

# Light Rail Transit Design in a Changing Economy: Adversity and Opportunity in Santa Clara County

BY: ROBERT D. DOÑA, Santa Clara County Transportation Agency  
ROBERT L. BERTINI, Parsons Brinckerhoff Quade & Douglas, Inc.

Since 1974, the Santa Clara County Transportation Agency (SCCTA) has served the transportation needs of Santa Clara County's 1.5 million residents. With 72 bus routes and a 21-mile long light rail line, SCCTA serves more than 150,000 passengers per day with light rail connecting residential communities with urban employment centers, Super Express and Express bus service for commuters, local bus service for intracity riders, and as one of three counties forming the Peninsula Corridor Joint Powers Board, the agency also participates in the 78-mile CalTrain commuter rail system serving riders between Gilroy and San Francisco. SCCTA is also responsible for the implementation of the Countywide Transportation Plan, which includes a commitment to a comprehensive rail corridor development plan for Santa Clara County. A critical link in this regional rail network is the Tasman Corridor Project, currently in the Final Design phase.

The objectives of this paper are to present a picture of the evolution of the Tasman Corridor Light Rail project in Santa Clara County; discuss the challenges and opportunities facing the project due to a changing economic picture; and to offer important lessons to be applied in the implementation of transportation improvements as we move into the 21st century.

## Existing System

The existing 21-mile Guadalupe Corridor Light Rail Transit (LRT) system is comprised of 33 stations, 50 light rail vehicles and 11 Park-and-Ride lots (see Figure 1). The first segment, operating since December 1987 (service extended to the Downtown San Jose Transit Mall in June 1988), links downtown San Jose and businesses along North First Street to the industrial centers of North San Jose and Santa Clara. The light rail vehicles (LRVs) travel 10 and 35 mph through the pedestrian-oriented Transit Mall and in the median of city streets respectively.

In 1990, LRT service was extended two miles south to the Tamien Station, providing commuters a direct link to CalTrain, bus connections, parking and eventually a child care facility. In 1991, full service was extended the final eight miles to south San Jose residential neighborhoods, 99 days ahead of schedule. Speeds in this segment reach a maximum 55 mph within freeway medians on State Routes 85 and 87. Trackways are fully separated from vehicular and pedestrian traffic, and

stations in this segment include elevators and escalators for passenger access and egress.

LRVs generally operate on ten-minute headways during peak hours, 15- and 30-minute headways during non-peak hours and 30-minute headways on weekends, with one- and two-car trains under normal circumstances and three-car trains for special events. Each vehicle has a capacity of 167 passengers.

The daily ridership currently stands at approximately 21,000, which is consistent with original projections, and with the performance of other similar U.S. light rail systems. With the opening of the new San Jose Arena and the success of the San Jose Sharks and other events, a bus shuttle now links LRT passengers directly to the Arena. Since the Arena's Grand Opening, LRT ridership has increased approximately three percent. The success of the Guadalupe Corridor has led Santa Clara County's transportation leaders to look to the future.

## SCCTA Vision For The Future

Implementation of a comprehensive, multimodal, integrated transportation system requires a skillfully prepared and continually updated long range plan. The Santa Clara County Transportation Plan—T2010, provides guidance to the SCCTA and all transportation in Santa Clara County. This comprehensive document sets out a program of transportation and land use actions "designed to make the transportation system perform better and the County a better place to live." (7) The Plan includes, as a key component of the Transit Element, the Long Range Rail Master Plan as the basis for rail corridor development in Santa Clara County.

In addition to specific corridor goals, the plan calls for development of Activity Center Systems at key centers to support the rail plan, and involves a commitment to assess whether rail development plans adequately address systemwide operating issues, intermodal facilities, feeder bus service, and coordination of land use plans. Studies and modeling carried out during the development of the T2010 Plan indicate that as a result of the improvements recommended, transit use would rise substantially. Between 6% and 10% of work trips would be made using transit, more than doubling from the present transit share. The priority system established in the T2010 Plan has led to varying levels of planning and design effort on a number of corridors. As the top priority, the Tasman Corridor Project has advanced the farthest to date.

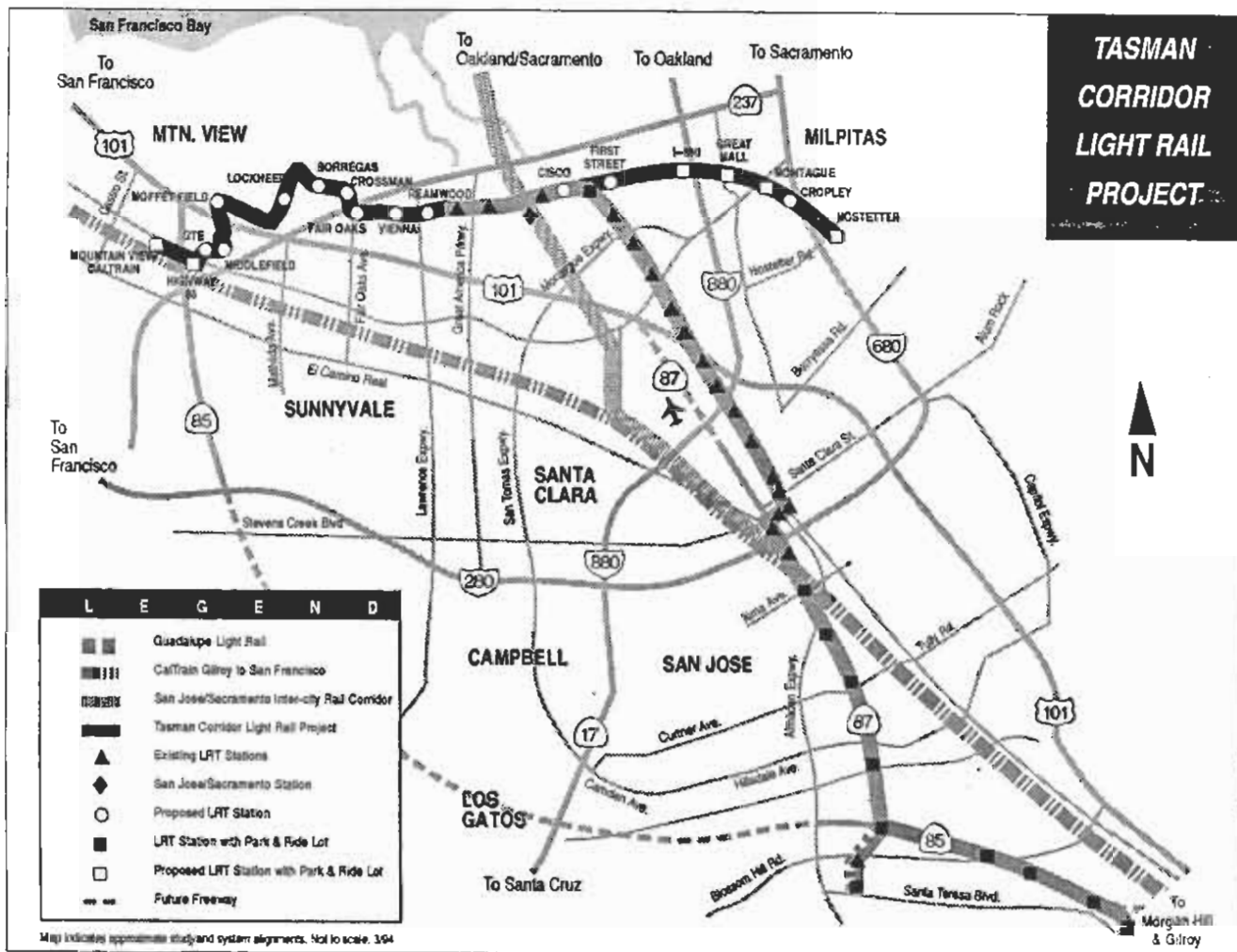


Figure 1. Tasman Corridor LRT Project Map

### Tasman Corridor Planning

In concert with the recommendations of the T2010 Plan, a Fremont-South Bay Corridor Study was undertaken in 1984 by SCCTA and the Metropolitan Transportation Commission (MTC). This study included consideration of an extension of the Guadalupe Corridor LRT in what became known as the Tasman Corridor. The Tasman Corridor Project Policy Oversight Committee was formed, comprised of representatives of SCCTA and the Cities of Milpitas, Mountain View, San Jose, Santa Clara and Sunnyvale. In 1988 the Policy Committee determined that the Tasman Corridor should continue to be studied under the federal Alternatives Analysis/Environmental Impact Statement process, separate from the Fremont-San Jose/corridor. The Tasman AA/DEIS/DEIR was issued in May 1991 with the Locally Preferred Alternative (LPA) defined as LRT between Hostetter Road in northeast San Jose and Downtown Mountain View. The Tasman Corridor is a heavily traveled corridor extending approximately 15 miles across northeastern Santa Clara County from Mountain View to San Jose. The eastern end spans the I-880/I-680 corridor. The

freeway/expressway system dominates the existing transportation system in the corridor. The Tasman Corridor crosses the U.S. 101, I-880 and I-680 freeways, SR 237 (part expressway and part freeway), and the Montague, Central and Lawrence Expressways. All of these facilities are congested during peak hours. Coupled with this current congestion are significant growth projections for the Santa Clara County region. The Association of Bay Area Governments (ABAG) has predicted up to 33 percent growth in employment in Santa Clara County between 1990 and 2010. In addition, ABAG has predicted as much as 8 percent population growth in Santa Clara County between 1990 and 2000. Growth in population and employment will increase the demand on the transportation network. Studies have shown that in order to meet the increased travel demand in the year 2005, local freeways would need to be widened to 14 lanes. As a result of this proposition, the region has made a commitment towards an improved public transit system. The Tasman Corridor Project is just the first extension project in the regional rail network envisaged.

**Table 1. Tasman Corridor Cost Comparison**

Category	Guadalupe Corridor Project			Tasman Corridor Project		
	Total (Million)	\$/Mile (Million)	Percent	Total (Million)	\$/Mile (Million)	Percent
Construction	\$251.5	\$12.0	55.5%	\$240.0	\$19.3	50.0%
Right-of-Way	\$62.4	\$3.0	13.8%	\$82.1	\$6.6	17.1%
Vehicles	\$55.2	\$2.6	12.2%	\$77.8	\$6.3	6.3%
Engr/Admin	\$83.7	\$4.0	18.5%	\$80.0	\$6.5	16.7%
<b>Total</b>	<b>\$452.8</b>	<b>\$21.6</b>	<b>100%</b>	<b>\$480.0</b>	<b>\$38.7</b>	<b>100%</b>

**Tasman Corridor Design Features**

Currently in the final design phase, the Tasman Corridor is a 12.4-mile east-west extension of the Guadalupe Corridor, with 18 new stations, modifications to three existing stations and five new Park-and-Ride lots. The corridor extends through the cities of San Jose, Milpitas, Santa Clara, Sunnyvale and Mountain View. SCCTA and cities are working with their funding partners, including the Local Transportation Authority (LTA), Federal Transit Administration (FTA) and the State of California to complete Final Engineering on an accelerated schedule.

The Tasman Corridor is truly intermodal, providing a direct cross-platform link to CalTrain in Mountain View; considerations of a future BART connection; and a nearby link to the San Jose-Sacramento Capitol Corridor intercity rail line in Santa Clara.

The east segment of the corridor begins in the residential areas near I-680 in northeast San Jose and Milpitas and continues through the industrial areas of Milpitas, crossing I-880 and Coyote Creek into northern San Jose. Joining the existing system on Tasman Drive near North First Street, the Tasman project includes a new Cisco station.

Near Great America, the Tasman Corridor begins its western extension along Tasman Drive through Santa Clara and a residential portion of Sunnyvale. Crossing Route 237 at Fair Oaks Blvd., the line continues west to serve Lockheed and adjoining industrial parks. Continuing west, the line parallels U.S. 101 and crosses under the landing path of the NASA/Moffett Field main runway in a depressed section and serves NASA Ames Research Center.

Crossing under U.S. 101, the corridor turns south along an existing railroad right-of-way, the Southern Pacific's Moffett Drill Track. The Tasman Corridor joins the Peninsula Corridor Joint Powers Board right-of-way, paralleling the CalTrain tracks into downtown Mountain View.

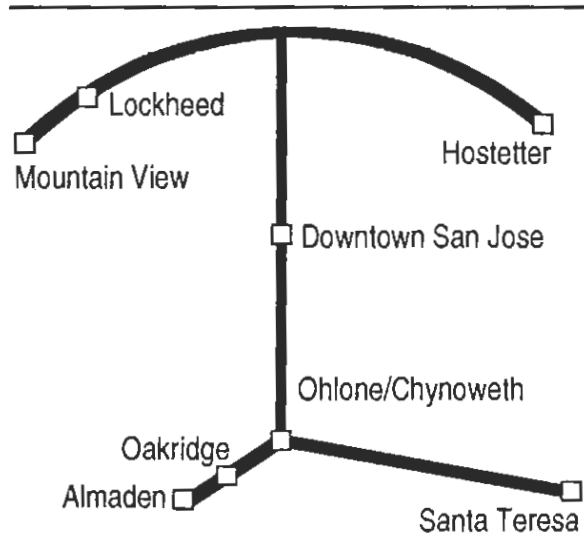
Cost estimates are an important component of Final Design efforts. Basic cost categories are compared below for the start-up Guadalupe Corridor and the new Tasman Corridor extension. Guadalupe Corridor Project costs are expressed in 1992 dollars and Tasman Corridor Project costs are presented in 1994 dollars. It should be noted that the Guadalupe Corridor is 99% at-grade

north of Downtown San Jose and grade-separated from cross streets when in the median of State Routes 85 and 87; the Tasman Corridor is approximately 85% at-grade.

**Operating Characteristics**

As a key component of the design phase, the project team is ensuring that the physical characteristics of the Tasman Corridor will allow optimum flexibility for future LRT operations. Alternative operating plans currently under consideration are:

- **Alternative A:** Three-route operation during peak periods. Route one operates on 12-minute headways with one-car trains from Almaden Station to proposed Hostetter Station. Route two operates on 12-minute headways with two-car trains from Santa Teresa to proposed Mountain View station. Route three is a one car shuttle on 12-minute headways from Mountain View to Hostetter.
- **Alternative B:** Three-route operation during peak periods. Route one operates three-car trains on 10-minute headways from Santa Teresa to Lockheed Station. Route two operates as a one-car shuttle on 10-minute headways from Mountain View to Hostetter. Route three is a one car shuttle on 10-



**Figure 2. Tasman Corridor Schematic**

**Table 2. Tasman Corridor Alternative Operating Characteristics**

Alternative	Daily Riders	Peak Riders	Off-Peak Ridership	Daily Transfers	Peak Transfers	Off-Peak Transfers
Existing	20,000	9,900	10,100	-	-	-
Alternative A	31,100	20,400	10,700	35	25	10
Alternative B	28,500	19,300	9,200	790	540	250
Alternative C	29,300	20,100	9,200	1,725	1,475	250

minute headways from Almaden to Ohlone/Chynoweth.

- **Alternative C:** Two-route operation during peak periods. Both routes include two-car trains operating at 12-minute headways. Route one extends from Almaden to Hostetter and route two extends from Santa Teresa to Mountain View. This alternative does not include a direct route from Mountain View to Hostetter during peak periods.

Of significant concern are the obligatory passenger transfers which would result with the various alternatives. It is significant to note that 500 to 600 transfers are generated in the peak period due to the fact that a direct route from the Almaden and Oakridge stations to downtown San Jose is not provided under Alternative B. It should also be noted that more than 1,600 peak period trips occur between the west Tasman stations and the east Tasman stations, resulting in a larger number of transfers for Alternative C when the Mountain View to Hostetter connection is not included. Specific ridership and transfer data are shown in Table 2.

### Ensuring Accessibility

The physical layout and the actual operations of the Santa Clara County LRT system are greatly influenced by the requirements of the Americans with Disabilities Act (ADA) of 1990. The Tasman Corridor Project must meet ADA's accessibility requirements, as must all future light rail extensions. According to the ADA, "access to light rail vehicles operating entirely within a dedicated right-of-way should be achieved with level boarding." (3) In addition, access to vehicles designed for and operated on city streets, pedestrian malls and other areas where level boarding is not feasible may be provided with level-change mechanisms such as ramps, bridge plates, mini-high platforms, car-borne lifts or wayside lifts. The Guadalupe system employs wayside lifts as the means of providing access for mobility-impaired passengers. The lead car of each train is accessible with two wheelchair locations provided. Presently, 15 to 20 mobility-impaired boardings are made each day. The operator stops the LRV, exits the cab to operate the lift control panel, provides passenger assistance, closes and locks the lift, and then returns to the train. Approximately 120 to 180 seconds typically elapse during this process, compared to the 20- or 30-second dwell times when the lift is not used. During the preliminary engineering phase, completed in August 1992, accessibility options for the Tasman Corridor were reviewed and mini-high platforms were being

considered as a means to provide level change. Further study toward resolving the ADA issues resulted in analysis of eight alternatives, contained in the *Vehicle Accessibility Study*. Evaluation criteria have included ADA compliance, cost, potential risk, interface with Guadalupe system, impacts on future extensions, community needs and acceptance, and urban impact. Alternatives considered include:

- Wayside lift at single door, low platform, high floor vehicle with fixed steps.
- Lift on vehicle at single door, low platform, high floor vehicle with fixed steps.
- Mini-high platform at single door, low platform, high floor vehicle with fixed or movable steps.
- Level boarding at all doors, high platform, high floor vehicle with movable steps.
- Level boarding at all doors, high platform, high floor vehicle, no steps.
- Level boarding center doors, low platform, low vehicle center with second articulation (30% low).
- Level boarding at all doors, low platform, low floor between end trucks (70% low).
- Level boarding at all doors, low platform, low floor vehicle (100% low).

The current plan is to design high platforms for the Tasman Corridor Project, with the option to:

- Convert the existing Guadalupe stations to high platform, convert existing vehicles to be high floor and purchase new high floor vehicles; or
- Depending on the means of access selected for the Transit Mall stations, it may be necessary to convert existing vehicles for movable steps and purchase new vehicles with movable steps.

Strides are presently being made in finalizing this decision. Planning, designing, constructing, and operating a LRT system that is integrated with the needs of the disabled community is a notable challenge. The project must also be carefully integrated with the needs of other transportation modes.

### Integration Of LRT Into City Streets

Integration with vehicular traffic is an important achievement for this primarily at-grade LRT system. The corridor consists of several distinct segments with differing impacts on vehicular traffic. The western portion through Mountain View is largely along existing rail corridors. However, the remaining portion of the Tasman Corridor includes seven grade separation structures, including four existing structures and a new

single-column aerial structure over two railroads, one expressway and five arterials. This 1.8-mile double-track aerial structure will include two aerial stations, and a pedestrian overcrossing. Where not grade-separated, the project includes 30 signalized intersections with LRT crossings, of which 7 are gated LRT crossings, and the remaining 23 include LRV control.

The basic design philosophy employed has been largely identical to that used on the Guadalupe LRT system. The Tasman Corridor project will include:

- Separate traffic signal displays, phases and timing parameters for LRVs.
- A flashing warning sign for left turn movements similar to the "Trolley Coming" sign on the existing system.
- Traffic signal coordination and LRT priority in order to minimize LRT delay, maintaining acceptable intersection level of service (LOS).
- Railroad gates with standard railroad preemption.

There are three unique sites along the Tasman Corridor which involve more complicated relationships between vehicles and LRVs:

- **Ellis Street/U.S. 101:** LRT crosses under U.S. 101 in a side-running alignment, and crosses two on-/off-ramp intersections. Railroad gates and traffic signals will be installed. Both intersections will be preempted during railroad gate operation.
- **Tasman Drive/I-880 Interchange:** The LRT crosses over I-880 in the median of Tasman Drive, crossing two on-/off-ramp intersections. Both intersections will operate at LOS D or better under future traffic considerations.
- **Tasman Drive/North First Street:** The LRT operates on a half-grade union, with up to 30 LRVs passing through the intersection during the peak hour, along with 5,000 vehicles. Additional "Trolley Coming" warning signs will be added, and traffic signal phasing will be optimized.

The signal system is being designed with maximum flexibility to allow fine-tuning in close coordination with all traffic signal authorities. As an example, there are three levels of LRV priority (none, partial, and full) that can be varied by time of day and can be operated with or without signal coordination. In addition to careful integration of LRT into city streets, one of the project's ultimate goals is to "develop a transportation system in the corridor compatible with adjacent land uses and is consistent with planned regional development." (11) In this regard, several noteworthy new transit/land use relationships are being forged.

### Land Use Opportunities

In terms of land use, SCCTA is working closely with local cities to integrate land use and transportation. Despite the recession, development along the Tasman Corridor has been accelerating at increased densities. The rail corridor gives planners and developers the opportunity to work together to create and approve transit oriented land uses for mutual benefit, eventually

contributing to the mutual success of the development and the rail system. Efforts already underway include:

**San Jose.** In 1989, the City of San Jose established The Housing Initiative, a program designed to encourage the development of high density housing near public transit facilities. The city has established a new General Plan land use designation known as Transit Corridor High Density Residential, which is defined as 12+ dwelling units per acre (DU/AC) applied to sites within 2,000 feet of LRT stations. Densities of at least 20 DU/AC are generally encouraged unless a low density neighborhood exists in the vicinity, which might necessitate a less abrupt transition. The city has also increased the height limit of high density residential development within 2,000 feet of a LRT station from 45 to 90 feet.

Also within the City of San Jose, the new Cisco headquarters includes over 800,000 square feet of industrial and office space for 3,000 employees, supporting the growth of this high technology firm. Included at this 56-acre site are pedestrian oriented design elements, next to a new LRT station along Tasman Drive. The Renaissance Village housing project is nearby, with 1,500 residential units, a day-care facility and commercial uses, located within the North San Jose Industrial Area.

Also within the City of San Jose is an example of the LRT project leading the establishment of a new multimodal transportation corridor alignment. Passing through a currently vacant parcel of State owned property, the Tasman project is establishing the alignment of the future Tasman Drive Connection between San Jose and Milpitas. Studies are underway to determine the best possible mixed-use development for this 100-acre parcel, along with accommodation of a future LRT station. In this example, the LRT project is establishing the overall transportation corridor prior to the construction of the roadway.

**Milpitas.** The City of Milpitas is implementing a major transportation improvement program in conjunction with the conversion of the Ford Assembly Plant to the 1.3 million square foot Great Mall of the Bay Area. The mall is expected to be a dominant destination for shoppers and employees. A unique feature of the Tasman project is a pedestrian overcrossing leading from the new Great Mall LRT Station directly towards the main entrance of the mall. The city's program also includes a Tasman Drive interchange with I-880 and a Tasman Drive connecting arterial between the interchange and Capitol Avenue. This is an example of mutually beneficial SCCTA/City/Developer coordination, reflected in the fact that construction of two LRT bridges recently began as part of the interchange project.

**Santa Clara.** Within the City of Santa Clara a station is in operation at the Tasman Corridor/San Jose-Sacramento Corridor connection. The Santa Clara Convention Center and Paramount's Great America amusement park are major destinations and are adjacent

to the Great America LRT Station.

**Sunnyvale.** The City of Sunnyvale's major employers, such as Lockheed and Hewlett-Packard, will continue to employ thousands of commuters in need of transportation alternatives. A comprehensive multimodal transit center at Lockheed is currently under design, to facilitate efficient LRT, bus, employee shuttle, and automobile transfers. Lockheed is the county's largest employer, with 18,000 employees.

**Mountain View.** The LRT system will make a direct connection with CalTrain in downtown Mountain View at a multimodal transit center. Mountain View plans a new residential neighborhood and network of street connections that will combine with the transit hub and recent downtown redevelopment to create a distinctive environment.

With the many successes have come the inevitable challenges and uncertainties, particularly in the area of funding. However, an aggressive schedule is being pursued by the entire project team.

### Funding Challenges

Conceptual Engineering began in August 1991 upon completion of the AA/DEIS phase, and continued through January, 1992. Preliminary Engineering was completed in August 1992. Final Engineering began in May 1993, and will continue through May 1995. Also included during this period is early right-of-way acquisition and construction of the two LRT bridges as part of the I-880 interchange.

Adversity is not a stranger to the project; the Bay Area economic profile has changed rapidly with drastic impacts to defense industries. Meeting the local funding requirements for the Tasman Corridor remains the top priority for the Agency and its project team. In November 1992, Santa Clara County voters passed Measure A, to renew a half-cent sales tax for transportation. Nearly 90% of the \$3.5 billion in revenue projected over the twenty-year life of the measure is pledged for financing construction and operation of an integrated countywide rail system. In addition to providing the local matching funds for construction of the Tasman project, six other light rail corridors are included as well as express bus, highway and expressway projects.

Measure A has been challenged by opponents who believe that the measure required a two-thirds supermajority and not the 54% vote received. In a recent split decision, the Sixth District Appellate Court rendered Measure A void, and the implementation of the tax is now pending a decision by the California State Supreme Court. Assuming a favorable decision by the Supreme Court by March 1995, it is projected that construction could start in the third quarter of 1995, with revenue service beginning in August, 1999. Due to the local and regional consensus that light rail is a key element of the transportation network, funding the Tasman Corridor project remains a high priority.

### Conclusions

Thanks to the vision of policy makers, planners, designers and managers, the Tasman Corridor Project is proceeding with design and advancing toward construction despite the impacts of the changing economy. Major design packages are under SCCTA and local agency review, and construction recently began on the I-880 interchange. A key component in this success is effective communication among the design team and in the community. Based on the experience gained in this economic environment, several conclusions can be drawn which would be applicable to future projects:

- Work closely with local/regional agencies to verify that the funding package can respond to changing conditions in creative ways.
- Begin early coordination with cities that are affected--early approvals of traffic engineering and visual elements can mean early cooperation. This coordination should include elected officials and city staff at all levels.
- Early coordination and agreements with utility companies and other affected agencies such as flood control districts and resource agencies.
- Strive to freeze alignment and intersection layouts as early as possible; this allows all disciplines to proceed while minimizing conflicts.
- Communicate early and effectively with adjacent property/land owners to encourage mutual benefit due to development and the transit project.
- Include early discussions and agreements with other modes and maximize integration of intermodal concepts.

Working within the rapidly changing economic environment in the West in the early 1990's, the Tasman Corridor Project can offer valuable lessons to be learned as we approach the 21st century.

### Acknowledgements

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