El Camino Corridor General Plan Amendment and Redevelopment Plan, Draft Environmental Impact Report*. February 1993.

\_\_\_\_\_. *El Camino Corridor Redevelopment Plan Amendment, Draft Environmental Impact Report*. March 2000.

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

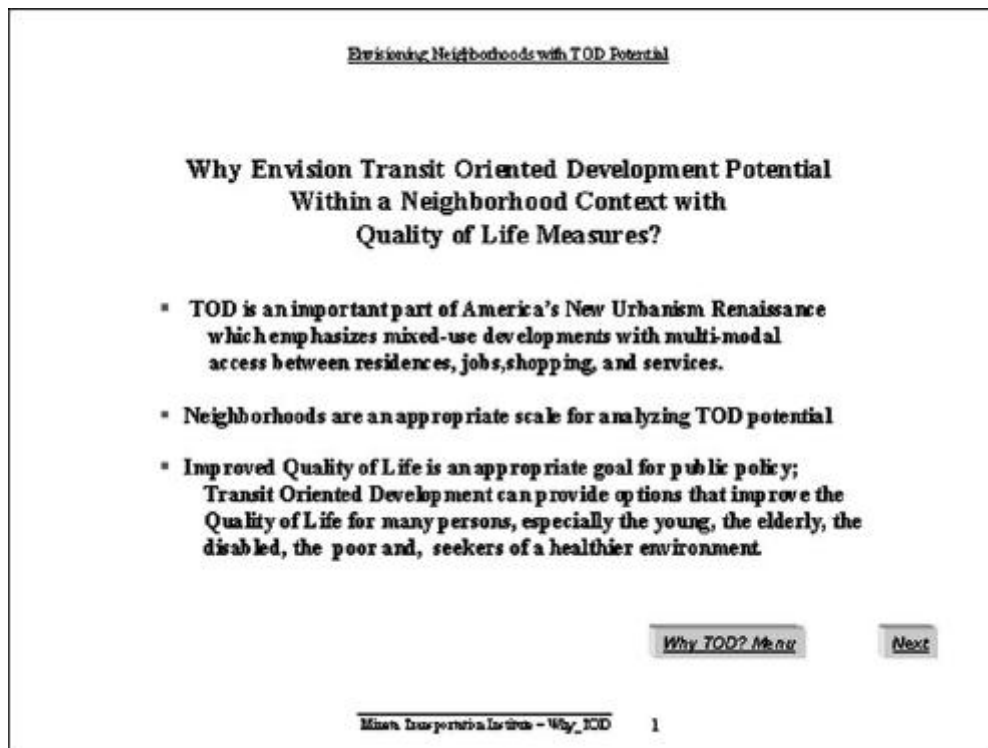
Untermann, Richard. *Accommodating the Pedestrian: Adapting Towns and Neighborhoods for Walking and Bicycling*. New York: Van Nostrand Reinhold, 1984.



## **APPENDIX C: WHY ENVISION TRANSIT-ORIENTED DEVELOPMENT POTENTIAL WITHIN A NEIGHBORHOOD CONTEXT WITH QUALITY-OF-LIFE MEASURES?**

Appendix C is a complete, turnkey PowerPoint presentation that explains what transit-oriented development is about. It also links TOD's connection to the New Urbanism movement and introduces the viewer to the *Envisioning* project from San José State University.

To view this presentation, please select CD file Why\_TOD.



**Figure 2-1. CD File: Why\_TOD, slide 1**



---

## APPENDIX D: OPERATIONS HELP

For assistance in working with the PowerPoint files on the CD-ROM that accompanies this report, see CD-ROM file: 0\_Operating\_Instructions.

### OPERATING INSTRUCTIONS AND TECHNICAL NOTES

#### System Requirements

- Windows PC running Microsoft PowerPoint 2000
- 64 MB or more CPU (Fruitvale Summary and panorama views for Hayward are the most demanding.)
- 200 MB hard disk space
- 17-inch or larger monitor with XGA resolution (1024 x 780)
  - SVGA resolution (800 x 600) is generally OK, but has some graphics problems
  - XGA resolution (640 x 480) shows most text, but graphics are poor

Microsoft PowerPoint 97 will run most of the options in this data set, but does NOT handle transitions between the multiple files well. Users are encouraged to use either PowerPoint 2000 or XP.

The video clips and scrollable panorama views in the Hayward, Fruitvale, and Redwood City studies require video software that may not be on all PCs: Apple QuickTime for videos, Casio Panorama for panorama views, and GIF Animator for animated population and job density maps.

#### Operating Instructions

1. Copy the entire contents of the CD-ROM into a file in the root directory of your hard drive entitled ETODP00; that is, create a folder in the C: drive called C:\ETODP00 (for **E**nvisioning **TOD** Potential 2000)
2. Confirm that the display resolution of your monitor is 1024 x 768 or higher by using the Windows>Settings>Control Panel>Display>Settings>Screen Area command. (If the highest resolution is 800 x 600, some images will be fuzzy; 640 x 480 resolution will produce many poor-quality presentation displays, although the presentation text should be readable.)



3. Using PowerPoint 2000, open the file **0\_TOD\_Main.ppt**. This is **the only file** you should have open when accessing the set of linked presentation files. Note that PowerPoint 97 will run most files and operations, but does not return to the previous file after the ESC key is pressed, making it difficult to transition between files.
4. The menu tree is from **Main TOD\_Menu** out to **Summary** and **Detailed** files for each of the six study areas, with other choices for county and region context information. There are also a set of theoretical slides explaining the **Envisioning Neighborhoods Principles**, a **Why TOD?** file discussing the rationale for TOD, and a file presenting **TOD History**. Text notes, located near the beginning of the O\_TOD\_Main file, explain the operation of the Main TOD Menu. The “Understanding This Menu” link on the bottom right of the TOD Main Menu displays a simplified menu tree.
5. To navigate from screen to screen in this PowerPoint show, left click on the underlined black text portion of the raised gray buttons on each screen. These buttons usually can be found along the bottom or right. When in doubt as to what to do on a screen, left click on the underlined text on a gray background button with an appropriate label. It is important to click on the text portion of the navigation buttons, because many presentations use multiple files with links out to other files.  
Note that suggestions and advice regarding navigation have been presented with blue text on very light gray boxes that are not raised buttons.
6. Press the ESC key to back out of any presentation file and return to the previous presentation file. Files vary from 1 to 68 screens or slides.
7. The Hayward BART study area and Alameda County are the most fully developed presentations and should be considered as the prototype examples, although each of the other study areas has some unique applications of merit.
8. Directories identifying slide/screen components have been placed near the end of many files, and are compiled in a single file (1\_Directory\_Listings...) which can be used to access most slides/screens directly.

### **Suggested Paths Through the Envisioning Neighborhoods with TOD Potential Files.**

This multimedia collection of linked files is designed to be used interactively with multiple optimum paths that depend on the objectives of the user. Presented below are a few suggested possible approaches/paths that may be of

interest. With repeated use, you are likely to find and develop approaches that best meet your needs.

### 1. Suggestions for First-Time Users

First-time users are encouraged to read these notes, then view the 1\_Introductory\_Presentation.ppt file to preview what is available.

To work with the full set of project files, close the 1-Introductory ... file and open only the 0\_TOD\_Main.ppt file and proceed through the Project Overview Presentation, clicking on the text portion of the Next buttons, which are near the bottom right of most presentation screens. In a few cases, pressing Next takes you beyond the TOD\_Main file you started with; in that case, press the ESC key to return to the TOD\_Main file and continue by clicking the Beyond Next button text. To see a text discussion of a presentation screen, click the “T” on a gray button, generally near the Next button. To view the presentation screen related to any text screen, you usually only need to click on the small miniature of the presentation screen, usually located in the top left of the first text screen that discusses it.

After completing the Project Overview, first-time users may want to review the summary overview screens, perhaps starting with the Hayward example.

2. **Users interested in obtaining general background regarding TOD** are encouraged to view the Why TOD? presentation accessed from the top right of the Main TOD menu. The TOD History paper provides more detail regarding TOD, while Envisioning QOL presents theoretical concepts regarding Envisioning Neighborhoods with TOD potential. Both of these presentations are accessed from the right side of the Main TOD Menu.
3. **Users interested in obtaining a better understanding of the rationale behind Envisioning Neighborhoods principles** are encouraged to access the presentation of that name.

The Detailed Views for several areas contain a variety of additional material beyond the materials in the summary overviews. The Hayward BART Downtown menu contains more than a dozen links to files at various scales, from easy walking out to broader regional contexts.

The County or Regional Contexts presentation files, accessed from the second column from the right of the Main TOD Menu, are best viewed

either before or after the study area presentations, depending on the user's knowledge of the region.

4. **Advanced Users interested in finding the right neighborhood for a particular possible TOD project** might want to first review the regional and county patterns and then view Summary Overviews to help decide the area or areas worthy of additional attention. Then the Detailed Views for those areas can be carefully pursued.
5. **Advanced computer gurus** may want to use the Directory of Principal Files, which has direct links to 465 screens. A search for keywords likely to be in screen titles could enable users to directly access screens with information they want.

**Disclaimer:** A goal of this study is to present examples of how digital information can be used to understand local conditions, especially the suitability of areas for TOD developments. In no case are the examples presented in this project sufficiently comprehensive to be the basis of a definitive decision regarding a place. Also, much of the data presented in this study is based on 1990 census data. Once the 2000 census data is released, then the techniques demonstrated in this project can be used more effectively for real-world decisions.

## FEEDBACK REQUEST

We would appreciate your views on the buttons and link procedures and feedback regarding what seems to work well and what does not. Try the presentation/text options in the main TOD file by first looking at a presentation screen, then viewing the text discussion of it, then moving on to the next presentation screen. Does this work for you? How long could you view in this way? Any suggestions for making a viable interactive way to view data will be appreciated. Please let us know the operating system, PowerPoint version, and CPU capacity of the PC you used, along with your comments or suggestions.

E-mail: [Bosssard3@pacbell.net](mailto:Bosssard3@pacbell.net)

Tel: 408-924-5882

Fax: 408-924-5860

### ArcView Extension: SJSU Zone Summary

SJSU Zone Summary is an ArcView extension that summarizes data for zones around specified locations. Zones may be distance rings, sectors, or both. The summary is performed using the numeric fields from the active themes (active themes are the ones that have been selected or "highlighted"). You may choose to summarize using the proportion of overlap between the underlying feature and the zone ( $Assigned\_Value = Total\_Value * Overlap\_Area / Total\_Area$ ). Alternatively, you may assign values based on the centroid for the underlying feature, in which the entire value for that feature's fields will be added to the zone containing its centroid.

The specified locations serve as the center for constructing the summary zones. The centers may be selected points or the centers of selected polygons from a theme you specify. The selected features will be identified in the summary table by values from a field you select. For example, the selected features may include a field named "Feature ID". The values of this field will be inserted into the summary table for each selected feature.

Distance rings all use the same distance interval. For example, if the interval is set at 2 km, then the first ring will range from 0 to 2 km, the second ring will be from 2 to 4 km, etc. The distance units may be something other than those currently set for the view.

Sectors represent directional zones radiating out from the specified location. You may select 0, 4, or 8 sectors. Each sector is centered on a major direction. For example, if you choose 4 sectors, then you will get sectors centered on north, east, south, and west. The summary table includes

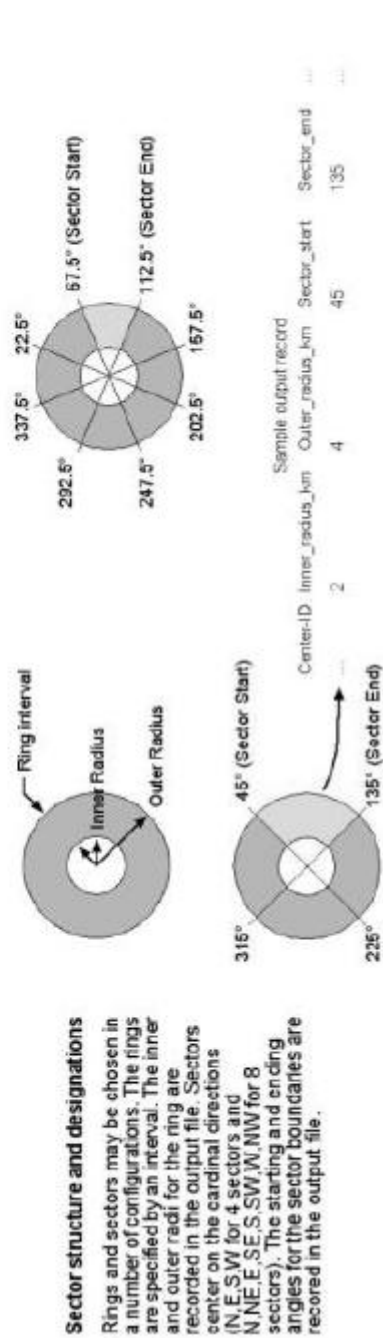
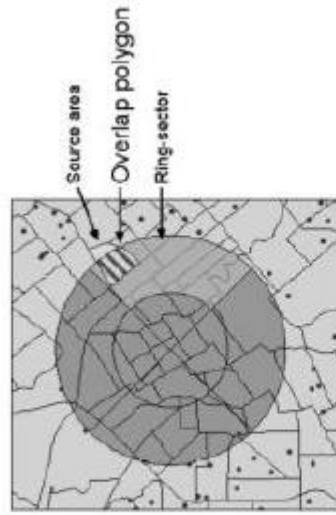


Figure 1-ArcView Extension: SJSU Zone Summary

### SJSU Zone Summary – 2

fields for the bounding azimuths for each zone (an azimuth is a direction given in degrees clockwise from north). So, the north sector will be indicated by bounding azimuths of 315° and 45°, the east sector by 45° and 135°, etc. If you choose no sectors (0), then summaries are performed only by ring.

You may choose to have the polygons representing the overlaps between the zones and the underlying polygons shown as graphic geometry in the view. These are simply graphic elements, and may be deleted at any time.  
The output table is a tab-delimited text file. The summary field names are a concatenation of the theme name and the field name from that theme's attribute table.

The procedure for using the extension is as follows:

1. Add the *SJSU Zone Summary* extension to your ArcView project (use *File>Extensions*)
2. Set up the view with the required themes. The view units must be set (use *View>Properties*)
3. Select the features that will form the centers for the zones. These must all be from one theme.
4. Activate the themes providing the data values to summarize. (Click the first theme's legend. Hold the shift key down while clicking to activate additional themes).
5. Invoke the *Zone Summary (SJSU)>Summarize by zone*
6. Select the theme containing the centroid features. Also select the field from this theme's attribute table containing the identifiers for the features.
7. Select the method for allocating the values from the data tables (*Overlap Proportion or Feature Center*).
8. Select the number of rings (> 0) and the ring interval and distance units.
9. Select the number of sectors (*No, 4, or 8 sectors*).
10. Check *Show zone polygons* if you wish to see the overlaps; otherwise, leave this unchecked.
11. Click *OK* if all parameters are satisfactory.
12. Specify the output file name and folder location.

Figure 2-ArcView Extension: SJSU Zone Summary 2

**SJSU Zone Summary – 3**

**Sample output file**

The data source for this example was 1990 Census Tract populations for Santa Clara County. The centroid (San Jose State College) was selected from a point theme containing landmarks for Santa Clara County. Populations were allocated to two rings of 2 km and four sectors. The highlighted record shows the data for the eastern sector in the second ring.

Center-ID	Inner_Radius_km	Outer_Radius_km	Sector_Start	Sector_End	Census traci-Total pop
San Jose State College	0	2	315.000	45.000	15679.6
San Jose State College	0	2	45.000	135.000	14044.2
San Jose State College	0	2	135.000	225.000	14181.3
San Jose State College	0	2	225.000	315.000	8307.87
San Jose State College	2	4	315.000	45.000	25444.5
San Jose State College	2	4	45.000	135.000	37946.1
San Jose State College	2	4	135.000	225.000	18279.8
San Jose State College	2	4	225.000	315.000	17020.2

Example Ring-sector



Source Note: The ArcView Extension: SJSU Zone Summary was created by Professor Richard Taketa, Geography Department, San Jose State University.

**Figure 3-ArcView Extension: SJSU Zone Summary 3**



## APPENDIX E: PRESENTATION OVERVIEW\*

File Name	Content Description
0_Operating_Instructions.ppt	Outlines system requirements, technical notes and installation requirements. 12 slides.
0_TOD_Main.ppt	Project overview and introduction; menu explanation. 41 slides.
Directory of Listings of Screens for Project and Study Areas.ppt	Project overview; list of cities and regions studied, about the authors, why study transit oriented development? 38 slides.
1_Intro_Exec_Sum.ppt	Executive summary of document. 1 slide.
01_Intro_To_Envisioning_files.ppt	Explanation of project contents, navigation techniques, viewing suggestions. 5 slides.
1_Introductory_Presentation.ppt	Project overview, file relationships chart, explanation of the envisioning neighborhoods technique. 23 slides.
85TODrev.ppt	Research outline, data sources, TOD index construction. 35 slides.
About_the_Authors.ppt	Brief biographies of study authors. 7 slides.
AL_PD9022.ppt	Animated slide show illustrating growth in Alameda County, CA. 8 slides.
Al_Setting.ppt	Alameda County discussion, study area maps. 26 slides.



<b>File Name</b>	<b>Content Description</b>
Bibliography.ppt	Complete bibliography for project. 9 slides.
BK_EQOL.ppt	Summary of paper presented at Second International Conference on Quality of Life in Cities, Singapore, March, 2000 by Bossard and Kelly. 25 slides.
C_Bus_Maps.ppt	Businesses within walking distance of Campbell's Vasona Line light rail station (completion 2004). 17 slides.
C_DriveTime.ppt	Driving times around Campbell's Vasona Line light rail station. 2 slides
C_Main.ppt	Lists slides available regarding Campbell's TOD, photo of vicinity of light rail station. 2 slides
C_Pop_Housing&Hispanics.ppt	Number of households, breakdown and location of Hispanic households in Campbell; location of Hispanic households in relation to light rail station. 4 slides.
C_Sum.ppt	Summary and highlights of findings for Campbell, CA. 19 pages.
C_Walking Time.ppt	Walking time in relation to Campbell light rail station. 2 slides.
C_Zon&LU.ppt	Land use and zoning information for walking distance vicinity of Campbell light rail station. 3 slides.
EN_Concepts.ppt	Overview of the Envisioning concept, data sources and method of utilizing data, methods of displaying data via maps, charts and digital image displays. 48 slides
EN_Presentation_File..._Requirements.ppt	File location and operating requirements. 1 slide.

<b>File Name</b>	<b>Content Description</b>
EN_Schema.ppt	Use of information visualization techniques and why it facilitates learning. 30 slides.
F_3D_access_F8.ppt	Fruitvale BART station area 2000 profile. 1 slide.
f_bike.ppt	Business types, school and crime data for Fruitvale vicinity. 8 slides.
F_DOP.ppt	Digital ortho photo of Fruitvale vicinity. 1 slide.
F_LU&Zon.ppt	Land use diagram and walking distance zoning information. 2 slides.
F_Main.ppt	List of available slides in Fruitvale study. 1 slide.
f_sum.ppt	Fruitvale BART station in Oakland, CA. summary and highlights. 27 slides.
F_vicin1.ppt	Maps of Fruitvale in regional context, transit routes and neighborhood photographs. 4 slides.
F_Vicin2_trans Village.ppt	Architect rendering, Fruitvale transit village. 2 slides.
F_Vicin4_videos.ppt	Four videos of Fruitvale area (click to view). 4 slides.
F_W&D2000.ppt	Walking and driving times to Fruitvale station. 2 slides.
FV_IBNltr.mpg	QuickTime clip–Fruitvale area
FV_IBNRL2.mpg	QuickTime clip–Fruitvale area
FV_IBNr1.mpg	QuickTime clip–Fruitvale area

<b>File Name</b>	<b>Content Description</b>
FV_IBSlrt.mpg	Quicktime clip–Fruitvale area
FV_TVsite_BART_PL.mpg	Quicktime clip–Frutvale area into BART station
H_5MileR.ppt	Digital ortho photograph of area, race/ethnic groups, driving distances. 26 slides.
H_BART view from city hall.AVI	QuickTime clip–view of BART station from Hayward City Hall
H_Bike.ppt	Bicycling distances, businesses witin biking distance from Hayward BART. 24 slides.
H_busroutes_www.ppt	Bus routes near Hayward BART station. 2 slides.
H_casiopan_BART_East.cpi	Windows Media of TOD setting. Will not work on Macintosh Operating Systems.
H_DOP.ppt	Digital ortho photo of Hayward BART vicinity and census block groups. 9 slides.
H_DOP_5mile_JPG.ppt	Digital ortho photograph. 1 page.
H_F_PD9022.ppt	Population density in Hayward and Fruitvale; animated. 9 slides.
H_Main.ppt	Study area menu. 3 slides.
H_Scales.ppt	Scales for envisioning places and understanding the context of TOD. 14 slides.
H_sum.ppt	Summary of and highlights of Hayward findings. 17 slides.
H_TODspecs.ppt	Digital ortho maps with location overlays, neighborhood proposed developments and existing development photos. 11 pages.

<b>File Name</b>	<b>Content Description</b>
H_W_Scene.ppt	Photographs of Hayward BART station and vicinity. 15 slides.
H_Walk.ppt	Businesses within walking distances of Hayward BART station, land use and zoning information, housing cost charts, transportation modes, population racial demographics. 68 slides.
H_ZoningLU.ppt	Maps regarding land use and zoning information. 4 slides.
H&F_PD9020_1page.ppt	Population density in Hayward and Friutvale composite. 1 page.
Intro_Present1.ppt	Introduction to Envisioning Neighborhoods with TOD potential. 5 slides.
Intro_Present2.ppt	Project overview, menu functions, data file relationship chart, envisioning techniques and principles. 15 slides.
M_bus98W&B.ppt	Businesses in vicinity of Mountain View CalTrain and light rail stations. 17 slides.
M_main.ppt	Mountain View CalTrain and light rail study area. 1 slide.
m_sum.ppt	Summary and highlights of findings of the Mountain View VTA/CalTrain Station vicinity. 8 pages.
M_WalkTime.ppt	Driving and walking times to Mountain View CalTrain and light rail station. 6 slides.
MC_PopD20.ppt	Population density near Mountain View and Campbell light rail stations. and animated maps. 9 slides.
MV_ZonLUD OP.ppt	Land use and zoning information, digital ortho photos. 9 slides.
R_Zon.ppt	Zoning information for Redwood City. 3 slides.

<b>File Name</b>	<b>Content Description</b>
R_Zon&DOP.ppt	Digital ortho photo, zoning and census blocks, vicinity of Redwood City rail station. 4 slides.
R_bus9898W&B.ppt	Businesses located within walking distance of Redwood City rail station. 17 slides.
R_main.ppt	Study area menu. 1 slide.
R_MV_PD902 2.ppt	Population density in Redwood City and Mountain View. 9 slides.
R_SUM.ppt	Summary and highlights of Redwood City presentation. 10 slides.
R_WalkTime.ppt	Walking time to Redwood City CalTrain station. 2 slides.
RW_overpass_eastview8.mpg	QuickTime clip of vicinity of Redwood City CalTrain station from the east.
RW_overpass_westviewuseb.mpg	QuickTime clip of vicinity of Redwood City CalTrain station from the west
RW_PL1.mpg	QuickTime clip of vicinity of Redwood City CalTrain station: shopping.
RW_PL2.mpg	QuickTime clip of vicinity of Redwood City CalTrain station.
RW_RR1.mpg	QuickTime clip of Redwood City CalTrain station.
RW_RR2.mpg	QuickTime clip of Redwood City CalTrain station with train.
RW_Station_to_use_ba.mpg	QuickTime clip of view from Redwood City CalTrain station to surrounding area.
RW_station5.mpg	Quicktime clip of Redwood City CalTrain station with train.

<b>File Name</b>	<b>Content Description</b>
RW_stationLTR_6.mpg	QuickTime clip of Redwood City CalTrain station showing nearby businesses.
RW_stationRTLLookingwest7.mpg	QuickTime clip of Redwood City CalTrain station panning west.
RW_statwtrain_tor...kingTODsite9.mpg	QuickTime clip of Redwood City CalTrain station panning toward transit parking area.
RW_train4.mpg	QuickTime clip of Redwood City CalTrain station with train coming in.
S_Sum.ppt	Sacramento 65th Street light rail station vicinity, complete presentation, 31 slides.
SC_Setting.ppt	Santa Clara county settings map of TOD study area. 4 slides.
SCC_PD9022.ppt	Animated population density and projections in San Jose, Campbell and Mountain View. 8 slides.
sfb_JD9022LR.ppt	Animated job densities and projections in Bay Area. 10 slides.
SFB_PD9022LR.ppt	Animated population density study of San Francisco Bay area. 9 slides.
SM_Setting.ppt	Redwood City and San Mateo county setting. 4 slides.
stacked bar template.xls	Excel templates used to gather data for this report and instructions for use.
TOD_History.ppt	History of transit oriented development by Brett Hondorp. 13 slides.
TOD_Region.ppt	Regional setting maps for study, including maps of highways and airports, population projections and demographics. 25 slides.

<b>File Name</b>	<b>Content Description</b>
TOD_Small_Multiples.ppt	Small replicate schema and reasoning. 2 slides.
Why_TOD.ppt	Reasons for transit oriented development, including scales. 13 slides.

\* For disc content listings to be in same order as this table, in Envisioning CD-ROM Disc's File Menu, view as list and arrange by name.

---

## BIBLIOGRAPHY

### GEOGRAPHIC INFORMATION SYSTEMS

- Davis, David E. *GIS for Everyone*. Redlands, CA: ESRI Press, 1999.
- \_\_\_\_\_. *Getting to Know Desktop GIS*. Redlands, CA: ESRI Press, 1995.
- 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., Michael F. Goodchild, David J. Maguire, and David W. Rhind. *Geographic Information Systems and Science*. New York: John Wiley and Sons, Inc., 2001.
- \_\_\_\_\_. *Geographical Information Systems: Principles, Techniques, Applications, and Management*, 2nd ed. New York: John Wiley and Sons, Inc., 1999.
- 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.
- 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.” In *Spatial Analysis: Modeling in a GIS Environment*. Edited by Paul Longley and Michael Batty. Cambridge, England: GeoInformation International, LTK, 1996.
- Ormsby, Timothy, and Jonell Alvi. *Extending ArcView GIS*. Redlands, CA: ESRI Press, 1999.
- Wrigley, Neil, Tim Holt, David Steel, and Mark Trimmer. Ch. 2 in *Spatial Analysis: Modeling in a GIS Environment*. Edited by Paul Longley and Michael Batty. Cambridge, England: GeoInformation International, LTK, 1996.
- Zeiler, Michael. *Modeling Our World: The ESRI Guide to Geodatabase Design*. Redlands, CA: ESRI Press, 1999.



**INFORMATION DESIGN AND TECHNOLOGY**

- Batty, Michael. "Digital Planning: Preparing for a Fully Wired World." In *Computers in Urban Planning and Urban Management, Keynote Papers*. Edited by P. K. Sikdar, S. L. Dhingra, and K. V. Krishna Rao. New Delhi, India: Narosa Publishing House, 1998, 13-30.
- Bossard, Earl G. "Spreadsheet Design Guidelines." 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." In *Proceedings of The First International Conference on Quality of Life in Cities*. 2:246-260. Singapore: School of Building and Real Estate, National University of Singapore, 1998.
- Bossard, Earl, and Priya Tallam. "Envisioning Neighborhoods: Understanding Areas Using Multiple Replicates of Maps, Graphs, and Photos." In *Computers in Urban Planning and Urban Management*. 1: 481-492. Edited by P.K. Sikdar, S.L. Dhingra, and K.V. Krishna Rao. New Delhi, India: Narosa Publishing House, 1998.
- Card, Stuart K., Jock D. Mackinlay, and Ben Shneiderman. *Readings in Information Visualization—Using Vision to Think*. San Francisco: Morgan Kaufmann, 1999.
- 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, MA: The MIT Press, 1999.
- Meyers, Dowell. *Analysis with Local Census Data, Portraits of Change*. Boston, MA: Academic Press, 1992.
- Mitchell, William J. *City of Bits: Space, Place and the Infobahn*. Cambridge, MA: The MIT Press, 1995.
- \_\_\_\_\_. *E-topia—“Urban Life, Jim – But Not As We Know It.”* Cambridge, MA: 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, MA: The MIT Press, 1966.
- Bay Area Rapid Transit District (BART), San Mateo County Transit District, U.S. Department of Transportation. *BART-SFO Extension, Final Environmental Impact Statement/Final Environmental Impact Report*. June 1996.
- Beatty, David F., et al. *Redevelopment in California*. Point Arena, CA: Solano Press, 1995.
- 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: 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." In *Proceedings of The Second International Conference on Quality of Life in Cities*. 2:334-352. 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.
- \_\_\_\_\_. *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.
- 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, MA: 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, Douglas. *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: Sierra Club Books, 1986.
- 1000 Friends of Oregon. *Making the Connections: A Summary of the LUTRAQ Project*. Portland: 1000 Friends of Oregon, 1997.

## **DATABASE SOURCES**

- San Francisco Bay Area 1990 U.S. Census data  
[www.census.gov](http://www.census.gov) (particularly CD-ROMs of STF 3A & 1B data)

Association of Bay Area Governments *Projections '98* data

[www.bag.org](http://www.bag.org) "Services," "Bay Area Information," "Bay Area Transit Information," and "Local Government"

Internet links to BADGER-based digital ortho photos

<http://Badger.parl.com>

Internet links to other data

California School data: <http://greatschools.net/gas/find.html>

Oakland Crime data: <http://Oaklandnet.com> "*Crime Watch*"

---

## ACRONYMS AND ABBREVIATIONS

2-D	two-dimensional
3-D	three-dimensional
ABAG	Association of Bay Area Governments
BART	Bay Area Rapid Transit
CD-ROM	compact disc, read-only memory
CUPUM	Computers in Urban Planning and Urban Management
DOP	digital ortho photograph
EN	Envisioning Neighborhoods
GIS	geographic information system
GPS	global positioning systems
ICQOLC	International Conference on Quality of Life in Cities
LRT	Light Rail Transit
MAUP	modifiable areal unit problem
PO	Project Overview
QOL	quality of life
TOD	transit-oriented development
VMT	vehicle miles traveled
VTA	(Santa Clara County) Valley Transit Authority



---

## 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. He produced the final report and oversaw production of all project components, created Envisioning Neighborhood concepts, photographed site areas, and produced PowerPoint presentations.

### **Steve Colman, AICP**

Steve Colman is an adjunct faculty member of Urban and Regional Planning at San José State University, specializing in transportation planning. He provided technical advice and 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 ArcView database and map production expertise. He 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.

### **Brett Hondorp**

Brett Hondorp is a student volunteer from the Urban and Regional Planning Department. He created the draft of the TOD literature overview, which was part of his planning report for the Master in Urban Planning degree he received from San José State University in the summer of 2000. Hondorp has worked as a planner for several planning firms and celebrated completion of his studies by bicycling across the country from San Francisco to Washington, D.C. He currently works as a bicycle, pedestrian, and trail planner from Alta Transportation Consulting.



**Tara Kelly**

Tara Kelly is a student of the Urban and Regional Planning Department. She produced Fruitvale BART vicinity area study, undertook lead with school and crime data, and edited text of the report. Kelly holds a B.A. degree from Wellesley College and has worked as the grants manager for the Spanish Speaking Unity Council, which has taken a lead role in expediting the Fruitvale Transit Village. Since the fall of 2000, she has worked as a planner for the city of San Jose.

**Erin Mayer**

Erin Mayer is a student of Urban and Regional Planning at San José State University. She undertook the Excel spreadsheet processing of census data, collected land use and zoning information, and helped to film several study areas. Mayer has a B.S. degree from California State University, Sonoma, and is currently working as a planner for the City of San Jose.

**Scott Plambaeck**

Scott Plambaeck is an Urban and Regional Planning Department student. He produced the Campbell area case study, which started as a class project in his spring 2000 class on introduction to GIS techniques. His undergraduate work was undertaken at Humboldt State University, and he has worked for the planning departments of Santa Clara County and the City of Morgan Hill.

**Dayana M. Salazar**

Dayana Salazar is an associate professor of Urban and Regional Planning at San José State University, and oversaw the land use and zoning data collection for study areas. She received a bachelor's degree in architecture, a professional degree from the Universidad Javeriana in Bogota, Colombia, and a Master of Community Planning from the University of Cincinnati. Salazar is an associate with Eduardo Martinez Architects and has worked extensively on urban design and community planning issues in the greater San Jose area.

**Richard Taketa**

Richard Taketa is an associate professor of geography at San José State University. He provided consultation on ArcView mapping, summarizing data in rings and sectors, and oversaw map database design and creation. Professor 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.

**Andrea Subotic**

Andrea Subotic is a graduate student of geography at San José State University. She produced the Sacramento area study, creating a variety of ArcView maps, Excel charts, and data layers, using U.S. Census data.

**Tung Tran**

Tung Tran is an Urban and Regional Planning Department student and started the Mountain View area study. He holds a degree in landscape architecture from the University of California, Davis, and won best student poster at the Bay Area Automated Mapping Association poster conference in Oakland in November 1999 for his poster envisioning the Mountain View CalTrain and LTR station areas.

**Pin-Yuan Wang**

Pin-Yuan Wang is a student of Urban and Regional Planning and produced the Redwood City area case study, coproduced the Mountain View area case study, and filmed several study areas. Wang holds bachelor's and master's degrees in landscape architecture from National Taiwan University and has worked for the Association of Bay Area Governments.

**Dali Zheng**

Dali Zheng is a student of Urban and Regional Planning. He produced all the maps, charts, and digital images for the Hayward study. He produced several county and region maps, including the animated density maps and maps showing as embedded bars the estimated numbers of residents and workers within one-half mile of transit stations. Zheng has a bachelor's degree from Tongji University in Shanghai, China, and a Master of Civil Engineering degree from Tokyo University.

