Integration of Sacramento Light Rail Transit System into the Central City

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Sacramento, the capital of California, is located midway between San Francisco and Lake Tahoe in the great central California agricultural valley. Sacramento was settled at the confluence of the Sacramento and American Rivers in 1850 as a central location for gold seekers.

From a small settlement of 2,000, Sacramento City has grown to a population of more than 300,000. The city is the seventh largest in California and the metropolitan area has a population of more than 1 million and employs almost 400,000 persons. More than 100,000 jobs are within a mile of the state capitol in the central business district (CBD).

Sacramento's transportation systems are varied. The city is served by three major railroads, 40 interstate truck carriers, four freeway systems, a deep water channel, eight major air carriers, and three bus systems. Sacramento is now in the process of complementing the existing public transportation systems with a light rail transit commuter line to augment the existing bus fleet.

BACKGROUND

The Sacramento City Council voted in September 1979 to delete the I-80 bypass freeway from the Interstate system. Withdrawal of the I-80 bypass freeway project gave Sacramento the capability of funding a major transit project to serve the Northeast Corridor of the city. To select the locally preferred transit project for the Northeast Corridor, work began on a draft alternatives analysis and an environmental impact statement (AA/EIS) in February 1980. Preparation of this draft AA/EIS was a cooperative effort between the city and county of Sacramento, Regional Transit, the Sacramento Area Council of Governments (SACOG), and the California Department of Transportation (Caltrans).

The Sacramento Transit Development Agency (STDA) was formed in early 1981 to implement the project. The STDA governing board has one representative from Caltrans, one from the city of Sacramento, one from the county of Sacramento, one from the Regional Transit District, and one public member appointed by the other members. The board makeup has since changed in response to a more active local interest.

SYSTEM DESCRIPTION

The 18.5-mi (29.5-km) Sacramento light rail transit (LRT) starter line project is being designed and constructed to provide trunk line service for an integrated bus-LRT public transportation system for the greater Sacramento metropolitan area, which has a population of 1.1 million and an annual growth rate of 2.5 percent. Initially, a single-track main line primarily at grade will be built with double-track sections provided over 40 percent of the route to allow running meets between trains operating at 15-min headways in both directions. The design provides for future expansion to a fully double-tracked system as the predicted initial ridership of 25,000 increases.

This project is typical of European LRT design in which major structures are minimized by using existing rights-of-way and at-grade crossings. The integrated bus-LRT system will operate eight one- to four-car trains on 15-min headways on the trunk line to relieve express bus congestion in the downtown core and reduce operating costs of the present all-bus public transit system. The bus element will operate some 100 buses to provide feeder service to six "timed transfer" stations, thus maintaining the flexibility of buses to adjust routes as population patterns shift. The combined system will be operated at an annual operating subsidy less than that of the present all-bus transit system because of LRT operating economies attributable to lower operating costs and higher passenger-to-driver ratios. Total capital project costs for this LRT system are approximately $8.5 million per mile ($6 million per kilometer) for double track compared to $50 to $100 million per mile ($31 to $62 million per kilometer) and more for double-tracked "heavy rail" systems that are completely grade separated. The trade-off for this lower cost is reduced level of service, but, in most western U.S. cities, population density does not warrant the more expensive heavy rail public transit systems.

The Sacramento LRT line will follow the two major transportation corridors along Interstate 80 from the northeast and US-50 from the east to feed commuters into the CBD (Figure 1).

The starter line project will begin at Watt Avenue and I-80 in the Northeast Corridor. It will follow the abandoned I-80 bypass freeway right-of-way (ROW), the abandoned Sacramento Northern Swanston branch ROW along Arden Way, Del Paso Boulevard, the Route 160 bridge across the American River, 12th Street, K Street, 7th Street (southbound) and 8th Street (northbound), O Street, 12th Street, Union Pacific

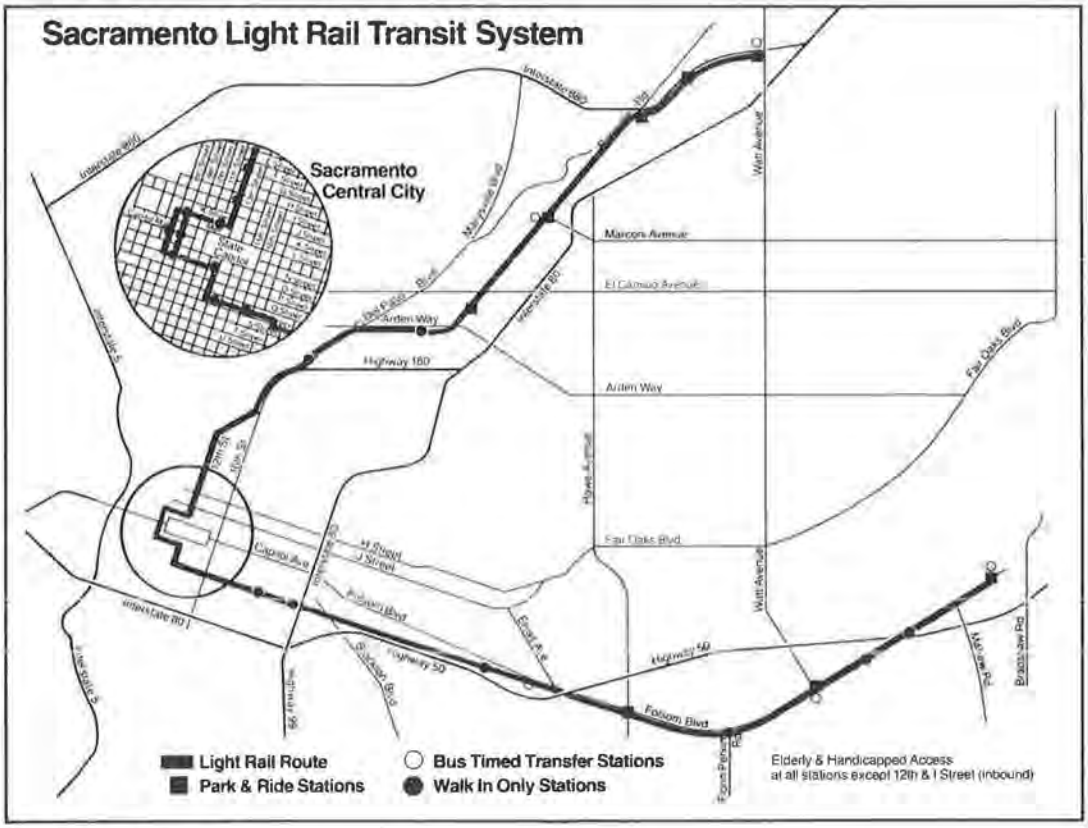

FIGURE 1 Route map.

ROW adjacent to the alley between Q and R Streets, R Street, and the Southern Pacific Placerville branch ROW in the Folsom Corridor to Butterfield Way. Future expansion to the northeast, east, and south is in the current planning program. Acquisition of critical rights-of-way for the initial starter line makes expansion to a fully double-tracked system easy.

A total of 27 passenger stations will be provided; six are to include bus transfer facilities, and seven are to include automobile park-and-ride lots. Outlying stations will have bicycle parking facilities where appropriate. A yard and shop complex will be located in the I-80 bypass ROW near Academy Way between El Camino and Marconi Avenues.

Vehicles and other critical components and materials are on order or already delivered. Construction is under way and the first leg (the Northeast Corridor) will be completed and opened to revenue service by January 1987. Revenue service in the remaining leg (Folsom Corridor) is scheduled for June 1987. Of the several extensions to the trunk line that are being studied, double tracking the Northeast Corridor is the highest priority and could become reality in the next few years. Funding for this first expansion has been identified. Other expansions will depend on ridership and availability of funding.

COST-EFFECTIVE DESIGN

The Sacramento LRT design philosophy produced an economical "starter line" that maximized cost-effectiveness initially and preserved the ability to easily expand to accommodate increased future demands. The basic design criteria adopted by the agency and rigidly enforced throughout planning and design phases were highlighted by four principles:

- Maximum use of existing rights-of-way;
- Use of off-the-shelf, proven technology in all vehicle, equipment, and system design;
- Low-cost functional stations with minimum frills; and
- Integration with existing bus fleet to optimize service and reduce operating costs.

The alignment followed existing transportation corridors throughout the city including portions of abandoned freeway land parallel to the Southern Pacific Railroad main line, shoulders of existing state highways and city streets, the parking lane of some downtown city streets, abandoned Western Pacific and Southern Pacific Railroad industrial spur rights-of-way, and an easement parallel to an active Southern Pacific branch line. Total right-of-way costs including the maintenance shop, light rail vehicle (LRV) storage yards, and automobile parking facilities at suburban stations are $17.4 million, which represents only 11.1 percent of the $156 million project cost. Only three commercial businesses and eight family dwellings had to be relocated to accommodate the LRT system. These relocations were all accomplished to clear land for station parking and platform facilities.

Because of the flexibility of standard light rail articulated vehicles, the route was threaded through the downtown center city with no need to interfere with, alter, or move existing buildings. It was also possible to bypass all environmentally sensitive and historical areas. The Sacramento design maintained the true light rail philosophy of at grade crossings that was implemented so well in San Diego. Sacramento also followed the "no frills" station design criteria used in San Diego. Rigid adherence to the four basic principles resulted in a functional LRT system that initially cost $8.5 million per mile and can be

expanded to full double track for approximately $1 million per mile additional costs for overhead catenary, track construction, additional platform area, and some modification of the signal system.

INFRASTRUCTURE RECONSTRUCTION

Although the system was designed to minimize costs and provide a basic, functional, no-frills system, there were numerous opportunities for enhancement of the city infrastructure that were "spin-off" benefits to the city at minimum cost. Many of these enhancements were in future plans but would not have been completed in the foreseeable future without the joint cooperation between city public works staff and STDA staff. The major infrastructure reconstruction features are itemized here and discussed individually.

- Construction of three new railroad grade separations,
- Installation of a pumping plant,
- Reconstruction and realignment of an existing on-ramp,
- Resurfacing city streets,
- Rehabilitation of abandoned railroad right-of-way,
- Reconstruction of 100-year-old city sewer system,
- Redesign of city traffic signal system,
- Upgrading of existing railroad grade crossings,
- Reconstruction of major downtown pedestrian mall,
- Construction of new transportation mall,
- Improvement of traffic flow at newspaper plant,
- Major improvement to existing all-bus system,
- Rehabilitation of redevelopment area, and
- Improvement of economically depressed area.

This impressive list of major improvements to the city infrastructure, estimated to cost more than $20 million, was achieved at minimum cost to the city as a direct result of LRT construction or of joint development. Most of these improvements were funded by UMTA, FHWA, the state of California, and the Southern Pacific Railroad. Although the city share of total project costs is estimated at approximately $23 million, there is an agreement between STDA and the city to repay $29 million in redevelopment tax increment bond funds when alternative local transit financing is legislated. Ultimately, the city will own a $158 million light rail transit system and the listed infrastructure improvements for a total city investment of approximately $4 million. All other project and infrastructure improvement costs were met by the various agencies listed earlier.

Grade Separations

When it was planning the LRT project the city of Sacramento filed an application with the State Public Utility Commission (PUC) for funding to construct two railroad grade separations. The California Department of Transportation administers a $15 million annual program to eliminate dangerous railroad grade crossings. Under the law a priority list is established by the PUC and those crossings highest on the list are funded 80 percent by the state, 10 percent by the affected railroad, and 10 percent by the local agency. In 1981 both crossings ranked high enough on the state PUC list to be eligible for funding in the 1982-1983 fiscal year.

The city was not in a position to finance the local 10 percent matching share. Through a cooperative agreement between STDA and the city, the LRT project provided the local match through design and construction engineering. The trade-off for STDA was the elimination of grade-crossing construction and protective crossing gates. As a result of working together the LRT project benefited by getting several miles of separated alignment in the Northeast Corridor and the city benefited from construction of three grade separations. A third grade-separated structure was an old substandard underpass that was eliminated with construction of the new structure. Addition of this third structure to the project was made possible by combining funds and right-of-way. Total cost of these three major traffic improvements to city arterials was $13 million, including rights-of-way. The state funded $6.4 million of the cost, the Southern Pacific Railroad paid $0.6 million, STDA paid $1.4 million, right-of-way worth $3.9 million was included in the Interstate transfer, and the city paid only $0.7 million for its share of all three crossings. This traffic safety project represents a significant improvement in the infrastructure that was a direct result of the LRT project and a fine example of interagency cooperation.

Pumping Plant

A major improvement to an existing highway railroad underpass will be made by the construction of a pumping plant to drain that facility. Presently that area floods a few times each year and forces closure of the highway for several hours at a time. This, of course, is totally unacceptable to the LRT system operation. The pumping plant and outflow line are a part of the LRT project but will be jointly funded because of the obvious betterment to the underpass operation. The city had planned for a pumping plant but did not have funds to construct one in the foreseeable future. Estimated cost of the pumping plant and outflow line is $500,000 with the city share to be paid from Federal Aid Urban (FAU) funds. This is another example of infrastructure improvement resulting directly from the cooperative planning and design efforts that produced the LRT project.

On-Ramp Improvement

As part of the agreement to use the left shoulder of the existing American River bridge for the LRT tracks, the agency redesigned the inbound on-ramp from Northgate Boulevard. This city street feeds traffic from the rapidly growing South Natomas area onto the inbound lanes of an existing freeway to the central city. The redesign and reconstruction improve traffic flow and capacity and eliminate a bottleneck, an improvement which the city would have had to independently fund and construct in the near future; cost of this reconstruction is estimated to be $80,000.

Resurfacing of Streets

Because of major utility relocation work, several downtown city streets will be resurfaced as part of the LRT contract. This work will prolong the life of those major streets and preclude the necessity for the city to budget this street maintenance work for a period of time. The utility relocation work was a contributing factor, but the streets were in need of resurfacing so this infrastructure improvement is another side benefit of the LRT project. Cost is estimated to be $200,000.

Rehabilitation of Abandoned Railroad Right-of-Way

In the Folsom Corridor the LRT alignment follows the existing Southern Pacific Railroad abandoned industrial spur for approximately 2 mi. The existing street is a gravel surfaced "alley" with numerous chuck holes and minimum railroad grade-crossing protection. The Folsom Corridor LRT contract will include reconstruction of major portions of this street at no cost to the city. In addition, crossing gates will be installed to improve traffic safety. Again, it can be argued that LRT construction dictated these improvements, but the side benefits to the city cannot be overlooked. Cost is estimated to be $500,000.

Sewer Reconstruction

Along a busy arterial in downtown Sacramento, a major 100-year-old sewer line is carried in a brick arch culvert that is in need of repair or replacement. Because the brick arch culvert will not carry the additional loads imposed by the LRT vehicles, the center city contract includes replacing portions of this sewer with a 36-in. culvert. Cost of this reconstruction is estimated at $500,000 and is being borne by the LRT project with no cost to the city.

Redesign of City Traffic Signals

At some 35 intersections where the LRT line interfaces with existing city street traffic signals, redesign to accommodate LRT movements is a necessary LRT project cost. On the other hand, the city benefits from installation of new microprocessor signal controllers that incorporate the latest in traffic signal technology and equipment. Cost of this upgrading is approximately $1.1 million.

Upgrading Railroad Grade Crossings

There are 74 railroad grade crossings on the entire LRT alignment and because the line follows existing rail corridors 39 are new crossings. On 24 of the 43 existing crossings the LRT signal contract includes crossing gates where only stop signs or flashing lights previously existed. These gates are another traffic safety improvement to the city infrastructure. Cost of these improved grade crossings is estimated at $2.2 million.

Reconstruction of Downtown Mall

The five-block K Street segment is presently a pedestrian mall, closed to public automobile traffic. In the early 1970s the downtown portion of K Street was closed to vehicular traffic and a controversial pedestrian mall with concrete sculptures, waterfalls, grass, and play areas was constructed. Since the closure, retail activity has been in a constant state of flux and deterioration.

Because the LRT trackway and station platforms occupy the major portion of the area between building front sidewalks (center 52 ft of an 80 ft corridor), the project included complete demolition of the existing mall elements. Major utility relocation began immediately and included betterment of many of the utilities, especially a 69-kVA main electrical system for downtown Sacramento.

Retail activity is in various stages of redevelopment; several buildings are vacant, but many proposals are before the planning commission awaiting approval. A major central city redevelopment study was recently prepared and has been going through the public-hearing process. Light rail was a key element in that study as was the revitalization of K Street. The light rail project would satisfy two major elements of that redevelopment report: the return of people to the central city by providing safe, secure, and reliable service into the center city from the outlying residential areas and the improvement of the infrastructure within the K Street alignment. As a part of the LRT project, a commitment to improve lighting, streetscape, signs, drainage, landscaping, and surface treatment was made. These elements are included in the light rail project and will make this portion of the alignment a major attractor to the system and the redeveloped K Street mall. Cost of the mall improvements is estimated to be approximately $1.2 million.

Construction of a New Transportation Mall

The O Street mall was a location for which a Capitol Area Plan (CAP) study was completed in 1977, but no work was started. This area of O Street is surrounded mostly by government office buildings and the plan was to create a pedestrian mall with provisions for some form of public transportation (i.e., shuttle, mini bus, LRT). The LRT O Street mall design concept includes intersection improvements, sidewalk, curb and gutter removal and replacement, improved lighting, landscaping and drainage, decorative interlocking pavers in the station platform areas, and benches and other passenger amenities. After the final alignment was determined, renewed interest in the complete mall development was generated. Much joint planning was done not only to accommodate the LRT system but also to provide for the ultimate needs dictated by the CAP. State legislation, which would provide funds to complete that portion of the O Street mall not being completed by the LRT contract, is pending. Again, LRT provided the stimuli to turn plans into action and construct the mall many years ahead of its anticipated completion. Cost of these improvements is estimated to be $1.5 million of which $1 million is being paid by the state.

Improvement of Traffic Flow

Near the center city portion of the project a major railroad line must be separated from the LRT line. This separation structure clears the Union Pacific Railroad main line tracks by 24 ft and, to maintain no more than 7 percent grades on the LRT track, it extends approximately 600 ft in each direction from the Union Pacific line. The structure also grade separates the LRT line from two major one-way streets providing for nonstop city traffic flow. This type of costly grade separation would not normally be planned on a light rail project and crossing gates would have been installed at these streets.

Improvement to Existing All-Bus System

The existing Regional Transit District all-bus system operates approximately 230 buses in the metropolitan area. Because of high operating costs some areas of the suburbs are serviced at 1-hr intervals and other areas are not served at all. This operation has a detrimental effect on ridership, which in turn forces additional service reductions. Historically, the Sacramento Regional Transit District (SRTD) has been faced with this recurring cycle and, as it is

for many other bus systems, ridership decline is steady.

Because of the integration of LRT into the major corridors as a trunk line, the existing bus system is being redesigned to provide more frequent service and cover a greater portion of the suburban areas. The SRTD goal is to maintain 15-min headways on all bus routes throughout the working day with reduced service levels at night and on weekends. LRT trains and buses will operate on consistent schedules.

Rehabilitation in Redevelopment Area

Alkali Flat, an area along CA-160 (12th Street), has been economically depressed for many years. An urban design plan was adopted several years ago but was never implemented; however, redevelopment funds are now available for community improvements. After the LRT route was established, a desire to implement the plan and coordinate with the LRT project became evident. An agreement was executed in which the urban design improvements would be integrated and included in the design and construction documents for the LRT center city contract. This approach was cost-effective and sparked much interest from the local community not only in their improvements but in the entire LRT project. Sidewalks will be replaced and widened; lighting will be installed; and drainage, landscaping, and streetscape improvements will be made. Parking lots will be constructed to replace on-street parking removed for the LRT line. Cost of these improvements, from federal Housing and Urban Development funds, is estimated to be $250,000.

Improvement of Economically Depressed Area

Del Paso Boulevard is another economically depressed area and has been for the past 20 years since a bypass freeway was constructed. Joint planning with the redevelopment agency as well as with local community groups dictated the exact LRT alignment that allows for an existing transportation corridor improvement and retains vehicular traffic capacity. The agreement to locate an LRT station where it could be considered an anchor for future redevelopment and the construction of an off-street parking lot to replace the on-street parking removed for the station acted as a catalyst for building upgrading, more activity in the local business community, and a renewed interest in further development.

JOINT DEVELOPMENT

Joint development has been limited to date, but future opportunities will be enhanced because of more land use considerations along the route. Planning staffs have been supportive in seeing that planned developments along the LRT route and especially adjacent to the station areas are accessible to LRT. Often concessions are given to developers (in the form of reduced parking requirements) if they locate adjacent to a station and provide necessary access to the station.

Examples of limited but relevant contiguous development include

- A commitment of $450,000 from a developer for a pedestrian bridge to provide direct access from an LRT station to a major commercial and office development.
- A planned pedestrian underpass to tie an LRT station to another major office complex that will be constructed over an old aggregate pit. This $300,000 expenditure will allow LRT access to a proposed 600,000 ft^2 office development.
- Property deeded to the agency will allow an LRT passenger platform to be constructed adjacent to another major office development.
- A location adjacent to the Folsom Corridor terminal station was selected for a state office building. This 1 million ft^2 site was selected from six possible sites; the overriding consideration was the proximity to the LRT park-and-ride station.

Other opportunities are beginning to present themselves because developers are now assured that LRT will be constructed.

CONCLUSION

As can be seen, this was not just another LRT project. Many other peripheral elements will be reconstructed and upgraded. This would not have been done had it not been for the light rail project. This project is an excellent example of integration of a transportation project into an existing central city infrastructure.