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Urban Mass
Transportation
Administration

Light Rail Transit Capital Cost Study

Prepared by:

Booz•Allen & Hamilton Inc.

with assistance from

Gibbs & Hill
and

Parsons, Brinckerhoff, Quade & Douglas
UMTA-MD-08-7001

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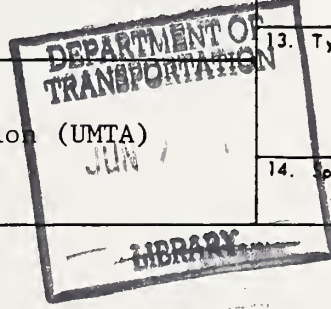


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PREFACE

This document was prepared for the Office of Technical Assistance and Safety of the Urban Mass Transportation Administration (UMTA). The study was conducted by the Transportation Consulting Division of Booz•Allen & Hamilton Inc. through a task order funding grant from the U.S. Department of Transportation, Urban Mass Transportation Administration. Guidance was provided through both the Office of Technical Assistance and Safety and the Office of Grants Management. Technical support was provided by Parsons Brinkerhoff Quade & Douglas in the development of the data collection format and Gibbs & Hill in the review of the cost input and unit cost results. The contents of this report are based on the project staff research and do not necessarily reflect the official views or policies of the U.S. Department of Transportation or the Urban Mass Transportation Administration.

This report was authored by Donald C. Schneck, Richard M. Amodei and Michael G. Ferreri of Booz•Allen with technical assistance from Dr. Fred Ducca and Ghassan Salameh of Booz Allen, Thomas Jenkins of Parsons Brinkerhoff, and David Weiss of Gibbs & Hill. Valuable insight and direction was contributed by Edward Thomas and Ron Jensen-Fisher of UMTA. The authors would like to express their appreciation for the assistance and information provided by the light rail transit systems that became a part of this Fixed Guideway Capital Cost Study. Employees and consultants of these agencies were very helpful in furnishing detailed construction cost information of each system element and then reviewing the initial results.

The Fixed Guideway Capital Cost Study is an attempt to develop a capital cost data base of actual unit costs to construct and procure the various assets necessary to operate mass transit busway and rail systems. This report documents the initial effort at this overall objective by concentrating on the light rail transit mode of passenger rail systems. The term light rail refers more to this mode's relative simplicity and



operational flexibility rather than actual vehicle weight or cost. With an overhead power supply source, light rail systems can operate in mixed traffic and various alignment configurations. Service can be operated in single or multi-unit trains of standard and articulated vehicle fleets that permit close service level design in line with passenger demand. Seven light rail systems that were developed over the past ten years, were the focus of this project. However, only five of the system operating agencies responded with pertinent capital cost information that formed the basis of this study.

INTRODUCTION

This report presents the results of the study to document actual construction and related developmental costs for the most recently-constructed light rail transit systems in the United States. With the successful opening of the San Diego Trolley in 1981, other U S cities have followed with the development of their own light rail systems. Through the decade of the 1980's, a total of seven light rail systems were constructed or significantly reconstructed.

- San Diego inaugurated initial line service in 1981;
- Buffalo began service in 1985;
- Portland opened service in 1986;
- Sacramento initiated service in 1987;
- San Jose opened their first segment in 1987;
- Los Angeles initiated service (1990) to Long Beach; and,
- Pittsburgh reopened service on their line in 1988.

These new light rail systems represent an important investment of public funds in the passenger transportation industry. The documentation of the actual component capital costs of these systems represents an opportunity to help prepare realistic capital cost estimates in the planning and engineering of the next set of systems.

This project has been sponsored by UMTA, of the U. S. Department of Transportation to document the actual construction and procurement costs of all component assets and related developmental costs for each system. The study objectives included an examination of unit cost characteristics that could be pertinent to the planning of similar systems, such as the distribution of costs by component categories, consistent unit cost ranges, and commonalities of component types and capacity requirements for a light rail system. The Office of Technical Assistance and Safety, Capital Development Division directed the study with the assistance of the Office of Grants Management Planning Analysis and Support Division.

This fixed guideway capital cost study is intended to provide a data base of actual unit costs for the various asset components used in the construction of light rail transit systems. The transit authorities operating these recently-completed light rail systems supplied the basic component cost data and then examined the translation of their cost data into the reporting structure for interpretational consistency. The resulting component cost information is intended to assist agencies in the planning and engineering stages to better prepare capital cost estimates for proposed new systems or lines.

This study and resulting report did not attempt to evaluate or explain the unit cost variances among the systems or the effectiveness of component type and capacity decisions. There are many reasons for these differences that reach beyond the analytical scope and objectives of this study. The size of this study sample did not support the establishment of statistically significant norms or variances in each of the cost categories. This was likely due to the unique characteristics of each system that exceed standard unit cost and capacity calculations. This report should not be construed as a follow-up to the UMTA Report "Urban Rail Transit Projects: Forecast Versus Actual Ridership And Costs". There was no explicit or implied effort to prepare any cost effectiveness comparisons of these systems. In addition, no attempt was made to critique the planning, engineering, procurement, construction management and construction costs incurred in the development of each system.

STATEMENT OF PURPOSE

Introduction

This fixed guideway capital cost study represents the first in a series of studies to examine the actual costs of major transit capital investments. This report presents the results of the first task to focus on the recent light rail projects that have been developed during the 1980's. Following studies will utilize this basic analysis structure and apply it to the other transit fixed guideway modes that have been implemented recently.

The information presented in this report should be used in line with the objectives posed for the study. The range of component unit costs should not be confused with any measures of efficiency since there remain other cost sensitive factors that lie outside those measured here. Further, the basic design philosophy of each system will directly affect unit and total costs. For example, some systems adopt a minimum cost design approach while others add amenities to attract higher market share. Station designs are a good example of these different developmental approaches. These effects on unit and total component costs do not easily conform to the quantitative focus of this study.

The component cost ranges produced in this report should provide a test for reasonableness of planning-level capital cost estimates and some guidance on the number and type of assets required for a light rail project. The cost ranges could also be used as a measure of project complexity and overall service levels and passenger carrying capacity -- the more complex and/or greater ridership demand, the more likely the project costs would tend toward the higher end of each component cost range. In addition, site conditions and interpretational provisions will have some direct effect upon the unit cost results. These effects should all be considered with the use of the information presented in this report.

Background

Capital cost estimates are key ingredients in determining the cost effectiveness, financial capacity and overall engineering feasibility of major capital investments. Fixed guideway transit systems, which involve Federal funding are developed in accordance with the Major Capital Investment Policy. This policy established a structured decision-making process that requires the careful development of costs, benefits and impacts of proposed systems. Reliable capital cost estimates are an important element of the investment decision process. The project development study process for major capital investments includes system planning, alternatives analysis and preliminary engineering. Since capital cost estimates are key ingredients to the decisions reached in each of the project study phases, the results of this study are intended to help guide the preparation of these capital costs through the availability of pertinent unit cost information and the typical asset requirements of a fixed guideway transit project.

An important aspect of the cost estimation procedures is the development of "Composite Unit Costs for Sections and Stations." The purpose of this study is to improve the accuracy and comparative compatibility of the capital cost estimates of the various systems under study. The benefit to the industry is the opportunity to check the reasonableness of planning-level cost estimates with the actual experience of building similar systems nationwide.

Good methods and reliable cost information are particularly important when comparing cost effectiveness and financial impacts among alternative capital investment projects. These comparisons require cost information that is compatible among alternative investments and reasonably in line with actual construction and procurement costs of each proposed system under study. More certainty of cost estimates and less variation to actual costs is more critical given the limited governmental

funding capacity and the expanded funding demand posed by the increased number of new systems requesting these capital funds.

In the recent past, preliminary capital cost estimates have often underestimated the actual costs and possibly blurred the alternative cost effectiveness decision. More importantly, underestimated capital costs have in the past stretched project financing plans, since required contributions from each funding source increased upon implementation -- sometimes beyond the capacity of certain funding mechanisms. On the Federal side, funding priorities were necessary to accommodate project cost increases, which sometimes led to decreased or delayed funding elsewhere. State and local funding sources were less able to directly absorb capital cost increases, leading to more difficult funding decisions.

The differences between planning estimates and actual construction cost results often include other impacts of ongoing project development, such as:

- Changes in the scope of the project;
- Changes in design standards;
- Unforeseen complexities in field conditions;
- Expanded environmental & community responsibilities; and
- Difficulties in implementation.

The sum of these cost impacts, coupled with the underestimation of unit costs and omission of some asset requirements, identifies most of the causes behind the underestimation of capital costs. A data base of actual project experiences on quantities and unit costs for major capital investments should help improve the degree of confidence in planning-level capital cost estimates.

Objectives

The size and complexity of the issues behind the underestimation of planning-level capital cost estimates required a careful review of causal

factors. The technical analysis was focused on where the most benefit could be achieved from an examination of actual project development experience. The objectives of the study were then defined as:

- To provide UMTA with the unit cost information to check the reasonableness of the capital cost estimates for major capital projects at the various stages of development;
- To provide local and state transportation planning agencies and consultants with experience-based cost information that could be used in generating more accurate and consistent capital cost estimates; and
- To reduce some of the original data collection effort needed to generate unit capital cost data for each study.

These objectives were then used to guide the study in the documentation and analysis of actual capital costs of five recent light rail transit projects.

STUDY APPROACH

The study approach concentrated on the development of a data base of actual unit capital costs that could be drawn from actual system development experience. The two key requirements of the data base were the consistent definition of capital asset components and the identification of actual construction and procurement costs at the same level of detail. The workplan structure to meet these technical needs and the overall study objectives included six tasks:

- Identify candidate systems;
- Develop data collection guide;
- Complete data collection survey;
- Prepare file structure and layout;
- Refine data base results; and
- Publish the results.

This task structure was followed in the conduct of the study with varying levels of effort required for each candidate system.

This project focused on the recently constructed light rail transit systems designed and built over the last ten years. Light rail systems were selected as the initial system mode for this analysis, since more systems have been constructed within this system definition and the resulting data base would be the most complete.

There were several steps followed to assemble the complete data base. These included:

1. Definition of a comprehensive list of cost categories and subsets;
2. Development of a data collection guide form;

3. Submission of the data collection guide form to target systems for completion;
4. Checking of returned forms for completeness and/or misunderstandings;
5. Follow-up phone calls and, in several cases, site visits to fill in missing data and clarification of misunderstandings;
6. Entry of data into spreadsheet data base;
7. Return of spreadsheet to target systems for checking and verification; and
8. Editing and finalization of data base.

The development of the data collection guide was accomplished through a cooperative effort of industry professionals representing system operators, funding agencies, engineering and planning firms, and study professionals. The guide was important because it formalized the initial definition of asset components and established the minimum level of unit cost detail. Summary asset categories were included at appropriate subtotal levels to provide more comparative unit cost information, and accommodate systems with a more consolidated level of cost information. The data collection guide was then distributed to each of the candidate systems for completion. Continuous interaction between project staff and system operating staff was necessary to clarify the request; assist in the interpretation of special conditions; and adapt the original data base structure and component definitions to better fit the composition of the available cost information.

The data base file structure was constructed around the format of the data collection guide. As the data collection guides were returned, the cost information was entered into the data system for review and analysis. The data file was prepared in a Lotus 1-2-3 spreadsheet system for ease of

access in this project and later additions of other fixed guideway transit modes. A Lotus 1-2-3 add-in system Impress, was used to prepare the final data base and exhibit graphics for final publication.

Cost values were entered into the data base at the finest level of detail provided by each agency. Costs and quantities at the subsystem level were subtotaled into system level costs. Unit costs were calculated at each level of cost detail available. Unit costs were then updated into a constant 1990 dollar value using published construction cost indices. These 1990 dollar values were then normalized using nationwide cost indices to standardize the unit cost values from each city and form a more comparative cost basis.

The individual category unit costs were indexed to reach a consistent level of comparability. Individual unit costs were indexed in two separate ways. The first method involved inflating the costs to a consistent time basis. All costs were inflated to a Year 1990 base using the following formula and the historical cost indices published by *Means Construction Cost Data*.

$$\text{Cost in Year 1990} = \frac{\text{Index in 1990}}{\text{Index in Construction Year}} * \text{Construction Year Cost}$$

Means Construction Cost Indices are published annually by the R.S. Means Company, Inc. and are also available through the *Engineering News-Record*. City Cost Indices from the same 1990 *Means* report were then applied to the Year 1990 unit costs to normalize to a consistent nationwide comparative cost basis. The total weighted average construction cost indices were applied, representing all construction types and including both material and installation costs.

$$\text{Nationwide Average Unit Cost} = \text{Unit Cost in City A} * \frac{100}{\text{Cost Index for City A}}$$

The nationwide average cost basis of 100 represents the 30 major city cost average as of January 1, 1990. This provides the unit cost comparative basis for the fixed guideway capital cost categories. The cost index for each of the five light rail cities that were used in this study are the following values.

- Portland 99.0
- Sacramento 91.0
- San Jose 80.0
- Pittsburgh 99.4
- Los Angeles 87.6

These five light rail cities all have nationwide cost indices that are less than 100, which indicates that construction costs in those cities exceed the 30 major city cost average as of January 1990. This results in nationwide 1990 unit costs that are consistently lower than the city 1990 unit costs for the same capital cost category.

The data base in Appendix A - E includes all three of the basic costs: 1) actual cost; 2) 1990 costs for each city; and 3) 1990 by city normalized to the nationwide average. Costs presented in the body of the report are 1990 costs normalized to the nationwide comparative basis for each city.

METHOD OF APPLICATION

The estimation of capital costs in project planning is typically based on the definition of alignment conditions, capital asset requirements and unit cost measures of each asset category. The unique alignment conditions and their impact on unit capital costs should be represented by the cost ranges measured for each component. Therefore, development of the study data base concentrated on actual unit capital costs and quantities that should help guide the capital cost estimates under development for the current round of cities considering light rail transit systems.

Candidate Systems

This study concentrated on the actual construction and procurement costs of the light rail transit systems developed over the past few years. Of these seven systems, five were able to provide the type of actual capital cost information necessary for this project. A general description of these five systems, their size, type, complexity and operating characteristics are presented below. System developmental conditions and other unique local conditions and expectations should be carefully considered before drawing any conclusions about the relative costs and how they may be applied to other system plans.

Portland - - Regional public transportation is operated by the Tri-County Metropolitan Transportation District of Oregon (Tri-Met). Portland's light rail system was opened in September 1986 and was christened "MAX", for metropolitan area express. The 15-mile east-west alignment is mostly at-grade with some elevated sections along joint highway alignments. The line utilizes reserved rights-of-way in city streets, arterials and highway medians to connect the city of Gresham and other eastern suburbs with central Portland. Passenger access is through 25 at-grade stations that provide spacing of less than one mile and easy walk-on accessibility for most of the alignment length. Only 5 stations offer park-and-ride facilities, but almost all stations have coordinated bus

transfer facilities. A 26 vehicle articulated fleet operates the full service schedule requirement of 22 peak vehicles with the remaining 4 for scheduled maintenance.

Sacramento - - The Sacramento Light Rail Project became operational with the opening of the first phase in 1987. This first phase includes both the Northeast and Folsom Lines connected through downtown Sacramento. This phase is mostly composed of a single-track main line with double-track passing sections along about 40% of the length. The alignment utilizes unused freeway and abandoned railroad rights-of-way for most of its length. There are 101 grade crossings along this first phase development, indicating the limited investment in guideway elements. The downtown portion was constructed within city streets in both a dedicated transit mall and a mixed traffic operation. The design philosophy was a low-cost approach using off-the-shelf technology and at-grade construction to minimize total project capital costs. However, Sacramento did note a preference for double track designs for the existing and proposed lines, and a priority for the existing line conversion to double track. A total of 28 passenger stations are included in this phase, with seven suburban stations offering parking facilities, and six with bus transfer facilities.

San Jose - - The Guadalupe Corridor Project, opened in December 1987, connects the cities of San Jose and Santa Clara with the surrounding suburban areas. The initial phase of the light rail system consists of a 20-mile North Line that is mainly located along the median area of major roadways and along a transitway through downtown San Jose. The alignment is at-grade along the full length and includes very little in new structural requirements. Only one bridge and two overpasses in new guideway facilities were necessary to connect the full length of the alignment. Almost the entire line is double-tracked with only two small sections of single-track operation. There are presently 22 stations in operation with the planned expansion to 30 upon completion of the proposed full line length to the southern sections of San Jose. This South Line extension will add ten more miles of right-of-way to this light rail

system, but since construction was not completed at the time of this study and actual final construction costs were not available, this section was not included in our project. However, some of the original system elements and support facilities included in this study for the North Line were designed to include this additional South Line operational needs and corresponding cost impacts.

Pittsburgh - - The Port Authority of Allegheny County (PAT) has extensively rehabilitated the previous trolley car alignment and built new extensions to the South Hills Light Rail Line. The expanded service is referred to as Stage I and includes 12.5 miles of new alignment construction and 12 miles of complete right-of-way rehabilitation. The downtown Pittsburgh service is now operated in a 1.6 mile subway alignment, that is fully grade separated and free of traffic congestion-related delay. The suburban alignment includes sections of new trackage over previously unused rail right-of-way and rebuilt trackage and structure along the existing right-of-way. The availability of unused rail alignments provided some low-cost opportunities that contrast with the high-cost subway alignment in the downtown business district area. Transfer connections are provided to local bus services at nine suburban stations plus to regional and busway services at downtown stations. Service and passenger levels have increased when the new and rehabilitated services were implemented and continue to expand. A Stage II plan will next consider expansion of this light rail network into other high density travel areas.

Los Angeles - - The Metro Blue Line connects Long Beach with downtown Los Angeles along a 22.6-mile, mostly at-grade (approximately 80%), and dedicated alignment, that includes a subway section and connection to the Metro Red Line (currently under construction) in downtown Los Angeles. This line was constructed as the first part of a regional network of rail service, serving the entire Los Angeles area. Initial service was inaugurated in July, 1990 over almost the full length, and since February, 1991, into the tunnel connection in central Los Angeles. There are 28 highway, 4 pedestrian and two at-grade railroad

crossings that required warning and control systems. The full alignment is double-tracked except for the one-directional loop in downtown Long Beach. The Blue Line was designed as a modern and more state-of-the-art rail line including connections with other planned lines along its length. There are 22 stations with only 5 offering parking facilities. One station is underground with connections to the Red Line, three on elevated sections, and one combined aerial/at-grade station with a link to the planned Green Line. The service and ridership levels were anticipated at fairly high rates, which required sophisticated control and support systems for this light rail line.

These five light rail transit systems were able to supply actual capital cost information in the format necessary for this study data base. The cost information provided by each agency reflected the full construction and systems procurement costs for the assets described in these candidate descriptions and supported by the detail in the appended data base listings for each system.

Cost Elements

The development of the project data base utilized fairly standard asset component definitions and requested capital cost information at the system and subsystem level. These system and subsystem definitions formed the basis to the structure of the project cost information request. The completion of the information requests by each agency required some flexibility in the level of detail and category definitions of the original request, since unique conditions were encountered in the design, construction and procurement for every light rail system. The individual contracting mechanisms and work scope within each construction or procurement contract directly affected the level of cost detail available for this capital cost data base. For example, when construction bids were contracted for certain line sections, some contractors provided the component cost details for the individual subsystems, while others were not required and submitted only total cost proposals. Only through

extensive research were the operating agencies able to generate the actual cost details, including appropriate subsystem change orders.

The structure of the resulting study data base reflected a consistent format at the subsystem level of detail for every light rail line. The data base format was established under nine major cost categories:

- 0.00 System description;
- 1.00 Guideway elements;
- 2.00 Yards and shops;
- 3.00 System elements;
- 4.00 Stations;
- 5.00 Vehicles;
- 6.00 Special conditions;
- 7.00 Right-of-way; and
- 8.00 Project soft costs.

These eight cost elements were each divided into the related system and subsystems included within each cost category. Units of measure were defined at each of the cost levels from subsystem up to system and category costs. The majority of guideway and right-of-way unit costs were measured in terms of linear feet, while the systems unit costs were mainly measured in terms of each system component. Unit costs which are calculated on either a per mile or per linear foot of guideway basis are defined by overall guideway length, as opposed to track miles, since the actual subsystem cost information was not available by single track and double track sections. In other words, a one mile section of guideway was presented in a combined or average guideway type mile, whether it is a single track or a double track section. The guideway elements were segmented into the various alignment grades and track construction types.

System Description - - A general information section was included at the beginning of each project information request to summarize the overall characteristics of each light rail system. Areas covered in this section include network or line size, service levels and

staffing levels by general categories. The intention of this section was to gauge the system sizing and service level complexities to better understand some of the unit cost differences among the rail systems and the individual asset components. The size and service section quantifies the length and breadth of the line, stations, and auto access facilities; revenue vehicles available and scheduled for service at peak and midday time periods; and, frequency of peak and off-peak services. Staffing levels were also included to size the system manpower requirements by functional area of light rail operation.

Guideway Elements - - This asset category includes the alignment components of track and structural requirements along the entire right-of-way. Capital cost information was requested for each alignment grade and track construction technique. Generally, there are two types of track construction for passenger rail systems - - direct fixation and ballast base. These two main construction techniques were segmented further for mixed traffic track alignments such as embedded and in-pavement ballasted. The alignment grades included all relevant categories that represented significant cost impact such as:

- At-grade;
- Elevated structure;
- Elevated, retained fill;
- Elevated fill;
- Subway; and
- Retained cut.

The asset requirements and capital cost of most all guideway elements were covered by guideway types. Each of these guideway elements were measured in linear feet. Special trackwork and structures were treated separately and noted for each system. The unique construction and operating conditions posed by each system make this category the highest overall cost component of these light rail passenger systems.

Exhibit 1 presents the summary of guideway costs which represented on average, 33% of total project costs, exclusive of the planning/engineering/developmental type soft costs. This summary of actual guideway unit costs presents the number of data entries or observations for each guideway element, plus the minimum, mean, maximum, and range of unit cost values. The unit costs presented in this summary represent the constant dollar values in 1990 dollars, calculated from the original construction cost and year of construction, and then normalized to the nationwide comparative standard using the *Means* construction cost indices.

Guideway element costs in total, ranged from a minimum of \$428 per linear foot to a maximum of \$1,508 per linear foot. This leads to a wide cost range of over \$1,000, which illustrates the extensive cost variation from a mainly single track at-grade alignment to the more sophisticated, higher service volume systems that include mainly grade separated and some subway alignment. The mean or average guideway cost of \$1,016 per linear foot is pertinent if the planned alignment is not sufficiently defined to select one of the more specific unit cost values. The lowest cost guideway was the ballasted track type on an at-grade alignment, while the highest expense guideway was as expected, the direct fixation track type in a subway alignment. The unit cost details are also provided to summarize the individual unit cost information as calculated from the original actual costs submitted by each agency.

Yards and Shops - - Maintenance of the rail system components requires specialty shops for each major asset category. Unit costs were requested for each shop and particular system support function. In cases where system development was more complex, detailed cost information was available by shop; however, in some systems, yard and shop construction was contracted out as a "package" and cost information was only available at a summary level. The capital cost information request included fourteen yard and shop areas that encompassed the full range of system support needs. Flexibility was designed into the request to accommodate both detailed and summary level responses.

RANGE OF UNIT COSTS

EXHIBIT 1

	UNITS OF MEASURE	UNIT COST SUMMARY				RANGE
		COUNTS	MINIMUM	MEAN	MAXIMUM	
1.00 GUIDEWAY ELEMENTS	Linear Feet	5	\$428	\$1,016	\$1,508	\$1,079
1.01 GUIDEWAY AT-GRADE	Linear Feet	5	\$413	\$665	\$1,205	\$792
DIRECT FIXATION		1	\$696	\$696	\$696	\$0
BALLASTED		5	\$350	\$491	\$679	\$329
IN-PAVEMENT BALLASTED		2	\$526	\$1,557	\$2,588	\$2,062
EMBEDDED		4	\$583	\$1,452	\$3,131	\$3,131
1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	4	\$410	\$1,768	\$3,041	\$2,631
DIRECT FIXATION		3	\$410	\$1,233	\$2,756	\$2,346
BALLASTED		3	\$1,119	\$2,746	\$4,516	\$3,397
IN-PAVEMENT BALLASTED		2	\$506	\$1,936	\$3,365	\$2,859
EMBEDDED		2	\$847	\$1,009	\$1,172	\$325
1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	2	\$847	\$1,009	\$1,172	\$325
DIRECT FIXATION		2	\$847	\$1,009	\$1,172	\$325
BALLASTED		2	\$847	\$1,009	\$1,172	\$325
IN-PAVEMENT BALLASTED		2	\$847	\$1,009	\$1,172	\$325
EMBEDDED		2	\$847	\$1,009	\$1,172	\$325
1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	1	\$616	\$616	\$616	\$0
DIRECT FIXATION		1	\$616	\$616	\$616	\$0
BALLASTED		1	\$616	\$616	\$616	\$0
IN-PAVEMENT BALLASTED		1	\$616	\$616	\$616	\$0
EMBEDDED		1	\$616	\$616	\$616	\$0
1.05 GUIDEWAY - SUBWAY	Linear Feet	2	\$6,329	\$7,443	\$8,557	\$2,228
DIRECT FIXATION		2	\$6,329	\$13,530	\$20,730	\$2,228
BALLASTED		2	\$6,329	\$13,530	\$20,730	\$2,228
IN-PAVEMENT BALLASTED		1	\$4,730	\$4,730	\$4,730	(\$0)
EMBEDDED		1	\$506	\$506	\$506	\$0
1.06 GUIDEWAY - RETAINED CUT	Linear Feet	3	\$329	\$3,354	\$5,410	\$5,081
DIRECT FIXATION		2	\$329	\$2,870	\$5,410	\$5,081
BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
IN-PAVEMENT BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
EMBEDDED		2	\$329	\$2,870	\$5,410	\$5,081
1.07 POCKET TRACK	L.F. Guideway	2	\$2.81	\$34.11	\$65.41	\$62.61
1.08 STORAGE TRACK	L.F. Guideway	2	\$2.81	\$34.11	\$65.41	\$62.61
1.09 SPECIAL TRACKWORK	L.F. Guideway	4	\$15.71	\$25.02	\$35.32	\$19.60
1.10 GUIDEWAY-SPECIAL STRUCTURES	Linear Feet	1	\$4,389	\$4,389	\$4,389	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

Exhibit 2 presents the unit cost summary for yards and shops components. The overall total category costs varied significantly from a minimum of about \$4.1 million to a high of \$42.8 million. This extremely wide cost range demonstrates that there are many factors affecting the cost of light rail yards and shops. The extent of maintenance facility and shop equipment requirements are at least partially driven by system design, capacity and complexity decisions. However, even when the yard and shop costs were measured on a guideway length or revenue vehicle unit cost basis, there was only a minor direct cost relationship to either unit cost measure. This yards and shops component cost information should therefore, be carefully applied in any planning level capital cost efforts, since there appeared to be little direct cost relationship among the standard unit capacity measures. The more detailed line item information about the 14 individual shop categories did not provide any better unit cost support, since the breakout of the cost information was very inconsistent. Therefore, these individual shop costs should only be used as an indication of prior actual experience.

System Elements - - The system needs were clearly defined by asset component and within four general functional categories.

- Signal system;
- Electrification;
- Communications; and
- Fare collection.

Capital cost information was normally available for each functional category, since these components are typically procured and/or installed through separate contracts.

As demonstrated in Exhibit 3, systems costs are somewhat more predictable and related overall, to the linear feet of each system. Systems costs ranged from \$179 per linear foot to a maximum of \$878 per linear foot. This cost range is indicative of the level of systems sophistication

RANGE OF UNIT COSTS

EXHIBIT 2

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
2.00 YARDS & SHOPS	Total	5	\$4,086,783	\$23,862,435	\$42,837,570	\$38,750,787
2.01 BUILDING	Each	5	\$4,086,783	\$17,019,418	\$36,002,375	\$31,915,592
2.02 OFFICE FURNITURE & EQUIP.	All	1	\$252,440	\$252,440	\$252,440	\$0
2.03 HEAVY REPAIR		3	\$69,070	\$349,318	\$731,367	\$662,297
2.04 MOTOR SHOPS		2	\$11,512	\$27,032	\$42,553	\$31,042
2.05 WHEEL SHOP		3	\$25,532	\$614,629	\$1,040,170	\$1,014,638
2.06 MACHINE SHOP		2	\$236	\$118,112	\$235,988	\$235,752
2.07 AIR CONDITIONING	(Y/N)	1	\$2,419,865	\$2,419,865	\$2,419,865	\$0
2.08 ELECTRONICS	(Y/N)	3	\$230,233	\$1,052,600	\$1,645,400	\$1,415,167
2.09 COMMUNICATIONS	(Y/N)	2	\$6,907	\$572,302	\$1,137,698	\$1,130,791
2.10 CAR WASH/CAR CLEANING	(Y/N)	2	\$144,470	\$508,143	\$871,816	\$727,347
2.11 MAINTENANCE OF WAY SHOPS		4	\$66,700	\$1,633,059	\$5,314,598	\$5,247,898
2.12 MAINTENANCE OF WAY EQUIPMENT		2	\$27,261	\$41,900	\$56,539	\$29,278
2.13 REVENUE CENTER	Each	1	\$1,206,213	\$1,206,213	\$1,206,213	\$0
2.14 CENTRAL CONTROL	(Y/N)	1	\$10,159,345	\$10,159,345	\$10,159,345	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

RANGE OF UNIT COSTS

EXHIBIT 3

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
3.00 SYSTEMS	Linear Feet	5	\$179	\$482	\$878	\$699
3.01 SIGNAL SYSTEM	L.F. Guideway	5	\$54	\$198	\$443	\$388
3.02 ELECTRIFICATION	L.F. Guideway	5	\$92	\$241	\$448	\$356
3.03 COMMUNICATIONS	Total	4	\$196,121	\$7,477,427	\$17,348,680	\$17,152,559
3.04 FARE COLLECTION	Total	4	\$1,080,497	\$3,407,019	\$5,456,404	\$4,375,907

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

necessary to operate the different service levels. The systems with higher service levels were grouped at the higher unit cost range, while the other systems were mainly grouped in the lower unit cost range. The mean of systems unit costs therefore is not as pertinent as the two ends of the unit cost range.

Stations - - This asset category was fairly straight forward with the identification of components and definition of their individual characteristics. Stations were first designated by grade, and then by center and side platform locations. Unique station descriptors were included to identify special asset requirements and related cost impacts. These descriptors included platform length, escalator/elevator availability, disability access mode, and weather coverage. In addition, station access amenities were separately requested to define the cost impacts of such elements as parking areas and pedestrian overpasses.

The station unit cost summary is presented in Exhibit 4, where total station-related costs averaged about \$1.4 million per station overall. At-grade center platform stations were the least expensive with a minimum cost of \$180,000 for the most basic station design. The more complex of these at-grade stations reach almost \$1.0 million for center platforms, and almost \$2.0 million for side platform stations. Subway stations were as expected the most expensive ranging from almost \$7.0 million to \$25.2 million for the most extensive station. There were only three elevated stations constructed in the five study systems, which cost almost \$2.7 million,. In addition, parking lots averaged about \$1.1 million and a passenger overpass was constructed for \$900,000.

Vehicles - - Revenue and non-revenue vehicles were included in this asset category. Revenue vehicles were identified by separate vehicle orders to differentiate any component and cost impacts. Only one light rail system (Sacramento) had a second vehicle order included in this time period and capital cost data base. Unique vehicle characteristics and/or special componentry were noted to identify unit cost impacts of each vehicle order. These included the make and manufacturer; size and layout

RANGE OF UNIT COSTS

EXHIBIT 4

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
4.00 STATIONS	Each	5	\$180,861	\$1,431,936	\$3,205,143	\$3,024,282
4.01 AT-GRADE	Each	5	\$180,861	\$800,732	\$1,961,305	\$1,780,443
4.02 SUBWAY	Each	2	\$6,936,659	\$16,046,881	\$25,157,102	\$18,220,444
4.03 ELEVATED	Each	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
4.04 PARKING LOTS	Total	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
4.05 PARKING GARAGES	Total					
4.06 PEDESTRIAN OVERPASSES	Total	1	\$908,360	\$908,360	\$908,360	\$0

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

dimensions. Special components such as cab signaling, air conditioning, wheelchair lifts, and the particular farebox system were denoted when included in each vehicle order -- otherwise the farebox costs were included in the systems cost category. Non-revenue vehicles were included as a separate category for service trucks, support automobiles and any other necessary non-revenue equipment.

This asset category had the most consistent unit cost experience for all five light rail systems. Exhibit 5 provides the unit cost summary for the vehicle category. Light rail vehicles had unit costs ranging from a low of \$800,000 to a high of \$1,300,000. These vehicles were all articulated with the main differences in the individual vehicle capability and componentry. The lowest unit cost vehicle order represents the most basic design criteria and the more recent order from this same system was at a much greater cost at over \$1.25 million each. Therefore, the higher unit cost range may be more representative than the low or average vehicle cost values.

Non-revenue vehicle costs varied significantly because of the different operational philosophies. Some systems procured all necessary non-revenue vehicles and others only purchased the minimum amount and contracted for the other support services. The unit cost range reflects these two developmental approaches with a minimum unit cost of \$11,000 for mainly automotive support vehicles and a maximum of \$86,000 each for a support fleet that also includes more heavy trucks and other support vehicles.

Special Conditions -- Development of a light rail system involves some mitigating construction requirements that are not directly related to rail service, but necessary to construct each rail line. The capital costs of these items have been included in this special conditions category. The largest cost component is the relocation of existing utility lines from or within the rail corridor under construction. These costs have been separated by replacements in the same or similar condition and replacement with improved or different utility conditions that was

RANGE OF UNIT COSTS

EXHIBIT 5

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
5.00 VEHICLES	Each	5	\$968,562	\$1,159,567	\$1,345,218	\$376,657
5.01 REVENUE VEHICLES -- ORDER A	Each	5	\$806,202	\$1,119,800	\$1,314,877	\$508,676
5.02 REVENUE VEHICLES -- ORDER B	Each	1	\$1,255,800	\$1,255,800	\$1,255,800	\$0
5.03 REVENUE VEHICLES -- ORDER C	Each					
5.04 NON-REVENUE VEHICLES	Each	2	\$11,267	\$48,750	\$86,232	\$74,965

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

denoted in the data base as betterments. These replacement costs were listed by utility:

- Gas;
- Telephone;
- Electric;
- Water;
- Pipeline;
- Railroad; and
- Other.

An additional section for utility replacement costs was provided for any unusual or unforeseen circumstances. Three more of these special condition categories were also included for demolitions, roadway changes, and environmental mitigation costs.

These special conditions were measured overall on a linear foot basis to provide a reasonable unit measure for use in planning other light rail systems. Exhibit 6 presents the unit cost summary of special conditions encountered in the development of these light rail systems. The total and unit costs varied significantly for this cost category and should therefore, be carefully considered in cost estimation applications. On a unit cost basis special conditions costs varied from a minimum of \$81 to a maximum of \$1,263 per linear foot, with a mean value of \$337 per linear foot. The total values per system were also provided for each individual cost category. When initial information is available about the extent of special conditions expected for the project, the total costs from the individual cost categories may be most useful, while in the absence of specific special conditions, the overall unit costs may be more appropriate. The lower unit costs may be more appropriate in less dense urban areas and the higher unit costs in more densely developed and/or mature urban areas.

Right-Of-Way - - This capital cost category covered all land acquisition and acquisition-related costs. Land acquisition costs were requested for direct purchases and estimated value for any land donations

RANGE OF UNIT COSTS

EXHIBIT 6

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
6.00 SPECIAL CONDITIONS	Linear feet	5	\$81	\$337	\$1,263	\$1,182
6.01 UTILITY RELOCATION - AS IS	Total	5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
6.02 UTILITY RELOCATION - BETMTS.	Total	3	\$495,549	\$41,497,095	\$118,409,923	\$117,914,373
6.03 UTILITY RELOCATION - OTHER	Total					
6.04 DEMOLITIONS	Total	5	\$112,628	\$511,718	\$956,912	\$844,284
6.05 ROADWAY CHANGES	Total	2	\$2,220,974	\$7,086,721	\$11,952,468	\$9,731,494
6.06 ENVIRONMENTAL	Total	3	\$356,640	\$6,349,686	\$16,785,885	\$16,429,246

Note: Unit Capital Costs Normalized to the 30 City National Average In 1990 Dollars

or swaps. The related purchase costs for management, appraisal, and relocation expenses were also listed in this capital cost category. The original data was requested on an acreage basis by functional use -- mainline, stations, yards, and parking.

Similar to the special conditions, land costs are presented on a linear foot basis for the overall category costs and on a project total for the individual cost categories -- Exhibit 7. Overall right-of-way costs ranged from \$160 per linear foot to a high of \$600 per linear foot, with a mean of \$346. Land acquisition costs in total cost from \$15.5 million to as high as \$50.4 million. Land acquisition related costs followed a similar cost pattern ranging from \$800,000 to a high of \$4.1 million. Relocation costs were fairly small and only reported by three of the five systems.

Project Soft Costs - - This section included all other miscellaneous costs related to development of passenger rail services. The majority of these costs were expended in the planning, engineering, and project management efforts. These services included in-house agency staff and the use of consultants for particular tasks. Project start-up and initiation expenses were also included in this cost category. Project financing cost and an "other" expense line item which includes any reconciliations and unaccountable costs, comprise the full range of any project development capital costs.

Exhibit 8 highlights the unit cost summary of all project soft costs incurred in the development of these light rail systems. This capital cost category represents a fairly large expenditure commitment for light rail system development. The wide cost range is some indication of the relative complexity of each system and the extent of professional services necessary for system development. The cost measurement of in-house agency staff support may not be fully represented and possibly an indication of the cost variance among the individual categories and overall project soft costs. The other expense line item included some reconciliation account costs and some other unidentified expenses.

RANGE OF UNIT COSTS

EXHIBIT 7

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
7.00 RIGHT-OF-WAY	Linear Feet	5	\$160	\$346	\$600	\$440
7.01 LAND ACQUISITION - PURCHASED	Total	5	\$15,470,477	\$30,823,677	\$50,376,726	\$34,906,250
7.02 LAND ACQUISITION - DONATED	Total					
7.0 ACQUISITION-RELATED COST	Total	4	\$813,454	\$2,296,128	\$4,083,215	\$3,269,761
7.04 RELOCATION	Total	3	\$139,942	\$267,577	\$471,332	\$331,390
7.05 OTHER	Total					

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

RANGE OF UNIT COSTS

EXHIBIT 8

	UNITS OF MEASURE	UNIT COST SUMMARY				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
8.00 SOFT-COSTS	Linear Feet	5	\$359	\$1,491	\$3,068	\$2,708
8.01 FEASIBILITY STUDIES	Total	3	\$3,718,000	\$14,612,295	\$36,398,671	\$32,680,671
8.02 ENGINEERING & DESIGN	Total	3	\$16,009,645	\$48,230,137	\$68,801,392	\$52,791,747
8.03 CONSTRUCTION MANAGEMENT	Total	5	\$4,788,081	\$35,548,854	\$85,158,669	\$80,370,588
8.04 PROJECT MANAGEMENT	Total	5	\$2,173,544	\$14,678,448	\$22,938,149	\$20,764,605
8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$4,539,183	\$4,539,183	\$4,539,183	\$0
8.06 PROJECT INITIATION	Total	3	\$1,319,808	\$14,136,884	\$35,235,765	\$35,235,765
8.07 FINANCE CHARGES	Total	1	\$546,621	\$546,621	\$546,621	\$0
8.08 TRAINING/START-UP/TESTING	Total	4	\$3,543,743	\$6,480,866	\$9,803,185	\$6,259,441
8.09 OTHER	Total	2	(\$16,589,228)	\$40,319,705	\$97,228,639	\$113,817,867

Note: Unit Capital Costs Normalized to the 30 City National Average in 1990 Dollars

RESULTS

This section presents the capital cost results for each light rail system included in the capital cost data base. Capital cost summaries were prepared to present total project costs of each light rail system for each of the eight asset categories described previously. A pie chart of the proportional costs of each cost category was included to illustrate the overall developmental cost requirements. These project cost summaries are presented within this results section, while the details are included in the data base appendicies. Detailed data were provided for five light rail systems, including:

- Portland;
- Sacramento;
- San Jose;
- Pittsburgh; and
- Los Angeles.

The component costs are presented by specific system to provide a higher level of unit cost information. When project plans begin to focus on a defined developmental design, unit costs from a specific system may be more pertinent to the cost estimation process.

Exhibit 9 provides a summary of system characteristics to aid in understanding the system specific unit cost data (and variances) that follow. The projects vary from 15 to 23 miles in guideway length, averaging approximately 18-1/2 miles. They are substantially all double-track operations, with the exception of Sacramento, which is approximately 60% single-track and currently in the process of extending double-tracking to about 60%. Average station spacing varies from slightly over one-half mile to one mile. Exhibit 9 also displays a key characteristic that significantly affects unit costs (especially stations and guideway) -- Sacramento and Santa Clara are virtually totally at-grade systems while

Exhibit 9 Summary of Light Rail System Characteristics

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

at-grade mileage for Portland and Pittsburgh is only two-thirds of the alignment.

The balance of this section provides an overall summary of unit costs by major category, followed by more detailed comparisons of subsystem costs within each category. Appendices A - E include the full capital cost data base of statistics organized by system. Data are provided in both aggregate and detailed unit costs to be useful at various stages in a project's development from early system planning stages to engineering.

Summary Cost Overview

Exhibit 10 presents a summary of the percent of actual (unescalated) as built project costs by major category. Guideway construction is the largest category, averaging 40% of "in-ground" cost. Systems (e.g., signals, electrification, communications, fare collection) comprise the second largest category at almost 18%. Right-of-way averages 14.4% and, if combined with guideway costs, these two items total more than half the "in-ground" costs varying from a low of 36% in Los Angeles to a high of 67% in Portland.

Unit costs by similar categories are displayed in Exhibit 11 (escalated to 1990 dollars). As would be expected, the widest variations occur in the categories most dependent on local characteristics such as "special conditions" where the range is 358% of the average and "stations" which vary from elevated structures to on-street stops. Conversely, the smallest variation is in vehicle unit costs which averaged \$1.272 million with the range being only 37% of the average.

Guideway unit costs average \$5.782 million, with Sacramento and San Jose being at the low end due to virtually 100% at-grade construction. Pittsburgh, with 13% of its alignment in subway, has the highest average guideway unit cost.

Exhibit 10

Summary Costs and Percentages of "As Built" Project Costs By Category

(Current \$ millions)

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Guideway Elements	\$94.6	\$46.7	\$65.9	\$110.5	\$148.7	\$93.3
	57.9%	42.5%	35.0%	40.4%	25.4%	40.2%
Yards & Shops	\$11.6	\$4.0	\$21.3	\$38.2	\$44.2	\$23.9
	7.1%	3.6%	11.3%	14.0%	7.5%	8.7%
Systems	\$21.2	\$19.4	\$33.1	\$58.9	\$115.3	\$49.6
	13.0%	17.7%	17.6%	21.5%	19.7%	17.9%
Stations	\$15.1	\$10.3	\$4.9	\$34.3	\$65.9	\$26.1
	9.3%	9.3%	2.6%	12.5%	11.2%	9.0%
Special Conditions	\$5.8	\$12.2	\$8.5	\$10.0	\$152.3	\$37.8
	3.5%	11.1%	4.5%	3.7%	26.0%	9.7%
Right-of-Way	\$15.1	\$17.4	\$54.6	\$21.5	\$60.1	\$33.7
	9.2%	15.8%	29.0%	7.9%	10.2%	14.4%
Total "In-Ground" Costs	\$163.4	\$110.0	\$188.3	\$273.4	\$586.5	\$264.3
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Vehicles as Percent of "In-Ground" Costs	\$25.2	\$34.6	\$55.6	\$57.4	\$79.9	\$50.5
	15.4%	31.5%	29.5%	21.0%	13.6%	22.2%
Soft Costs as Percent of "In-Ground" Costs	\$58.3	\$36.2	\$136.4	\$224.8	\$210.8	\$133.3
	35.7%	32.9%	72.4%	82.2%	35.9%	51.8%

Exhibit 11

**Summary of System Unit Costs
1990 National Dollars in Millions**

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>	<u>Range</u>	<u>Percent Range of Average</u>
Cost Per Route Mile								
• Guldeway	\$7.0	\$2.3	\$3.6	\$8.0	\$6.0	\$5.4	\$5.7	106%
• Systems	1.6	0.9	1.7	4.2	4.6	2.6	3.7	141%
• Special Conditions	0.4	0.6	0.5	0.7	6.7	1.8	6.2	351%
• Right-of-Way	1.1	0.8	3.2	1.6	2.4	1.8	2.3	127%
Yards & Shops Costs Per Shop Capacity	0.1	0.1	0.4	NR	0.7	0.3	0.7	198%
Station Costs Per Station	0.7	0.4	0.2	3.2	3.3	1.6	3.1	202%
Vehicle Costs Per Vehicle	1.3	1.0	1.0	1.2	1.3	1.2	0.4	33%
Total Project Cost Per Route Mile	18.6	8.9	21.5	40.1	36.6	25.1	31.2	124%
Project Cost Per Route Mile Less Vehicles and Soft Costs	\$7.5	\$5.3	\$10.4	\$19.8	\$24.1	\$13.4	\$18.8	140%

Percent of System At-Grade 65% 96% 99% 66% 81%

Total project cost per route mile averaged \$27.5 million with a range from \$9.746 million to \$41.748 million. Reasons for these variations are more evident from the sub-category data presented in the following sections.

System Cost Summaries

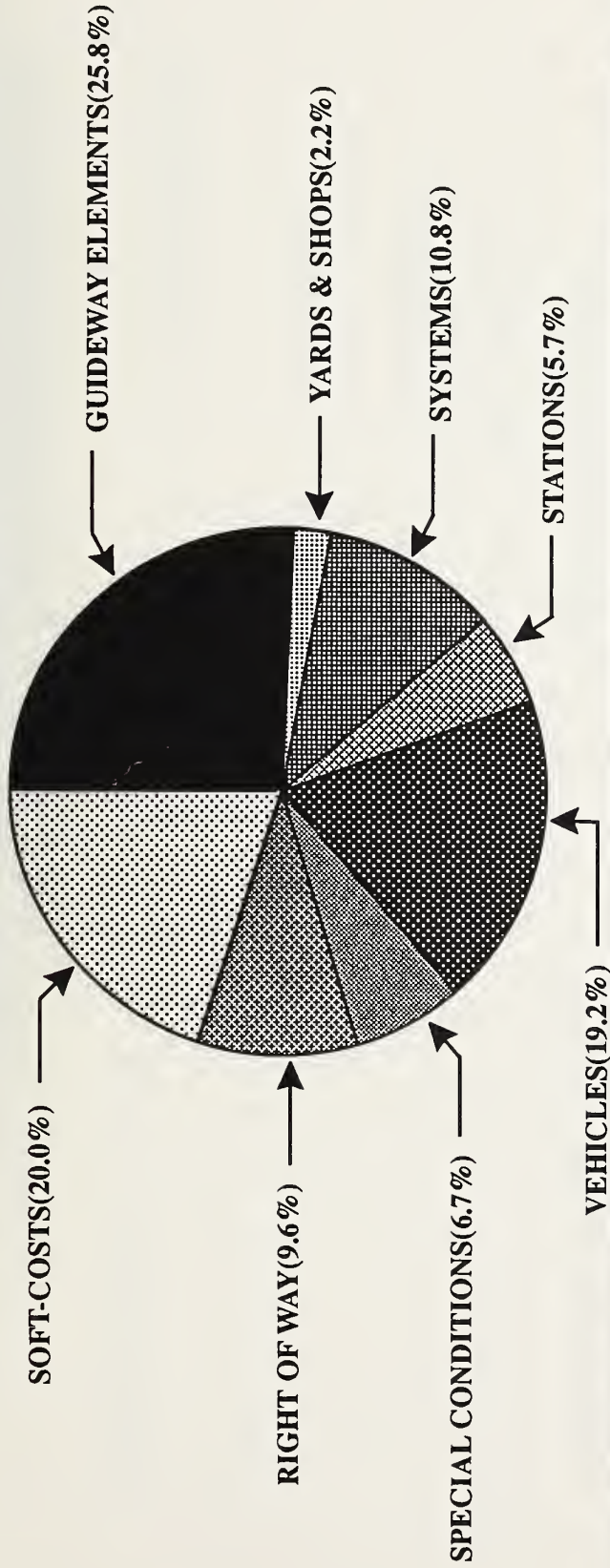
Prior to examining comparative unit costs in detail, it is helpful to review actual systems' cost by category to understand some of the underlying differences in design philosophy and local conditions. Exhibits 12 through 16 display total actual cost for each system in the three types of developmental costs. The "as built" system costs are based on the actual costs expended in the development of each project, and are measured in year-of-expenditure dollars. The city costs represent the inflation of the "as built" costs to a constant 1990 dollar value from each of the individual component procurement years. The national costs then normalize the category costs to account for construction costs of each major metropolitan area. It is evident that costs vary significantly. A few of the reasons for variations include:

- *Portland* is a double-track system with approximately one-third of the guideway elevated, resulting in higher guideway and station costs -- Exhibit 12. Portland represented a mid-range design approach that included some passenger amenities and the operational facilities necessary for a consistent service at a peak headway of 7.5 minutes. The at-grade downtown Portland sections helped to maintain guideway costs in the lower range, however the elevated sections introduced some of the higher range unit guideway costs. The "as built" cost proportions were about average except for the higher guideway and station cost categories.

- *Sacramento* is the lowest cost project of the responding systems -- Exhibit 13. This low cost reflects a philosophy of design simplicity using at-grade construction and single track operation as much as possible. A simplified design approach to stations and yards and shops costs also reflect this design philosophy. The capital costs of the recent and ongoing system upgrades to increase the proportion of double track and the additional turnouts necessary to increase operational consistency were not included in this cost summary of the original project. Vehicle costs and special conditions were the proportionately higher "as built" cost categories while the lower categories were yards and shops and soft costs for Sacramento in comparison to the other systems.

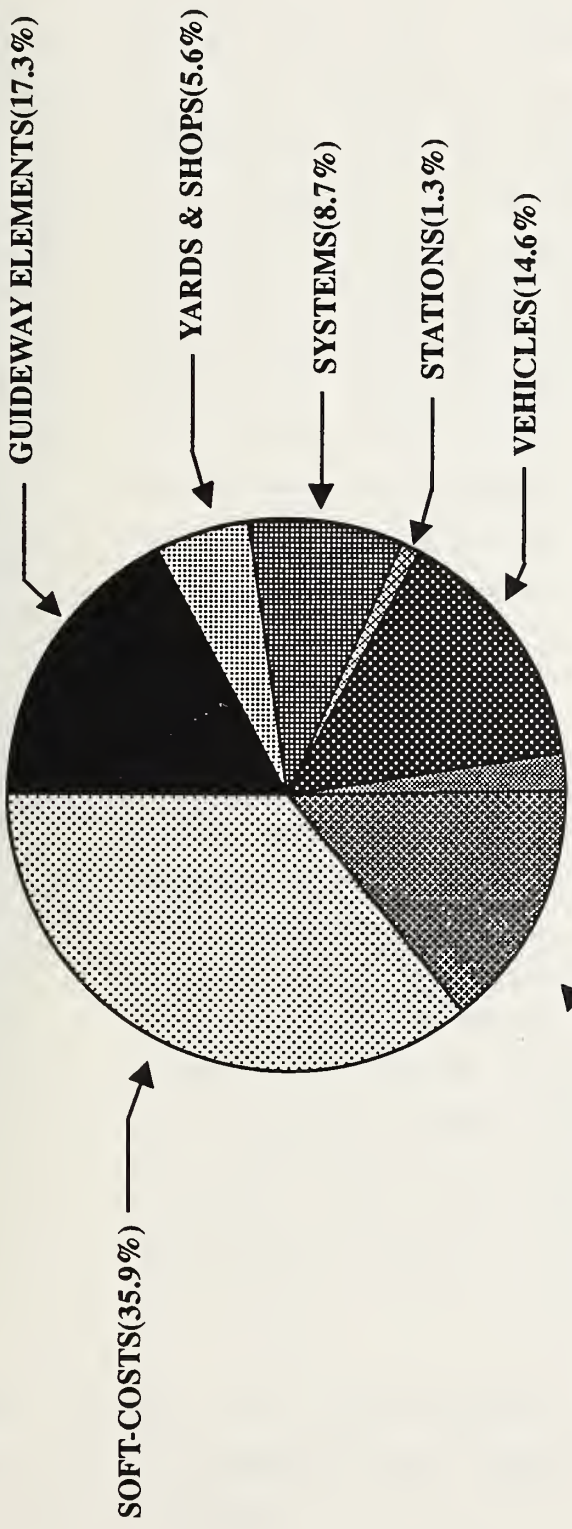
- *San Jose*, Exhibit 14, is the initial line of a planned larger light rail system which includes some higher unit costs and additional facilities that relate to the expanded system base, such as yards and shops and other systems capacity. These particular component unit costs would be more representative of the unit capital costs and asset requirements encountered by larger systems with an individual line under development. Elsewhere, this line's unit costs were maintained to about average for the five light rail lines in the data base, since almost the entire line length is at-grade. The 99% at-grade alignment held guideway and station costs below the average. This San Jose line was proportionately slightly high for right-of-way and project soft costs, and low on guideway and station cost proportions.

**EXHIBIT 13
SACRAMENTO REGIONAL TRANSIT DISTRICT
CAPITAL COSTS BY PROJECT CATEGORY**



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS		\$46,678,400	\$52,721,856	\$47,908,608
2.00 YARDS & SHOPS	2.2%	\$3,979,000	\$4,490,971	\$4,086,783
3.00 SYSTEMS	10.8%	\$19,448,037	\$22,051,392	\$20,036,544
4.00 STATIONS	5.7%	\$10,270,000	\$11,591,412	\$10,548,188
5.00 VEHICLES	19.2%	\$34,600,000	\$38,316,708	\$34,868,232
6.00 SPECIAL CONDITIONS	6.7%	\$12,153,425	\$13,768,128	\$12,536,832
7.00 RIGHT OF WAY	9.6%	\$17,408,000	\$19,700,736	\$17,909,760
TOTAL HARD COSTS	80.0%	\$144,536,862	\$162,641,203	\$147,894,947
8.00 SOFT-COSTS	20.0%	\$36,119,000	\$44,214,720	\$40,185,024
TOTAL PROJECT COST	100.0%	\$180,655,862	\$206,855,923	\$188,079,971

EXHIBIT 14
SANTA CLARA COUNTY TRANSPORTATION AGENCY
COSTS BY PROJECT CATEGORY



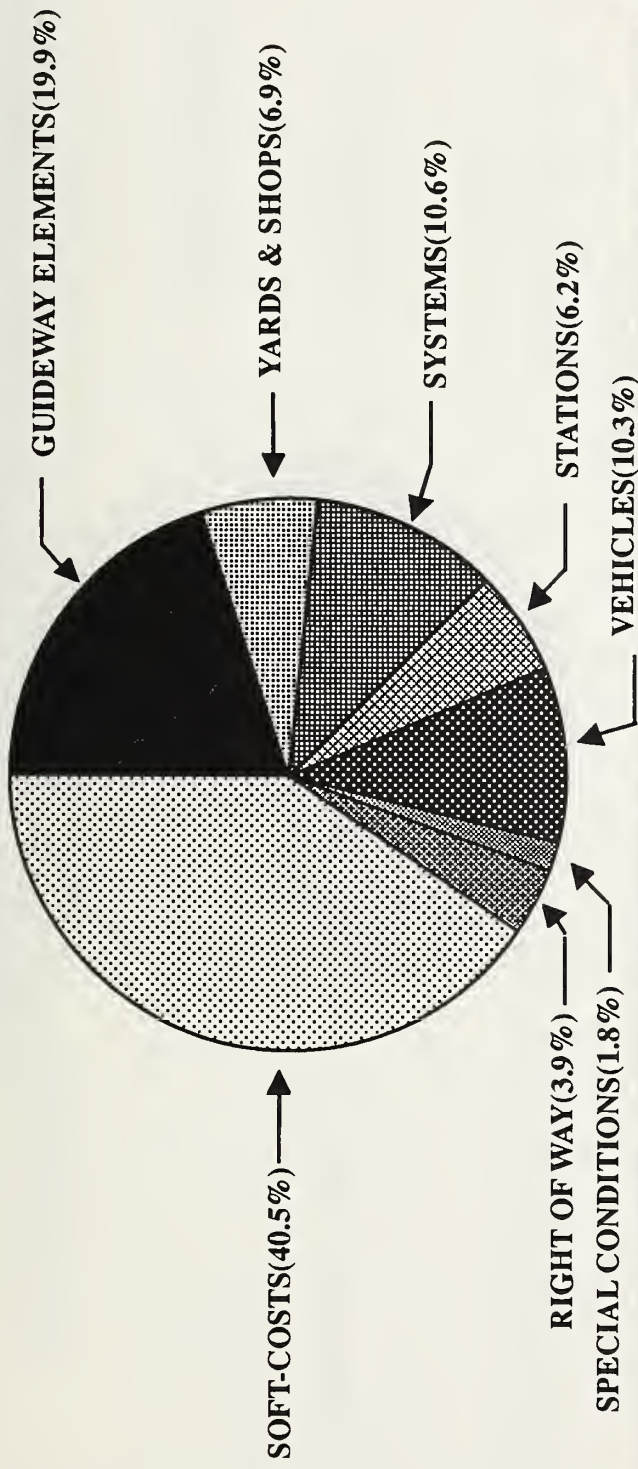
	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	17.3%	\$65,887,000	\$70,078,704	\$56,095,864
2.00 YARDS & SHOPS	5.6%	\$21,291,136	\$23,578,224	\$18,862,579
3.00 SYSTEMS	8.7%	\$33,124,742	\$33,158,400	\$26,505,600
4.00 STATIONS	1.3%	\$4,914,000	\$4,973,694	\$3,978,942
5.00 VEHICLES	14.6%	\$55,611,000	\$64,663,950	\$51,731,150
6.00 SPECIAL CONDITIONS	2.2%	\$8,487,000	\$9,376,728	\$7,484,932
7.00 RIGHT OF WAY	14.4%	\$54,617,000	\$61,606,748	\$49,351,200
TOTAL HARD COSTS	64.1%	\$243,931,878	\$267,436,448	\$214,010,267
8.00 SOFT-COSTS	35.9%	\$136,417,000	\$151,096,924	\$120,828,188
TOTAL PROJECT COST	100.0%	\$380,348,878	\$418,533,372	\$334,838,455

- *Pittsburgh* is a reconstruction and expansion of an existing line with commensurately lower costs for right-of-way and special conditions -- Exhibit 15. These unit costs are representative of the capital costs necessary to rehabilitate an existing light rail line or system. On the other hand, 13% of the line was placed in a new subway alignment, raising overall guideway costs, but also providing a good basis to estimate future subway costs, particularly the highest unit costs for the section through bedrock in downtown Pittsburgh. This subway section also offers cost information for the construction of subway stations through similar grade and high activity construction locations. Proportionately, Pittsburgh was high in soft costs, mainly due to a single line item of \$91 million in other costs.
- *Los Angeles*, is the first in a series of new lines for the region and the entire systems/support facilities were designed to integrate into the total network. The double-track guideway includes elevated and subway sections with provision for connections into the other portions of the regional rail network. This line also provides subway or tunnel construction costs that averaged about the same as Pittsburgh's overall. Exhibit 16 presents the "as built", city and national costs by category with relatively low guideway costs and high special conditions on a proportionate basis.

These "as built", city, and national costs by component category form the basis for the comparative unit cost analysis using the normalized national unit cost calculations.

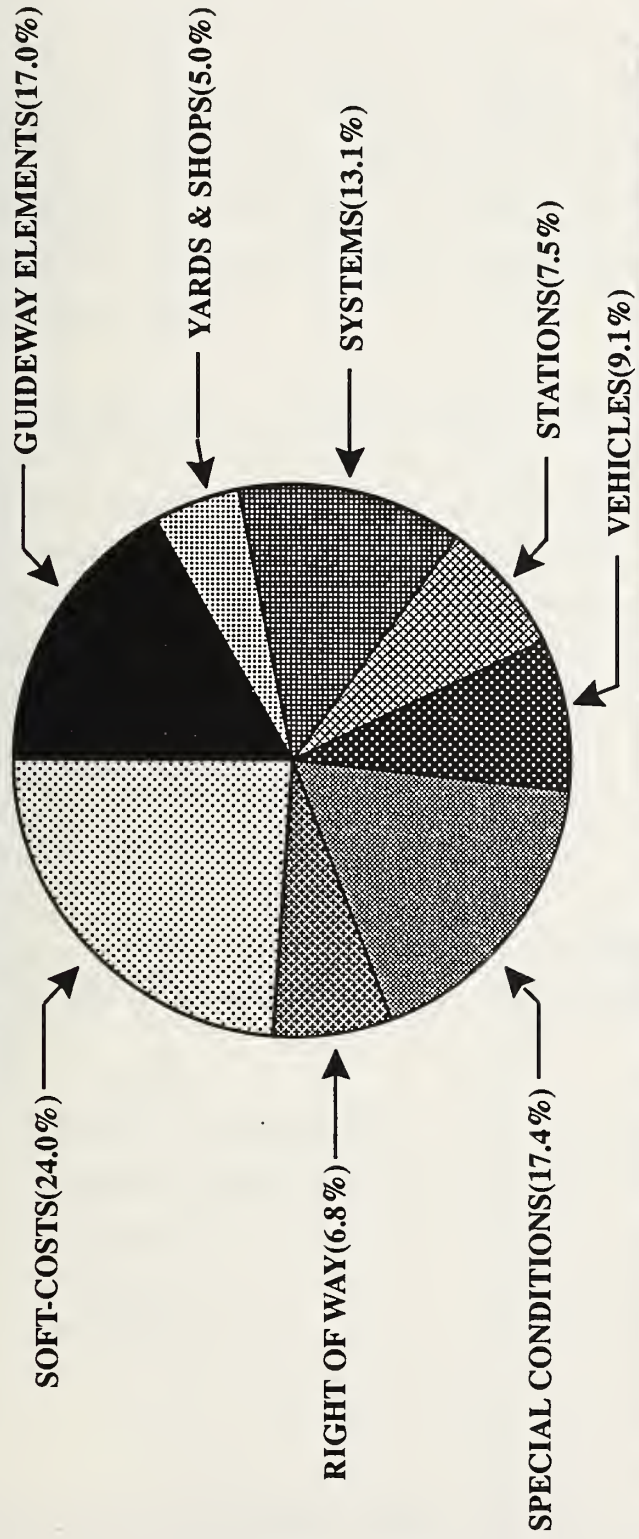
EXHIBIT 15

**PORT AUTHORITY OF ALLEGHENY COUNTY
COSTS BY PROJECT CATEGORY**



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	19.9%	\$110,472,428	\$125,786,606	\$123,954,584
2.00 YARDS & SHOPS	6.9%	\$38,183,186	\$43,096,147	\$42,837,570
3.00 SYSTEMS	10.6%	\$58,885,157	\$66,498,182	\$66,087,192
4.00 STATIONS	6.2%	\$34,282,779	\$38,693,880	\$38,461,716
5.00 VEHICLES	10.3%	\$57,399,440	\$64,784,940	\$64,396,200
6.00 SPECIAL CONDITIONS	1.8%	\$10,038,972	\$11,425,522	\$11,343,324
7.00 RIGHT OF WAY	3.9%	\$21,511,920	\$24,988,192	\$24,823,796
TOTAL HARD COSTS	59.6%	\$330,773,882	\$375,273,469	\$371,904,382
8.00 SOFT-COSTS	40.5%	\$224,751,180	\$253,663,028	\$252,183,464
TOTAL PROJECT COST	100.0%	\$555,525,062	\$628,936,497	\$624,087,846

**EXHIBIT 16
LOS ANGELES COUNTY TRANSPORTATION COMMISSION
CAPITAL COSTS BY PROJECT CATEGORY**



	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	17.0%	\$148,719,104	\$154,232,919	\$135,147,639
2.00 YARDS & SHOPS	5.0%	\$44,204,740	\$45,855,539	\$40,169,453
3.00 SYSTEMS	13.1%	\$115,273,245	\$119,520,564	\$104,729,596
4.00 STATIONS	7.5%	\$65,893,479	\$68,354,242	\$59,878,302
5.00 VEHICLES	9.1%	\$79,939,129	\$82,924,398	\$72,641,772
6.00 SPECIAL CONDITIONS	17.4%	\$152,349,392	\$172,004,644	\$150,653,166
7.00 RIGHT OF WAY	6.8%	\$60,084,803	\$62,384,486	\$54,631,156
TOTAL HARD COSTS	74.8%	\$666,463,892	\$705,276,792	\$617,851,084
8.00 SOFT-COSTS	24.0%	\$210,805,963	\$237,967,590	\$208,385,654
TOTAL PROJECT COST	100.0%	\$877,269,855	\$943,244,382	\$826,236,738

Comparative Unit Costs

Exhibits 17 through 23 show detailed comparative unit costs by component system. These exhibits cover each cost category except vehicles, which were displayed previously in Exhibit 11. The cost information is presented in 1990 national dollars which represents the individual component costs normalized to the 30 city nationwide construction index.

Guideway Cost per linear foot (Exhibit 17) varies considerably by system as previously mentioned, and also by grade as would be expected. The data base includes each of the major types of guideway construction. The average unit costs correspond with expected industry costs standards, except where at-grade guideway was slightly higher in cost than the elevated fill. The reason behind this was the rehabilitation of extensive elevated fill in Pittsburgh compared to new at-grade alignment costs elsewhere. For example:

<u>Type of Construction</u>	<u>Average Cost Per Linear Foot</u>	<u>Average Cost Per Guideway Mile</u>
At-Grade	\$665	\$3.51 M
Elevated Structure	\$1,768	\$9.34 M
Elevated Retained Fill	\$994	\$5.25 M
Elevated Fill	\$658	\$3.47 M
Subway	\$7,001	\$36.97 M
Retained Cut	\$3,319	\$17.52 M

Within grade categories, there are also variations in track laying methods. For example, the least expensive method for at-grade track is simple

Exhibit 17

Guideway Costs Per Linear Foot 1990 National Dollars

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles	Average
At-Grade Avg.	\$1,205	\$413	\$609	\$460	\$636	\$685
Direct Fixation	--	--	--	696	--	696
Ballasted	679	350	610	375	442	491
In-Pavement Ballasted	--	526	--	--	2,588	1,557
Embedded	3,713	--	606	583	906	1,452
Elevated Structure Avg.	3,041	410	--	636	2,986	1,768
Direct Fixation	--	410	--	535	2,756	1,233
Ballasted	2,602	--	--	1,119	4,516	2,746
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	3,365	--	--	506	--	1,935
Elevated Retained Fill Avg.	--	1,077	--	961	943	999
Direct Fixation	--	--	--	--	--	--
Ballasted	1,172	--	--	--	847	1,010
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	--	--	--	--	--	--
Elevated Fill Avg.	--	--	--	699	616	658
Direct Fixation	--	--	--	--	--	--
Ballasted	--	--	--	--	616	616
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	--	--	--	--	--	--
Subway Avg.	--	--	6,887	7,182	6,935	7,001
Direct Fixation	--	--	--	20,730	6,329	13,529
Ballasted	--	--	--	--	--	--
In-Pavement Ballasted	--	--	--	4,730	--	4,730
Embedded	--	--	--	506	--	506
Retained Cut	--	4,973	265	4,904	3,133	3,319
Direct Fixation	--	--	--	--	4,322	4,322
Ballasted	5,410	--	--	329	--	2,870
In-Pavement Ballasted	--	--	--	--	--	--
Embedded	--	--	--	--	--	--
Special Track Work Per Linear Foot of Guideway	\$33	\$15	\$17	NR	\$35	\$25

ballasted guideway and it is clear from the data that this method is used wherever possible -- two-thirds of the 392,000 linear feet of at-grade track in the sample was ballasted. This is also true for elevated track where 64% of the 57,000 linear feet in the sample was ballasted (combining all forms of elevated guideway). Combining the entire sample of 475,847 linear feet yields the following breakdown of construction methods:

<u>Type of Trackwork</u>	<u>Linear Feet</u>	<u>Percent</u>
Ballasted	305,022	64.1%
In-Pavement Ballasted	43,490	9.1%
Direct Fixation	28,912	6.1%
Embedded	<u>98,423</u>	<u>20.7%</u>
Total	475,847	100.0%

Exhibit 17 also presents comparative unit costs for special trackwork such as turnouts and crossovers which average \$25.00 per linear foot of guideway.

Yards and Shops Cost and comparative features are provided in Exhibit 18. Both cost per facility and cost per unit of shop capacity vary by a factor of almost 10. Some of this variation is explained by facility features (e.g., Sacramento does not incorporate heavy repair, motor or car wash/cleaning shops). There is also variation because some yards and shops were designed to accommodate future system expansions (e.g., Los Angeles). Variations also exist for local cost of construction. For example, even when "national average" construction indices were applied to Los Angeles and Pittsburgh costs, they were still significantly higher than the other three systems. Further unit cost and component details are provided

Exhibit 18
Summary Yards and Shops Costs and Features
1990 National Dollars

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Yards & Shops Per Facility	\$13.36M	\$4.09M	\$18.86M	\$42.84M	\$40.17M	\$23.86M
Cost per Shop Capacity	\$133,558	\$81,735	\$362,402	\$441,624	\$743,879	\$352,640
Heavy Repair	Y	N	Y	NR	Y	
Motor Shops	N	N	Y	NR	NR	
Wheel Shop	Y	Y	Y	NR	Y	
Machine Shop	Y	Y	Y	NR	NR	
Air Conditioning	NR	Y	Y	NR	NR	
Electronics	Y	Y	Y	NR	Y	
Communications	Y	Y	Y	NR	NR	
Car Wash/Cleaning	Y	N	Y	NR	Y	
Maintenance-of-Way Shops	Y	Y	NR	Y	NR	
Maintenance-of-Way Equipment	Y	Y	NR	NR	Y	
Revenue Center	NR	N	NR	Y	NR	
Control Center	NR	N	NR	NR	Y	

for every system and cost category in the data base sheets in Appendices A - E.

Systems Costs ranges vary by more than 100% of the average for every component category (Exhibit 19). Several of the categories vary because of operating complexities and designs for future expansion (e.g., communications costs in Los Angeles). The method of fare collection varies from on-board fareboxes to self-service impacting fare collection hardware costs. This category is also affected by single-track operation. For example, electrification costs per linear foot of guideway in Sacramento is \$92 compared to an average for the other four systems of \$259 per linear foot of guideway.

Station Cost is shown in Exhibit 20 which highlights the wide variation of designs from fairly simple "on-street" stops to major buildings. Of the 109 stations in the sample, over 90% are at-grade and three-quarters of the total are side platforms. At-grade costs range from a low of \$156,000 per station for a center platform to a high of \$1,924,000 for a side platform station. The other station cost categories are limited and provide mainly cost examples.

Special Condition Costs are driven by particular local situations (Exhibit 21). Utility relocations are the largest category and most typically include gas, telephone, electric and water. All systems incurred some "demolitions" costs, but the balance of the costs are very site-specific. On average, these systems cost \$353 per linear foot of guideway, but a consistent grouping was formed by four of the systems with an average of \$125.50 per linear foot.

Right-of-Way and Related Costs averaged \$412.76 per linear foot of guideway, with 90% of this category involving land acquisition (Exhibit 22). As would be expected, this group of costs are very location-sensitive, with the range being 70% of the average.

Exhibit 19

**Summary Systems Costs
1990 National Dollars**

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Signal System per Linear Foot of Guideway	\$105	\$76	\$54	\$322	\$310	\$173
Electrification per Linear Foot of Guideway	\$148	\$92	\$142	\$369	\$377	\$225
Total Communications Cost	NR	\$196,121	\$2,348,358	\$10,016,547	\$17,348,680	\$7,477,427
Total Fare Collection Equipment Cost	\$3,631,126	\$1,080,497	\$3,460,050	NR	\$5,456,404	\$3,407,019
Total Systems Cost per Linear Foot of Guideway	\$297	\$179	\$251	\$804	\$878	\$482



Exhibit 20

Summary Stations Costs and Features
1990 National Dollars in Thousands

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Number/ Average</u>
At-Grade						
Center Platform						
• Number	5	0	3	0	15	23
• Cost per Station	\$492	\$0	\$156	\$0	\$981	\$543
Side Platform						
• Number	20	28	19	9	3	79
• Cost per Station	\$539	\$377	\$185	\$1,924	\$830	\$771
Elevated						
Center Platform						
• Number	0	0	0	0	3	3
• Cost per Station	\$0	\$0	\$0	\$0	\$2,661	\$2,661
Side Platform						
• Number	0	0	0	0	0	0
• Cost per Station	\$0	\$0	\$0	\$0	\$0	\$0
Subway						
Center Platform						
• Number	0	0	0	0	0	0
• Cost per Station	\$0	\$0	\$0	\$0	\$0	\$0
Side Platform						
• Number	0	0	0	3	1	4
• Cost per Station	\$0	\$0	\$0	\$6,806	\$25,157	\$15,982
Parking Lots						
	5	8	NR	NR	5	
Parking Spaces						
	1,636	3,850	NR	NR	1,051	
Cost per Space	\$2	NR	NR	NR	\$7	\$5

Exhibit 21
Summary of Special Conditions Costs
1990 National Dollars in Thousands
All Costs Per Linear Foot of Guideway

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Utility Relocation Total	\$79.46	\$44.51	\$142.69	\$55.52	\$21.16	
• New Installation	\$0.00	\$3.55	\$54.76	\$0.00	\$0.00	
• Gas	\$0.00	\$0.00	\$1.70	\$7.95	\$3.29	
• Telephone	\$0.00	\$0.41	\$0.25	\$3.42	\$1.49	
• Electric	\$13.84	\$23.63	\$1.70	\$40.46	\$0.43	
• Water	\$65.62	\$0.00	\$3.80	\$3.70	\$1.08	
• Pipeline	\$0.00	\$11.29	\$0.00	\$0.00	\$8.34	
• Railroad	\$0.00	\$5.24	\$0.00	\$0.00	\$0.00	
• Other	\$0.00	\$0.39	\$0.47	\$0.00	\$6.53	
Utility Betterments Total	\$0.00	\$4.42	\$0.00	\$67.97	\$992.98	
• New Installation	\$0.00	\$4.42	\$0.00	\$7.71	\$0.00	
• Gas	\$0.00	\$0.00	\$0.00	\$9.14	\$38.45	
• Telephone	\$0.00	\$0.00	\$0.00	\$10.57	\$16.51	
• Electric	\$0.00	\$0.00	\$0.00	\$39.32	\$176.70	
• Water	\$0.00	\$0.00	\$0.00	\$0.00	\$51.14	
• Pipeline	\$0.00	\$0.00	\$0.00	\$0.00	\$227.02	
• Railroad	\$0.00	\$0.00	\$0.00	\$0.00	\$467.62	
• Other	\$0.00	\$0.00	\$0.00	\$1.22	\$15.55	
Demolitions	\$1.41	\$3.06	\$5.52	\$10.51	\$8.02	
Roadway Changes	\$0.00	\$59.52	\$0.00	\$0.00	\$100.21	
Environmental	\$0.00	\$0.00	\$23.18	\$4.33	\$140.72	
Total All Special Conditions	\$80.86	\$111.51	\$171.38	\$138.33	\$1,263.10	\$353.04

Exhibit 22
Summary of Right-of-Way and Related Costs
1990 National Dollars

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Cost per Linear Foot of Guideway						
• Land	\$192.95	\$152.46	\$563.41	\$302.48	\$422.34	\$326.73
• Legal & Consulting	\$33.99	\$4.41	\$10.14	NR	\$16.89	\$16.36
• Appraisal	\$33.99	\$2.78	\$10.14	NR	\$0.31	\$11.80
• Property Management	\$3.67	\$0.08	\$10.14	NR	\$17.13	\$7.76
• Relocation	\$2.39	NR	\$5.73	NR	\$1.17	\$3.10
• Total	\$266.98	\$159.73	\$599.57	NR	\$457.83	\$405.71
Land Cost per Acre	\$108.94	NR	\$302.89	NR	NR	--

Project Soft Costs are shown in Exhibit 23. Approximately half of these costs are in the construction/project management category, with almost 40% in the feasibility/engineering and design studies. Several projects were carried out prior to the requirement for project management oversight and show no cost in this category.

Exhibit 23
Summary of Project Soft Costs
1990 National Dollars
All Costs Per Linear Foot of Guideway

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
Feasibility/Engineering and and Design Studies	\$246.04	\$199.41	\$442.53	\$728.47	\$576.79	\$438.65
Construction/Project Management	\$422.36	\$124.39	\$887.26	\$355.65	\$906.23	\$539.18
Project Management Oversight			\$15.73		\$38.05	
Project Initiation	\$73.02	\$11.79			\$295.75	
• Insurance			\$75.58			
• Mobilization			\$5.40			
• Maintenance of Traffic						
Finance Charges		\$4.89				
Training/Start-Up/Testing	\$99.21	\$41.29	\$43.16		\$82.19	\$66.46
Total Soft Costs	\$840.64	\$381.77	\$1,469.58	\$1,084.13	\$1,899.01	\$1,135.02

**APPENDIX:
CAPITAL COST DATA BASE**

PORTLAND

Summary of Light Rail System Characteristics

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
• Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
LINEAR FEET	QUANTITY		UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
1.00	GUIDEWAY ELEMENTS	Linear Feet	80,179	\$1,180	\$94,599,637		\$1,329	
1.01	GUIDEWAY AT-GRADE	Linear Feet	52,212	\$1,070	\$55,869,000		\$1,205	
	DIRECT FIXATION							
	BALLASTED		42,949	\$590	\$25,327,000		\$679	
	IN-PAVEMENT BALLASTED							
	EMBEDDED		9,263	\$3,297	\$30,542,000		\$3,714	
1.02	GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	4,032	\$2,700	\$10,886,000		\$3,041	
	DIRECT FIXATION							
	BALLASTED		1,713	\$2,310	\$3,957,000		\$2,602	
	IN-PAVEMENT BALLASTED							
	EMBEDDED		2,319	\$2,988	\$6,929,000		\$3,365	
1.03	GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	23,665	\$1,018	\$24,089,000		\$1,172	
	DIRECT FIXATION							
	BALLASTED		23,665	\$1,018	\$24,089,000		\$1,172	
	IN-PAVEMENT BALLASTED							
	EMBEDDED							
1.04	GUIDEWAY - ELEVATED FILL	Linear Feet						
	DIRECT FIXATION							
	BALLASTED							
	IN-PAVEMENT BALLASTED							
	EMBEDDED							
1.05	GUIDEWAY - SUBWAY	Linear Feet						
	DIRECT FIXATION							
	BALLASTED							
	IN-PAVEMENT BALLASTED							
	EMBEDDED							
1.06	GUIDEWAY - RETAINED CUT	Linear Feet	270	\$4,804	\$1,297,000		\$5,410	
	DIRECT FIXATION							
	BALLASTED		270	\$4,804	\$1,297,000		\$5,410	
	IN-PAVEMENT BALLASTED							
	EMBEDDED							
1.07	POCKET TRACK	L.F. Guideway	80,179	\$2.49	\$200,000		\$2.81	
1.08	STORAGE TRACK	L.F. Guideway	80,179	\$28.17	\$2,258,637		\$32.43	
1.09	SPECIAL TRACKWORK	L.F. Guideway	80,179	\$28.17	\$2,258,637		\$32.43	
	TURNOUTS	Each						
	#5		58	\$21,163	\$1,227,445		\$24,362	
	#4		31	\$18,458	\$572,198		\$22,145	
	#6		7	\$19,237	\$134,659		\$22,369	
	#8		17	\$21,551	\$366,367		\$24,809	
	#10							

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
QUANTITY	UNIT COST		TOTAL COST	COMPONENT COST	YEAR			
1.00 GUIDEWAY ELEMENTS (continued)								
41	#20							
42	OTHER - SPECIFY		\$51,407	\$154,221	1983	\$59,776	\$59,178	
43	GIRDER,25 METER		\$51,560	\$1,031,192	1982	\$63,108	\$62,477	
44	GIRDER,50 METER		\$112,546		1982			
45	#4, GIRDER		\$46,804		1982			
46	#8 SINGLE CROSSOVER		\$49,741		1982			
47	#4,DOUBLE CROSSOVER							
48	#5,DOUBLE CROSSOVER							
49	INTERSECTION							
50	1.10 GUIDEWAY-SPECIAL STRUCTURES							
51	BRIDGES	Linear Feet						
52	OVERPASSES	Each						
53	OTHER	Each						
54								
2.00 YARDS & SHOPS								
55	2.01 BUILDING							
56	DESCRIPTION	Total	\$11,602,000	\$11,602,000	1983	\$13,490,698	\$13,355,791	
57	SHOP CAPACITY *	Each	\$9,201,000	\$9,201,000	1983	\$10,698,837	\$10,591,849	
58	YARD STORAGE CAPACITY	Revenue Vehicles	\$116,020		1983	\$134,907	\$133,538	
59	WORKSTATIONS	Revenue Vehicles						
60	TRACK LENGTH	Each						
61	PARKING	Linear Feet						
62		Spaces						
63	2.02 OFFICE FURNITURE & EQUIP.							
64	2.03 HEAVY REPAIR	All	\$60,000	\$60,000	1983	\$69,767	\$69,070	
65	BODY	(Y/N)						
66	TRUCK	(Y/N)						
67	EQUIPMENT	(Y/N)						
68	2.04 MOTOR SHOPS							
69	VARIABLE TEST LOAD	(Y/N)	\$10,000	\$10,000	1983	\$11,628	\$11,512	
70	REWIND	(Y/N)						
71	OTHER	(Y/N)						
72	2.05 WHEEL SHOP							
73	WHEEL PRESS	Each	\$676,000	\$676,000	1983	\$786,047	\$778,186	
74	WHEEL TRUING	Each						
75	2.06 MACHINE SHOP							
76	LATHE	Each	\$205,000	\$205,000	1983	\$238,372	\$235,989	
77	DRILL PRESS	Each						
78	2.07 AIR CONDITIONING							
79	2.08 ELECTRONICS	(Y/N)	\$200,000	\$200,000	1983	\$232,558	\$230,233	

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
QUANTITY	UNIT COST		TOTAL COST	COMPONENT COST	YEAR			
80	2.00 YARDS & SHOPS (continued)							
81	2.09 COMMUNICATIONS	(Y/N)	60	\$6,000	\$360,000	\$6,977	\$6,907	
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	1	\$137,000	\$137,000	\$159,302	\$157,709	
83	2.11 MAINTENANCE OF WAY SHOPS	(Y/N)						
84	SIGNAL	(Y/N)			\$137,000			
85	TRACTION POWER	(Y/N)						
86	COMPONENT REPAIR	(Y/N)						
87	TRACK	(Y/N)						
88	2.12 MAINTENANCE OF WAY EQUIPMENT		15	\$50,200	\$753,000	\$57,110	\$56,539	
89	TRUCK	Each	10	\$51,900	\$519,000			
90	CRANE	Each	1	\$54,000	\$54,000			
91	OTHER	Each	4	\$45,000	\$180,000			
92	2.13 REVENUE CENTER	Each						
93	CASH COUNTING MACHINE							
94	VAULT							
95	OTHER							
96	2.14 CENTRAL CONTROL	(Y/N)						
97	MIMIC BOARD	(Y/N)						
98	PUBLIC ADDRESS	(Y/N)						
99	COMPUTER	(Y/N)						
100	FIRE/INTRUSION DETECTOR	(Y/N)						
101	MAINLINE CONTROL	(Y/N)						
102	YARD CONTROL	(Y/N)						
103	SEISMIC OR GAS DETECTION	(Y/N)						
104	OTHER							
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity							
106	3.00 SYSTEMS		80,179	\$264.00	\$21,167,000	\$300	\$297	
107	3.01 SIGNAL SYSTEM	L.F. Guideway	80,179	\$92.99	\$7,456,000	\$106	\$105	
108	TRAIN CONTROL - WAYSIDE		80,179	\$85.52	\$6,857,000	\$97	\$96	
109	INSTALLATION		80,179	\$85.52	\$6,857,000			
110	HARDWARE							
111	DESIGN							
112	CROSSING PROTECTION	Each	21	\$28,524	\$599,000	\$32,450	\$32,126	
113	TRAFFIC SIGNALS	Each	21	\$28,524	\$599,000	\$32,450	\$32,126	
114	INSTALLATION							
115	GATES	Each						
116	OTHER							
117	3.02 ELECTRIFICATION	L.F. Guideway	80,179	\$130.79	\$10,487,000	\$149	\$147	
118	SUBSTATIONS	Each	15	\$236,667	\$3,550,000	\$269,245	\$266,553	

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

L'MTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
UNITS OF MEASURE	QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
3.00 SYSTEMS (continued)							
119 PURCHASE	15	\$220,000		\$3,300,000	1984		
120 INSTALLATION				\$250,000			\$97.44
121 CATENARY	80,179	\$86.52	\$6,937,000		1984	\$98	
122 INSTALLATION	80,179	\$6.24		\$500,000	1984		
123 POLES AND COMPONENTS	1,000	\$6,000		\$6,000,000	1984	\$6,826	\$6,758
124 WIRE	330,000	\$1.32		\$437,000	1984	\$1.51	\$1.49
125 TROLLEY	330,000	\$1.32		\$437,000	1984		
126 MESSENGER							
127 FEEDER							
128 RETURN							
129							
130							
131 3.03 COMMUNICATIONS							
132 3.04 FARE COLLECTION	1	\$3,224,000	\$3,224,000		1984	\$3,667,804	\$3,631,126
133 FAREBOX							
134 VENDING MACHINE	68	\$35,632		\$2,423,000	1984		
135 OTHER	88	\$9,102		\$801,000	1984		
4.00 STATIONS							
136 4.01 AT-GRADE	25	\$604,280	\$15,107,000		1985	\$682,032	\$675,211
137 CENTER PLATFORM	25	\$473,400	\$11,835,000		1985	\$534,312	\$528,968
138 PLATFORM LENGTH	5	\$440,200	\$2,201,000	\$2,000,000	1985	\$496,840	\$491,871
139 ESCALATOR/ELEVATOR	1,000	\$80,000					
140 HANDICAP ACCESS MODE	0/3						
141 WEATHER COVERAGE	WAYSIDE LIFT	\$40,200		\$201,000	1985		
142 SIDE PLATFORM	20	\$481,700	\$9,634,000		1985	\$543,679	\$538,243
143 PLATFORM LENGTH	8,000	\$1,104		\$8,831,000			
144 ESCALATOR/ELEVATOR							
145 HANDICAP ACCESS MODE							
146 WEATHER COVERAGE	WAYSIDE LIFT	\$40,150		\$803,000	1985		
147							
148 4.02 SUBWAY							
149 CENTER PLATFORM							
150 PLATFORM LENGTH							
151 ESCALATOR/ELEVATOR							
152 HANDICAP ACCESS MODE							
153 WEATHER COVERAGE							
154 SIDE PLATFORM							
155 PLATFORM LENGTH							
156 ESCALATOR/ELEVATOR							
157 HANDICAP ACCESS MODE							
WEATHER COVERAGE							

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	
158	4.00 STATIONS (Continued)						
159	4.03 ELEVATED	Each					
160	CENTER PLATFORM	Each					
161	PLATFORM LENGTH	Linear Feet					
162	ESCALATOR/ELEVATOR	(Y/N)					
163	HANDICAP ACCESS MODE	Type					
164	WEATHER COVERAGE	Percent					
165	SIDE PLATFORM	Each					
166	PLATFORM LENGTH	Linear Feet					
167	ESCALATOR/ELEVATOR	(Y/N)					
168	HANDICAP ACCESS MODE	Type					
169	WEATHER COVERAGE	Percent					
170	4.04 PARKING LOTS	Total	5	\$654,400	\$3,272,000	1985	\$731,214
171	NUMBER OF LOTS		5	\$654,400			
172	NUMBER OF SPACES			\$2,000		1985	
173	4.05 PARKING GARAGES	Total					
174	NUMBER OF LOTS		1,636		\$3,272,000		
175	NUMBER OF SPACES						
176	4.06 PEDESTRIAN OVERPASSES	Total					
177	5.00 VEHICLES	Each	26	\$969,923	\$25,218,000	1981	\$1,278,594
178	5.01 REVENUE VEHICLES -- ORDER A	Each	26	\$965,269	\$25,097,000	1981	\$1,272,459
179	MAKE/MANUFACTURER	Name	BOMBARDIER	\$883,000		1981	\$1,164,008
180	BODY TYPE (RIGID,ARTIC)	Type	ARTIC				
181	LENGTH OVER COUPLERS	Linear Feet	89				
182	WIDTH	Linear Feet	8.7				
183	NUMBER SEATS	Each	76				
184	AIR CONDITIONING	(Y/N)	N				
185	CAB SIGNAL EQUIPMENT	(Y/N)	N				
186	BRAKING SYSTEM (AIR,ELEC)	Type	HYDRAULIC				
187	TYPE OF STEPS (HIGHLOW)	Type	HIGH				
188	HANDICAPED (LIFT,RAMP)	Type	WAYSIDE LIFT				
189	ON-BOARD FAREBOX	(Y/N)	N				
190	PROCUREMENT COST	Total	26	\$34,615		1981	\$46,092
191	SPARE PARTS	Total	26	\$47,654		1981	\$63,454
192	SPECIAL EQUIPMENT COST	Total	26		\$900,000		\$45,631
193	5.02 REVENUE VEHICLES -- ORDER B	Each	26	\$1,239,000			\$62,819
194	MAKE/MANUFACTURER	Name					
195	BODY TYPE (RIGID,ARTIC)	Type					
196	LENGTH OVER COUPLERS	Linear Feet					

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
6.00 SPECIAL CONDITIONS (continued)								
236	RAILROAD							
237	OTHER							
238		Total						
6.02 UTILITY RELOCATION - BETTERMENTS								
239	NEW INSTALLATION							
240	GAS							
241	TELEPHONE							
242	ELECTRIC							
243	WATER							
244	PIPELINE							
245	RAILROAD							
246	OTHER							
247		Total						
6.03 UTILITY RELOCATION - OTHER								
248	NEW INSTALLATION							
249	GAS							
250	TELEPHONE							
251	ELECTRIC							
252	WATER							
253	PIPELINE							
254	RAILROAD							
255	OTHER							
256		Total	1	\$100,000	\$100,000		\$112,628	
257	BUILDINGS		6	\$16,667				
258	REMOVALS				\$100,000	1984		
259		Total						
6.04 DEMOLITIONS								
260								
6.05 ROADWAY CHANGES								
261	BRIDGES							
262	STREETS							
263	OTHER							
264		Total						
6.06 ENVIRONMENTAL								
265	NOISE							
266	VISUAL							
267	VIBRATION							
268	OTHER							
7.00 RIGHT-OF-WAY								
7.01 LAND ACQUISITION - PURCHASED								
269	MAINLINE	Linear Feet	80,179	\$188	\$15,070,000	1984	\$212	
270	STATION	Total	1	\$13,439,000	\$13,439,000	1983	\$15,470,477	
271	YARD	Acres	100	\$90,560	\$9,056,000			
272	PARKING	Acres	10	\$100,000	\$1,000,000			
273		Acres	12	\$103,333	\$1,240,000			
274		Acres	20	\$107,150	\$2,143,000			

CAPITAL COST DATA BASE

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$1,473,000	\$1,473,000	\$1,802,938	\$1,784,908	
282	LEGAL & CONSULTING		1			1982		
283	APPRAISAL		1		\$615,000	1982		
284	PROPERTY MANAGEMENT		1		\$615,000	1982		
285	7.04 RELOCATION	Total	1	\$158,000	\$158,000	\$193,390	\$191,457	
286	BUSINESS		1	\$79,000		1982		
287	RESIDENCE		1	\$79,000		1982		
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	80,179	\$727	\$58,278,000	\$820	\$812	
290	8.01 FEASIBILITY STUDIES	Total	1	\$2,535,000	\$2,535,000	\$3,755,556	\$3,718,000	
291	8.02 ENGINEERING & DESIGN	Total	1	\$13,212,000	\$13,212,000	\$16,171,359	\$16,009,645	
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$17,000,000	\$17,000,000	\$19,340,159	\$19,146,758	
293	8.04 PROJECT MANAGEMENT	Total	1	\$13,172,000	\$13,172,000	\$14,866,817	\$14,718,149	
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total						
295	8.06 PROJECT INITIATION	Total	1	\$5,240,000	\$5,240,000	\$5,914,221	\$5,855,079	
296	INSURANCE		1	\$5,240,000		\$5,914,221	\$5,855,079	
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES							
300	8.08 TRAINING/START-UP/TESTING	Total	1	\$7,119,000	\$7,119,000	\$8,034,989	\$7,954,639	
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER							

SACRAMENTO

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
1.00 GUIDEWAY ELEMENTS	1.01 GUIDEWAY AT-GRADE		QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
1	DIRECT FIXATION	Linear Feet	111,936	\$417	\$46,678,400		1985	\$428
2	BALLASTED	Linear Feet	106,920	\$402	\$42,966,000		1985	\$413
3	IN-PAVEMENT BALLASTED							
4	EMBEDDED		68,904	\$341		\$23,489,000	1985	\$350
5	DIRECT FIXATION		38,016	\$512		\$19,477,000	1985	\$526
6	BALLASTED							
7	IN-PAVEMENT BALLASTED	Linear Feet	5,016	\$399	\$2,000,000		1985	\$410
8	EMBEDDED		5,016	\$399		\$2,000,000	1985	\$410
9	DIRECT FIXATION							
10	BALLASTED							
11	IN-PAVEMENT BALLASTED							
12	EMBEDDED							
13	DIRECT FIXATION	Linear Feet						
14	BALLASTED							
15	IN-PAVEMENT BALLASTED							
16	EMBEDDED							
17	DIRECT FIXATION	Linear Feet						
18	BALLASTED							
19	IN-PAVEMENT BALLASTED							
20	EMBEDDED							
21	DIRECT FIXATION	Linear Feet						
22	BALLASTED							
23	IN-PAVEMENT BALLASTED							
24	EMBEDDED							
25	DIRECT FIXATION	Linear Feet						
26	BALLASTED							
27	IN-PAVEMENT BALLASTED							
28	EMBEDDED							
29	DIRECT FIXATION	Linear Feet						
30	BALLASTED							
31	IN-PAVEMENT BALLASTED							
32	EMBEDDED							
33	DIRECT FIXATION	L.F. Guideway	111,936	\$15.30	\$1,712,400		1985	\$15.71
34	BALLASTED	L.F. Guideway	25	\$34,248		\$856,200	1985	\$35,176
35	IN-PAVEMENT BALLASTED	L.F. Guideway						
36	EMBEDDED	Each						
37	DIRECT FIXATION							
38	BALLASTED							
39	IN-PAVEMENT BALLASTED							
40	EMBEDDED							
1.07	POCKET TRACK							
1.08	STORAGE TRACK							
1.09	SPECIAL TRACKWORK							
	TURNOUTS							
	#5							
	#4							
	#6							
	#8							
	#10							

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT			1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
				QUANTITY	UNIT COST	TOTAL COST		
		1.00 GUIDEWAY ELEMENTS (continued)						
41		#20		8	\$43,900		\$351,200	1985
42		OTHER - SPECIFY						
43		GIRDER,25 METER						
44		GIRDER,50 METER						
45		#4, GIRDER						
46		#8 SINGLE CROSSOVER						
47		#4,DOUBLE CROSSOVER						
48		#5,DOUBLE CROSSOVER						
49		INTERSECTION						
50		1.10 GUIDEWAY-SPECIAL STRUCTURES				N.R.		
51		BRIDGES	Linear Feet	1				
52		OVERPASSES	Each	2				
53		OTHER	Each					
54								
		2.00 YARDS & SHOPS						
55		2.01 BUILDING	Total	1	\$3,979,000	\$3,979,000	\$3,979,000	1985
56		DESCRIPTION	Each	1	\$3,979,000	\$3,979,000	\$3,979,000	1985
57		SHOP CAPACITY *	Revenue Vehicles	50	\$79,580		\$3,979,000	1985
58		YARD STORAGE CAPACITY	Revenue Vehicles	26				
59		WORKSTATIONS	Each	3				
60		TRACK LENGTH	Linear Feet	2,080				
61		PARKING	Spaces					
62		2.02 OFFICE FURNITURE & EQUIP.	All	76				
63		2.03 HEAVY REPAIR						
64		BODY	(Y/N)	N				
65		TRUCK	(Y/N)	N				
66		EQUIPMENT	(Y/N)	N				
67		2.04 MOTOR SHOPS						
68		VARIABLE TEST LOAD	(Y/N)	N				
69		REWIND	(Y/N)	N				
70		OTHER	(Y/N)	N				
71		2.05 WHEEL SHOP		2				
72		WHEEL PRESS	Each	1				
73		WHEEL TRUING	Each	1				
74		2.06 MACHINE SHOP		10				
75		LATHIE	Each	4				
76		DRILL PRESS	Each	6				
77		2.07 AIR CONDITIONING	(Y/N)	Y				
78		2.08 ELECTRONICS	(Y/N)	Y				
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CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT			1990 NATIONAL UNIT COST ESTIMATES				
			QUANTITY	UNIT COST	TOTAL COST		COMPONENT COST	YEAR	1990 CITY UNIT COST ESTIMATES	
80	2.00 YARDS & SHOPS (continued)									
81	2.09 COMMUNICATIONS	(Y/N)	Y							
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	N							
83	2.11 MAINTENANCE OF WAY SHOPS	(Y/N)	0							
84	SIGNAL	(Y/N)	Y							
85	TRACTION POWER	(Y/N)	Y							
86	COMPONENT REPAIR	(Y/N)	Y							
87	TRACK	(Y/N)	Y							
88	2.12 MAINTENANCE OF WAY EQUIPMENT		14							
89	TRUCK	Each	8							
90	CRANE	Each	1							
91	OTHER	Each	5							
92	2.13 REVENUE CENTER	Each	0							
93	CASH COUNTING MACHINE									
94	VAULT									
95	OTHER									
96	2.14 CENTRAL CONTROL	(Y/N)	0							
97	MIMIC BOARD	(Y/N)	N							
98	PUBLIC ADDRESS	(Y/N)	N							
99	COMPUTER	(Y/N)	N							
100	FIRE/INTRUSION DETECTOR	(Y/N)	Y							
101	MAINLINE CONTROL	(Y/N)	Y							
102	YARD CONTROL	(Y/N)	Y							
103	SEISMIC OR GAS DETECTION	(Y/N)	N							
104	OTHER	(Y/N)	N							
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity									
106	3.00 SYSTEMS		111,936	\$174.33	\$19,514,037				\$179	
107	3.01 SIGNAL SYSTEM	Linear Feet	111,936	\$73.58	\$8,236,632				\$76	
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway	111,936	\$61.67		\$6,903,484		1985	\$63	
109	INSTALLATION					\$311,989		1985		
110	HARDWARE									
111	DESIGN									
112	CROSSING PROTECTION	Each	90	\$14,813		\$6,591,495		1985	\$15,214	
113	TRAFFIC SIGNALS	Each	90	\$14,369		\$1,333,148		1985	\$14,758	
114	INSTALLATION					\$1,293,217		1985		
115	GATES					\$39,931		1985		
116	OTHER									
117	3.02 ELECTRIFICATION	L.F. Guideway	111,936	\$89.64	\$10,034,456				\$92	
118	SUITATIONS	Each	14	\$346,886		\$4,856,409		1985	\$356,283	

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 NATIONAL UNIT COST ESTIMATES	
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		YEAR
119	3.00 SYSTEMS (continued)							
120	PURCHASE	Each						
121	INSTALLATION	Each						
122	CATENARY	L.F. Guideway	111,936	\$46.26		\$3,618,472	1985	\$52.21
123	INSTALLATION	Each				\$1,237,937		
124	POLES AND COMPONENTS	Each	1,000	\$1,520		\$5,178,047	1985	\$1,716
125	WIRE	Each	438,000	\$2.70		\$2,475,877	1985	\$3.05
126	TROLLEY		194,000			\$1,520,025		
127	MESSENGER		142,000			\$1,182,145		
128	FEEDER		102,000					
129	RETURN							
130	3.03 COMMUNICATIONS	Total	1	\$190,949	\$190,949		1985	\$215,518
131	3.04 FARE COLLECTION	Total	1	\$1,052,000	\$1,052,000	\$66,000	1985	\$1,187,359
132	FAREBOX							
133	VENDING MACHINE							
134	OTHER					\$986,000		
135	4.00 STATIONS							
136	4.01 AT-GRADE	Each	28	\$366,786	\$10,270,000		1985	\$413,979
137	CENTER PLATFORM	Each	28	\$366,786	\$10,270,000		1985	\$413,979
138	PLATFORM LENGTH	Linear Feet						
139	ESCALATOR/ELEVATOR	(Y/N)						
140	HANDICAP ACCESS MODE	Type						
141	WEATHER COVERAGE	Percent						
142	SIDE PLATFORM	Each	28	\$366,786		\$10,270,000	1985	
143	PLATFORM LENGTH	Linear Feet	400					
144	ESCALATOR/ELEVATOR	(Y/N)	N					
145	HANDICAP ACCESS MODE	Type	Ramp					
146	WEATHER COVERAGE	Percent						
147	4.02 SUBWAY	Each						
148	CENTER PLATFORM	Each						
149	PLATFORM LENGTH	Linear Feet						
150	ESCALATOR/ELEVATOR	(Y/N)						
151	HANDICAP ACCESS MODE	Type						
152	WEATHER COVERAGE	Percent						
153	SIDE PLATFORM	Each						
154	PLATFORM LENGTH	Linear Feet						
155	ESCALATOR/ELEVATOR	(Y/N)						
156	HANDICAP ACCESS MODE	Type						
157	WEATHER COVERAGE	Percent						

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT			1990 NATIONAL UNIT COST ESTIMATES			
			QUANTITY	UNIT COST	TOTAL COST		COMPONENT COST	YEAR	1990 CITY UNIT COST ESTIMATES
158	4.00 STATIONS (continued)								
159	4.03 ELEVATED	Each							
160	CENTER PLATFORM	Each							
161	PLATFORM LENGTH	Linear Feet							
162	ESCALATOR/ELEVATOR	(Y/N)							
163	HANDICAP ACCESS MODE	Type							
164	WEATHER COVERAGE	Percent							
165	SIDE PLATFORM	Each							
166	PLATFORM LENGTH	Linear Feet							
167	ESCALATOR/ELEVATOR	(Y/N)							
168	HANDICAP ACCESS MODE	Type							
169	WEATHER COVERAGE	Percent							
170	4.04 PARKING LOTS	Total			N.R.				
171	NUMBER OF LOTS		8						
172	NUMBER OF SPACES		3,850						
173	4.05 PARKING GARAGES	Total							
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	Total							
177	5.00 VEHICLES								
178	5.01 REVENUE VEHICLES -- ORDER A	Each	36	\$961,111	\$34,600,000			1986	\$1,064,353
179	MAKE/MANUFACTURER	Each	26	\$800,000	\$20,800,000		\$20,800,000	1986	\$885,936
180	BODY TYPE (RIGID,ARTIC)	Name				Siemens/Duewag			
181	LENGTH OVER COUPLERS	Type				Artic			
182	WIDTH	Linear Feet				79.50			
183	NUMBER SEATS	Linear Feet				8.75			
184	AIR CONDITIONING	Each							
185	CAB SIGNAL EQUIPMENT	(Y/N)				Y			
186	BRAKING SYSTEM (AIR,ELEC)	(Y/N)				N			
187	TYPE OF STEPS (HIGH,LOW)	Type				Spring/Elec			
188	HANDICAPED (LIFT,RAMP)	Type				Low			
189	ON-BOARD FAREBOX	Type				Ramp			
190	PROCUREMENT COST	(Y/N)				N			
191	SPARE PARTS	Total							
192	SPECIAL EQUIPMENT COST	Total							
193	5.02 REVENUE VEHICLES -- ORDER B	Total	10	\$1,380,000	\$13,800,000			1990	\$1,380,000
194	MAKE/MANUFACTURER	Each							
195	BODY TYPE (RIGID,ARTIC)	Name							
196	LENGTH OVER COUPLERS	Type							
		Linear Feet							

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
5.00 VEHICLES (continued)								
197	WIDTH	Linear Feet						
198	NUMBER SEATS	Each						
199	AIR CONDITIONING	(Y/N)						
200	CAB SIGNAL EQUIPMENT	(Y/N)						
201	BRAKING SYSTEM (AIR,ELEC)	Type						
202	TYPE OF STEPS (HIGH,LOW)	Type						
203	HANDICAPED (LIFT,RAMP)	Type						
204	ON-BOARD FAREBOX	(Y/N)						
205	PROCUREMENT COST	Total						
206	SPARE PARTS	Total						
207	SPECIAL EQUIPMENT COST	Total						
208	5.03 REVENUE VEHICLES - ORDER C	Each						
209	MAKE/MANUFACTURER	Name						
210	BODY TYPE (RIGID,ARTIC)	Type						
211	LENGTH OVER COUPLERS	Linear Feet						
212	WIDTH	Linear Feet						
213	NUMBER SEATS	Each						
214	AIR CONDITIONING	(Y/N)						
215	CAB SIGNAL EQUIPMENT	(Y/N)						
216	BRAKING SYSTEM (AIR,ELEC)	Type						
217	TYPE OF STEPS (HIGH,LOW)	Type						
218	HANDICAPED (LIFT,RAMP)	Type						
219	ON-BOARD FAREBOX	(Y/N)						
220	PROCUREMENT COST	Total						
221	SPARE PARTS	Total						
222	SPECIAL EQUIPMENT COST	Total						
223	5.04 NON-REVENUE VEHICLES	Each						
224	SERVICE TRUCKS							
225	AUTOMOBILES							
226	OTHER							
227								
228	6.00 SPECIAL CONDITIONS	Linear feet	111,936	\$109	\$12,153,425	\$123	\$112	
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$4,850,611	\$4,850,611	\$5,474,730	\$4,982,005	
230	NEW INSTALLATION		1	\$386,933		\$386,933		
231	GAS		1	\$44,833		\$44,833		
232	TELEPHONE		1	\$2,574,580		\$2,574,580		
233	ELECTRIC		1	\$1,230,854		\$1,230,854		
234	WATER							
235	PIPELINE							

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
236	6.00 SPECIAL CONDITIONS (continued)							
237	RAILROAD		1	\$570,767		\$570,767		
238	OTHER		1	\$42,644		\$42,644		
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total	1	\$482,480	\$482,480		\$495,549	
240	NEW INSTALLATION		1	\$482,480		\$482,480		
241	GAS							
242	TELEPHONE							
243	ELECTRIC							
244	WATER							
245	PIPELINE							
246	RAILROAD							
247	OTHER							
248	6.03 UTILITY RELOCATION - OTHER	Total						
249	NEW INSTALLATION							
250	GAS							
251	TELEPHONE							
252	ELECTRIC							
253	WATER							
254	PIPELINE							
255	RAILROAD							
256	OTHER							
257	6.04 DEMOLITIONS	Total	2	\$166,568	\$333,136		\$171,080	
258	BUILDINGS							
259	REMOVALS							
260	6.05 ROADWAY CHANGES	Total	3	\$2,162,399	\$6,487,198		\$2,220,974	
261	BRIDGES					\$333,136		
262	STREETS							
263	OTHER							
264	6.06 ENVIRONMENTAL	Total						
265	NOISE							
266	VISUAL							
267	VIBRATION							
268	OTHER							
269	7.00 RIGHT-OF-WAY	Linear Feet	111,936	\$156	\$17,408,000		\$176	
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$16,616,000	\$16,616,000		\$18,753,950	
271	MAINLINE	Acres	1			\$15,983,000		
272	STATION	Acres						
273	YARD	Acres	1					
274	PARKING	Acres				\$633,000		

CAPITAL COST DATA BASE

SACRAMENTO REGIONAL TRANSIT DISTRICT

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SACRAMENTO REGIONAL TRANSIT DISTRICT				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$792,000	\$792,000	\$893,905	\$813,454	
282	LEGAL & CONSULTING		1	\$481,000	\$481,000			
283	APPRAISAL		1	\$302,000	\$302,000			
284	PROPERTY MANAGEMENT		1	\$9,000	\$9,000			
285	7.04 RELOCATION	Total						
286	BUSINESS							
287	RESIDENCE							
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	111,936	\$323	\$36,119,000	\$395	\$359	
290	8.01 FEASIBILITY STUDIES	Total	1	\$16,557,000	\$16,557,000	\$24,528,889	\$22,321,289	
291	8.02 ENGINEERING & DESIGN	Total						
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$9,050,000	\$9,050,000	\$10,523,256	\$9,576,163	
293	8.04 PROJECT MANAGEMENT	Total	1	\$4,199,000	\$4,199,000	\$4,777,019	\$4,347,088	
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total						
295	8.06 PROJECT INITIATION	Total	1	\$1,285,000	\$1,285,000	\$1,450,339	\$1,319,808	
296	INSURANCE		1	\$1,285,000	\$1,285,000	\$1,450,339	\$1,319,808	
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES	Total	1	\$528,000	\$528,000	\$600,683	\$546,621	
300	8.08 TRAINING/START-UP/TESTING	Total	1	\$4,500,000	\$4,500,000	\$5,079,007	\$4,621,896	
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER							

SAN JOSE

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Middlay Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Middlay Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
1.00 GUIDEWAY ELEMENTS	QUANTITY		UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
1.01 GUIDEWAY AT-GRADE	82,252	Linear Feet	\$801	\$65,887,000		\$852	\$682	
DIRECT FIXATION						\$761	\$609	
BALLASTED	48,050		\$717	\$34,473,000		\$763	\$611	
IN-PAVEMENT BALLASTED								
EMBEDDED	34,202		\$712	\$24,343,000		\$757	\$606	
1.02 GUIDEWAY - ELEVATED STRUCTURE		Linear Feet						
DIRECT FIXATION								
BALLASTED								
IN-PAVEMENT BALLASTED								
EMBEDDED								
1.03 GUIDEWAY - ELEVATED, RETAINED FILL		Linear Feet						
DIRECT FIXATION								
BALLASTED								
IN-PAVEMENT BALLASTED								
EMBEDDED								
1.04 GUIDEWAY - ELEVATED FILL		Linear Feet						
DIRECT FIXATION								
BALLASTED								
IN-PAVEMENT BALLASTED								
EMBEDDED								
1.05 GUIDEWAY - SUBWAY		Linear Feet						
DIRECT FIXATION								
BALLASTED								
IN-PAVEMENT BALLASTED								
EMBEDDED								
1.06 GUIDEWAY - RETAINED CUT		Linear Feet						
DIRECT FIXATION								
BALLASTED								
IN-PAVEMENT BALLASTED								
EMBEDDED								
1.07 POCKET TRACK		L.F. Guideway						
1.08 STORAGE TRACK		L.F. Guideway						
1.09 SPECIAL TRACKWORK		L.F. Guideway						
TURNOUTS		Each						
#5	82,252		\$19.51	\$1,605,000		\$20.76	\$17	
#4	36		\$8,611	\$310,000		\$9,161	\$7,329	
#6	35		\$8,000	\$280,000				
#8								
#10	1		\$30,000	\$30,000		\$31,915	\$25,532	

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
1.00 GUIDEWAY ELEMENTS (continued)	QUANTITY		UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
41	OTHER - SPECIFY							
42	GIRDER,25 METER		\$64,750	\$1,295,000		1987	\$55,106	
43	GIRDER,50 METER							
44	#4, GIRDER	2	\$5,000		\$10,000	1987		
45	#8 SINGLE CROSSOVER	14	\$52,500		\$735,000	1987		
46	#4,DOUBLE CROSSOVER	3	\$100,000		\$300,000	1987		
47	#5,DOUBLE CROSSOVER							
48	INTERSECTION	1	\$250,000		\$250,000	1987		
49		1060	\$5,157	\$5,466,000		1987	\$4,389	
50	1.10 GUIDEWAY-SPECIAL STRUCTURES							
51	BRT JES	1	\$4,822,000		\$4,822,000			
52	OVERPASSES	2	\$372,000		\$644,000			
53	OTHER							
54								
55	2.00 YARDS & SHOPS							
56	2.01 BUILDING	1	\$21,291,136	\$21,291,136		1986	\$18,862,579	
57	DESCRIPTION	1	\$13,500,000	\$13,500,000		1987	\$11,489,362	
58	SHOP CAPACITY *	1	\$13,500,000		\$13,500,000	1987	\$362,402	
59	YARD STORAGE CAPACITY	50	\$425,823			1987		
60	WORKSTATIONS	50						
61	TRACK LENGTH	13						
62	PARKING	10,000						
63	2.02 OFFICE FURNITURE & EQUIP.	1	\$279,577	\$279,577		1985	\$252,440	
64	2.03 HEAVY REPAIR	1	\$809,989	\$809,989		1985	\$731,367	
65	BODY	YES						
66	TRUCK	YES			\$809,989	1987	\$42,553	
67	EQUIPMENT	YES						
68	2.04 MOTOR SHOPS	1	\$50,000	\$50,000		1987	\$25,532	
69	VARIABLE TEST LOAD	YES						
70	REWIND	YES			\$50,000	1987	\$25,532	
71	OTHER	YES			\$30,000	1987	\$25,532	
72	2.05 WHEEL SHOP	1	\$30,000	\$30,000		1987	\$25,532	
73	WHEEL PRESS	1			\$30,000	1987	\$25,532	
74	WHEEL TRUING							
75	2.06 MACHINE SHOP	6	\$262	\$1,570		1985	\$236	
76	LATHE	0						
77	DRILL PRESS	6			\$1,570	1985	\$236	
78	2.07 AIR CONDITIONING	1	\$2,680,000	\$2,680,000		1985	\$2,419,865	
79	2.08 ELECTRONICS	1	\$1,420,000	\$1,420,000		1985	\$1,282,167	

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
80	2.00 YARDS & SHOPS (continued)							
81	2.09 COMMUNICATIONS	(Y/N)	1	\$1,260,000	\$1,260,000	\$1,422,122	\$1,137,698	
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	1	\$160,000	\$160,000	\$180,587	\$144,470	
83	2.11 MAINTENANCE OF WAY SHOPS		1	\$1,100,000	\$1,100,000	\$1,241,535	\$993,228	
84	SIGNAL	(Y/N)						
85	TRACTION POWER	(Y/N)						
86	COMPONENT REPAIR	(Y/N)						
87	TRACK	(Y/N)						
88	2.12 MAINTENANCE OF WAY EQUIPMENT							
89	TRUCK	Each						
90	CRANE	Each						
91	OTHER	Each						
92	2.13 REVENUE CENTER	Each						
93	CASH COUNTING MACHINE							
94	VAULT							
95	OTHER							
96	2.14 CENTRAL CONTROL	(Y/N)						
97	MIMIC BOARD	(Y/N)						
98	PUBLIC ADDRESS	(Y/N)						
99	COMPUTER	(Y/N)						
100	FIRE/INTRUSION DETECTOR	(Y/N)						
101	MAINLINE CONTROL	(Y/N)						
102	YARD CONTROL	(Y/N)						
103	SEISMIC OR GAS DETECTION	(Y/N)						
104	OTHER	(Y/N)						
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity							
106	3.00 SYSTEMS		105,600	\$313.68	\$33,124,742	\$314	\$250.95	
107	3.01 SIGNAL SYSTEM	L.F. Guideway	105,600	\$67.89	\$7,169,292	\$68	\$54.31	
108	TRAIN CONTROL - WAYSIDE		105,600	\$66.28	\$6,999,292	\$66	\$53.02	
109	INSTALLATION							
110	HARDWARE				\$3,182,635			
111	DESIGN				\$3,513,954			
112	CROSSING PROTECTION		6	\$28,333.33	\$170,000	\$28,333	\$22,667	
113	TRAFFIC SIGNALS							
114	INSTALLATION		4		\$110,000			
115	GATES		2		\$60,000			
116	OTHER							
117	3.02 ELECTRIFICATION	L.F. Guideway	105,600	\$177.04	\$18,694,939	\$177	\$141.63	
118	SUBSTATIONS		30	\$256,589.30	\$7,697,679	\$256,589	\$205,271	

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
QUANTITY	UNIT COST		TOTAL COST	COMPONENT COST	YEAR			
119	3.00 SYSTEMS (continued)							
120	PURCHASE	Each	15		\$5,527,894			
121	INSTALLATION	Each	15		\$2,169,785		\$83.31	
122	CATENARY	L.F. Guideway	105,600	\$104.14	\$10,997,260		\$104	
123	INSTALLATION	Each			\$4,132,000			
124	POLES AND COMPONENTS	Each			\$6,865,260			
125	WIRE							
126	TROLLEY							
127	MESSENGER							
128	FEEDER							
129	RETURN							
130	3.03 COMMUNICATIONS	Total	1	\$2,935,448	\$2,935,448	\$2,935,448	\$2,348,358	
131	3.04 FARE COLLECTION	Total	1	\$4,325,063	\$4,325,063	\$4,325,063	\$3,460,050	
132	FAREBOX							
133	VENDING MACHINE		93	\$43,394	\$4,035,602			
134	OTHER		54	\$5,360	\$289,461			
135	4.00 STATIONS	Each	22	\$223,364	\$4,914,000	\$226,077	\$180,861	
136	4.01 AT-GRADE	Each	22	\$223,364	\$4,914,000	\$226,077	\$180,861	
137	CENTER PLATFORM	Each	3	\$192,333	\$577,000	\$194,669	\$155,735	
138	PLATFORM LENGTH	Linear Feet	334					
139	ESCALATOR/ELEVATOR	(Y/N)	N					
140	HANDICAP ACCESS MODE	Type						
141	WEATHER COVERAGE	Percent	100					
142	SIDE PLATFORM	Each	19	\$228,263	\$4,337,000	\$231,036	\$184,828	
143	PLATFORM LENGTH	Linear Feet	312					
144	ESCALATOR/ELEVATOR	(Y/N)	Y					
145	HANDICAP ACCESS MODE	Type						
146	WEATHER COVERAGE	Percent	100					
147	4.02 SUBWAY	Each						
148	CENTER PLATFORM	Each						
149	PLATFORM LENGTH	Linear Feet						
150	ESCALATOR/ELEVATOR	(Y/N)						
151	HANDICAP ACCESS MODE	Type						
152	WEATHER COVERAGE	Percent						
153	SIDE PLATFORM	Each						
154	PLATFORM LENGTH	Linear Feet						
155	ESCALATOR/ELEVATOR	(Y/N)						
156	HANDICAP ACCESS MODE	Type						
157	WEATHER COVERAGE	Percent						



CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	
158	4.00 STATIONS (continued)						
159	4.03 ELEVATED	Each					
160	CENTER PLATFORM	Each					
161	PLATFORM LENGTH	Linear Feet (Y/N)					
162	ESCALATOR/ELEVATOR	Type					
163	HANDICAP ACCESS MODE	Percent					
164	WEATHER COVERAGE	Each					
165	SIDE PLATFORM	Linear Feet (Y/N)					
166	PLATFORM LENGTH	Type					
167	ESCALATOR/ELEVATOR	Percent					
168	HANDICAP ACCESS MODE	Total					
169	WEATHER COVERAGE						
170	4.04 PARKING LOTS						
171	NUMBER OF LOTS	Total					
172	NUMBER OF SPACES						
173	4.05 PARKING GARAGES						
174	NUMBER OF LOTS	Total					
175	NUMBER OF SPACES						
176	4.06 PEDESTRIAN OVERPASSES						
177	5.00 VEHICLES	Each	50	\$1,112,220	\$55,611,000		1983
178	5.01 REVENUE VEHICLES -- ORDER A	Each	50	\$1,112,220	\$55,611,000		1983
179	MAKE/MANUFACTURER	Name	UTDC			\$50,000,000	
180	BODY TYPE (RIGID,ARTIC)	Type	ARTIC				
181	LENGTH OVER COUPLERS	Linear Feet	89.50				
182	WIDTH	Linear Feet	8.75				
183	NUMBER SEATS	Each	75				
184	AIR CONDITIONING	(Y/N)	YES				
185	CAB SIGNAL EQUIPMENT	(Y/N)					
186	BRAKING SYSTEM (AIR,ELEC)	Type	AIR				
187	TYPE OF STEPS (HIGH,LOW)	Type	NO				
188	HANDICAPED (LIFT,RAMP)	(Y/N)	NO				
189	ON-BOARD FAREBOX	Total					
190	PROCUREMENT COST	Total					
191	SPARE PARTS	Total				\$1,405,000	1983
192	SPECIAL EQUIPMENT COST	Total				\$4,206,000	1983
193	5.02 REVENUE VEHICLES -- ORDER B	Each					
194	MAKE/MANUFACTURER	Name					
195	BODY TYPE (RIGID,ARTIC)	Type					
196	LENGTH OVER COUPLERS	Linear Feet					

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
197	5.00 VEHICLES (continued)							
198	WIDTH	Linear Feet						
199	NUMBER SEATS	Each						
200	AIR CONDITIONING	(Y/N)						
201	CAB SIGNAL EQUIPMENT	(Y/N)						
202	BRAKING SYSTEM (AIR,ELEC)	Type						
203	TYPE OF STEPS (HIGH,LOW)	Type						
204	HANDICAPED (LIFT,RAMP)	Type						
205	ON-BOARD FAREBOX	(Y/N)						
206	PROCUREMENT COST	Total						
207	SPARE PARTS	Total						
208	SPECIAL EQUIPMENT COST	Total						
209	5.03 REVENUE VEHICLES - ORDER C	Each						
210	MAKE/MANUFACTURER	Name						
211	BODY TYPE (RIGID,ARTIC)	Type						
212	LENGTH OVER COUPLERS	Linear Feet						
213	WIDTH	Linear Feet						
214	NUMBER SEATS	Each						
215	AIR CONDITIONING	(Y/N)						
216	CAB SIGNAL EQUIPMENT	(Y/N)						
217	BRAKING SYSTEM (AIR,ELEC)	Type						
218	TYPE OF STEPS (HIGH,LOW)	Type						
219	HANDICAPED (LIFT,RAMP)	Type						
220	ON-BOARD FAREBOX	(Y/N)						
221	PROCUREMENT COST	Total						
222	SPARE PARTS	Total						
223	SPECIAL EQUIPMENT COST	Total						
224	5.04 NON-REVENUE VEHICLES	Each			N.R.			
225	SERVICE TRUCKS		13					
226	AUTOMOBILES		4					
227	OTHER		4					
228	6.00 SPECIAL CONDITIONS	Linear feet	82,252	\$103	\$8,487,000		\$91	
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$5,822,000	\$5,822,000		\$5,157,918	
230	NEW INSTALLATION							
231	GAS					\$5,086,000		
232	TELEPHONE					\$158,000		
233	ELECTRIC					\$23,000		
234	WATER					\$158,000		
235	PIPELINE					\$353,000		

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
236	RAILROAD							
237	OTHER				\$44,000			
238		Total						
239	6.02 UTILITY RELOCATION - BETTERMENTS							
240	NEW INSTALLATION							
241	GAS							
242	TELEPHONE							
243	ELECTRIC							
244	WATER							
245	PIPELINE							
246	RAILROAD							
247	OTHER							
248		Total						
249	6.03 UTILITY RELOCATION - OTHER							
250	NEW INSTALLATION							
251	GAS							
252	TELEPHONE							
253	ELECTRIC							
254	WATER							
255	PIPELINE							
256	RAILROAD							
257	OTHER							
258		Total	1	\$513,000	\$513,000		\$454,485	
259	6.04 DEMOLITIONS							
260	BUILDINGS							
261	REMOVALS				\$513,000			
262		Total	1					
263	6.05 ROADWAY CHANGES							
264	BRIDGES							
265	STREETS							
266	OTHER							
267		Total	1	\$2,152,000	\$2,152,000		\$1,906,534	
268	6.06 ENVIRONMENTAL							
269	NOISE							
270	VISUAL							
271	VIBRATION				\$1,324,000			
272	OTHER				\$828,000			
273		Total	82,252	\$664	\$54,617,000		\$600	
274		Total	1	\$51,323,000	\$51,323,000		\$46,341,309	
275		Acres	73	\$342,394		\$25,029,000		
276		Acres	23	\$312,743		\$7,068,000		
277		Acres	37	\$313,333		\$11,468,000		
278		Acres	20	\$389,849		\$7,758,000		
279	7.00 RIGHT-OF-WAY							
280	7.01 LAND ACQUISITION - PURCHASED							
281	MAINLINE							
282	STATION							
283	YARD							
284	PARKING							

CAPITAL COST DATA BASE

SANTA CLARA COUNTY TRANSPORTATION AGENCY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	SANTA CLARA COUNTY TRANSPORTATION AGENCY					1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
275	7.00 RIGHT-OF-WAY (continued)	Total							
276	7.02 LAND ACQUISITION - DONATED								
277	MAINLINE								
278	STATION								
279	YARD								
280	PARKING								
281	7.03 ACQUISITION-RELATED COST	Total	1	\$2,772,000	\$2,772,000		1985	\$3,128,668	
282	LEGAL & CONSULTING					\$924,000			
283	APPRAISAL					\$924,000			
284	PROPERTY MANAGEMENT					\$924,000			
285	7.04 RELOCATION	Total	1	\$522,000	\$522,000		1985	\$589,165	
286	BUSINESS		15			\$476,000			
287	RESIDENCE		86			\$46,000			
288	7.05 OTHER	Total							
289	8.00 SOFT-COSTS	Linear Feet	82,252	\$1,659	\$136,417,000		1986	\$1,469	
290	8.01 FEASIBILITY STUDIES	Total	1	\$41,085,000	\$41,085,000		1986	\$36,398,671	
291	8.02 ENGINEERING & DESIGN	Total	1	\$63,260,000	\$63,260,000		1986	\$56,044,297	
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$19,115,000	\$19,115,000		1986	\$16,934,662	
293	8.04 PROJECT MANAGEMENT	Total	1	\$1,457,000	\$1,457,000				
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$7,500,000	\$7,500,000				
295	8.06 PROJECT INITIATION	Total							
296	INSURANCE								
297	MOBILIZATION		1			\$7,000,000			
298	MAINTENANCE OF TRAFFIC		1			\$500,000			
299	8.07 FINANCE CHARGES	Total							
300	8.08 TRAINING/START-UP/TESTING	Total	1	\$4,000,000	\$4,000,000		1986	\$4,429,679	
301	SAFETY CERTIFICATION								
302	OFF-SITE LRV TESTING								
303	8.09 OTHER	Total							

PITTSBURGH

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
1	0.00 SYSTEM DESCRIPTION							
2	0.01 SERVICE							
3	ROUTE MILES	Route Miles	* 41.1					
4	TRACK MILES	Track Miles	62.4					
5	STATIONS	Each	13					
6	VEHICLES IN SERVICE	Revenue Vehicles	97					
7	PEAK	Revenue Vehicles	70					
8	MIDDAY	Revenue Vehicles	28					
9	HEADWAY							
10	PEAK	Minutes						
11	MIDDAY	Minutes						
12	0.02 STAFFING - TOTAL	Total	502.7					
13	ADMINISTRATIVE	FTE's						
14	OPERATORS	FTE's	112.2					
15	MAINTENANCE	FTE's						
16	VEHICLE	FTE's						
17	FACILITY	FTE's						
18	OTHER (eg Fare Inspection)	FTE's	390.5					

* Total System Mileage not Project Mileage

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES	
LINEAR ELEMENTS	1.01 GUIDEWAY AT-GRADE		QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST			YEAR
1	DIRECT FIXATION	Linear Feet	82,198	\$1,344	\$110,472,428		1985	\$1,517	\$1,508
2	BALLASTED	Linear Feet	54,627	\$410	\$22,416,945		1985	\$463	\$460
3	IN-PAVEMENT BALLASTED		5,131	\$620		\$3,183,075	1985	\$700	\$696
4	EMBEDDED		34,933	\$334		\$11,666,125	1985	\$377	\$375
5	DIRECT FIXATION	Linear Feet	14,563	\$520		\$7,567,746	1985	\$587	\$583
6	BALLASTED	Linear Feet	5,012	\$567	\$2,841,209		1985	\$640	\$636
7	IN-PAVEMENT BALLASTED		2,141	\$477		\$1,020,441	1985	\$538	\$535
8	EMBEDDED		963	\$997		\$960,077	1985	\$1,126	\$1,119
9	DIRECT FIXATION	Linear Feet	1,908	\$451		\$860,691	1985	\$509	\$506
10	BALLASTED	Linear Feet							
11	IN-PAVEMENT BALLASTED								
12	EMBEDDED								
13	DIRECT FIXATION	Linear Feet							
14	BALLASTED	Linear Feet							
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	DIRECT FIXATION	Linear Feet							
18	BALLASTED	Linear Feet							
19	IN-PAVEMENT BALLASTED								
20	EMBEDDED								
21	DIRECT FIXATION	Linear Feet	10,721	\$7,627	\$81,770,847		1985	\$8,609	\$8,557
22	BALLASTED	Linear Feet	3,462	\$18,478		\$63,976,786	1985	\$20,855	\$20,730
23	IN-PAVEMENT BALLASTED		3,856	\$4,216		\$16,259,569	1985	\$4,759	\$4,730
24	EMBEDDED		3,402	\$451		\$1,534,493	1985	\$509	\$506
25	DIRECT FIXATION	Linear Feet	11,838	\$291	\$3,443,427		1984	\$331	\$329
26	BALLASTED	Linear Feet	11,838	\$291		\$3,443,427	1984	\$331	\$329
27	IN-PAVEMENT BALLASTED								
28	EMBEDDED								
29	DIRECT FIXATION	L.F. Guideway							
30	BALLASTED	L.F. Guideway							
31	IN-PAVEMENT BALLASTED	L.F. Guideway							
32	EMBEDDED	L.F. Guideway							
33	TURNOUTS	Each							
34	#5								
35	#4								
36	#6								
37	#8								
38	#10								
39									
40									

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS 1.00 GUIDEWAY ELEMENTS (continued)	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
41								
42	#20							
43	OTHER - SPECIFY							
44	GIRDER,25 METER							
45	GIRDER,50 METER							
46	#4, GIRDER							
47	#8 SINGLE CROSSOVER							
48	#4,DOUBLE CROSSOVER							
49	#5,DOUBLE CROSSOVER							
50	INTERSECTION							
51	1.10 GUIDEWAY-SPECIAL STRUCTURES	<i>Linear Feet</i>						
52	BRIDGES	Each						
53	OVERPASSES	Each						
54	OTHER	Each						
55	2.00 YARDS & SHOPS	Total	1	\$38,183,186	\$38,183,186	\$43,096,147	\$42,837,570	
56	2.01 BUILDING	Each	1	\$32,090,648	\$32,090,648	\$36,219,693	\$36,002,375	
57	DESCRIPTION	Each	1	\$32,090,648		1985		
58	SHOP CAPACITY *	Revenue Vehicles	1	\$393,641		1985	\$441,624	
59	YARD STORAGE CAPACITY	Revenue Vehicles	97					
60	WORKSTATIONS	Each						
61	TRACK LENGTH	Linear Feet						
62	PARKING	Spaces						
63		All						
64	2.02 OFFICE FURNITURE & EQUIP.	(Y/N)						
65	2.03 HEAVY REPAIR	(Y/N)						
66	BODY	(Y/N)						
67	TRUCK	(Y/N)						
68	EQUIPMENT	(Y/N)						
69	2.04 MOTOR SHOPS	(Y/N)						
70	VARIABLE TEST LOAD	(Y/N)						
71	REWIND	(Y/N)						
72	OTHER	(Y/N)						
73	2.05 WHEEL SHOP	Each						
74	WHEEL PRESS	Each						
75	WHEEL TRUING	Each						
76	2.06 MACHINE SHOP	Each						
77	LATHIE	Each						
78	DRILL PRESS	Each						
79	2.07 AIR CONDITIONING	(Y/N)						
80	2.08 ELECTRONICS	(Y/N)						

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY			1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST		
80	2.00 YARDS & SHOPS (continued)						
81	2.09 COMMUNICATIONS	(Y/N)					
82	2.10 CAR WASH/CAR CLEANING	(Y/N)					
83	2.11 MAINTENANCE OF WAY SHOPS		1	\$5,025,877	\$5,025,877	\$5,314,598	
84	SIGNAL	(Y/N)					
85	TRACTION POWER	(Y/N)					
86	COMPONENT REPAIR	(Y/N)					
87	TRACK	(Y/N)					
88	2.12 MAINTENANCE OF WAY EQUIPMENT						
89	TRUCK	Each					
90	CRANE	Each					
91	OTHER	Each					
92	2.13 REVENUE CENTER	Each	1	\$1,066,661	\$1,066,661	\$1,206,213	
93	CASH COUNTING MACHINE						
94	VAULT						
95	OTHER						
96	2.14 CENTRAL CONTROL	(Y/N)					
97	MIMIC BOARD	(Y/N)					
98	PUBLIC ADDRESS	(Y/N)					
99	COMPUTER	(Y/N)					
100	FIRE/INTRUSION DETECTOR	(Y/N)					
101	MAINLINE CONTROL	(Y/N)					
102	YARD CONTROL	(Y/N)					
103	SEISMIC OR GAS DETECTION	(Y/N)					
104	OTHER	(Y/N)					
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity						
106	3.00 SYSTEMS						
107	3.01 SIGNAL SYSTEM	Linear Feet	82,198	\$716.38	\$58,885,157	\$804	
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway	58,083	\$394.49	\$22,913,020	\$445	
109	INSTALLATION		58,083	\$394.49	\$22,913,020	\$445	
110	HARDWARE						
111	DESIGN						
112	CROSSING PROTECTION	Each					
113	TRAFFIC SIGNALS	Each					
114	INSTALLATION						
115	GATES	Each					
116	OTHER						
117	3.02 ELECTRIFICATION	L.F. Guideway	68,219	\$396.43	\$27,043,907	\$448	
118	SUBSTATIONS	Each	4	\$3,007,949	\$12,031,797	\$3,422,013	\$3,401,481

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
				QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
158		4.00 STATIONS (continued)							
159		4.03 ELEVATED	Each						
160		CENTER PLATFORM	Each						
161		PLATFORM LENGTH	Linear Feet						
162		ESCALATOR/ELEVATOR	(Y/N)						
163		HANDICAP ACCESS MODE	Type						
164		WEATHER COVERAGE	Percent						
165		SIDE PLATFORM	Each						
166		PLATFORM LENGTH	Linear Feet						
167		FUNNEL/ELEVATOR	(Y/N)						
168		HANDICAP ACCESS MODE	Type						
169		WEATHER COVERAGE	Percent						
170		4.04 PARKING LOTS	Total						
171		NUMBER OF LOTS							
172		NUMBER OF SPACES							
173		4.05 PARKING GARAGES	Total						
174		NUMBER OF LOTS							
175		NUMBER OF SPACES							
176		4.06 PEDESTRIAN OVERPASSES	Total						
177		5.00 VEHICLES	Each	55	\$1,043,626	\$57,399,440		\$1,170,840	
178		5.01 REVENUE VEHICLES -- ORDER A	Each	55	\$1,043,626	\$57,399,440		\$1,177,908	
179		MAKE/MANUFACTURER	Name						
180		BODY TYPE (RIGID,ARTIC)	Type						
181		LENGTH OVER COUPLERS	Linear Feet						
182		WIDTH	Linear Feet						
183		NUMBER SEATS	Each						
184		AIR CONDITIONING	(Y/N)						
185		CAB SIGNAL EQUIPMENT	(Y/N)						
186		BRAKING SYSTEM (AIR,ELEC)	Type						
187		TYPE OF STEPS (HIGH,LOW)	Type						
188		HANDICAPED (LIFT,RAMP)	Type						
189		ON-BOARD FAREBOX	(Y/N)						
190		PROCUREMENT COST	Total						
191		SPARE PARTS	Total						
192		SPECIAL EQUIPMENT COST	Total						
193		5.02 REVENUE VEHICLES -- ORDER B	Each						
194		MAKE/MANUFACTURER	Name						
195		BODY TYPE (RIGID,ARTIC)	Type						
196		LENGTH OVER COUPLERS	Linear Feet						

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
197	5.00 VEHICLES (continued)							
198	WIDTH	Linear Feet						
199	NUMBER SEATS	Each						
200	AIR CONDITIONING	(Y/N)						
201	CAB SIGNAL EQUIPMENT	(Y/N)						
202	BRAKING SYSTEM (AIR,ELEC)	Type						
203	TYPE OF STEPS (HIGH,LOW)	Type						
204	HANDICAPED (LIFT,RAMP)	Type						
205	ON-BOARD FAREBOX	(Y/N)						
206	PROCUREMENT COST	Total						
207	SPARE PARTS	Total						
208	SPECIAL EQUIPMENT COST	Total						
209	5.03 REVENUE VEHICLES -- ORDER C	Each						
210	MAKE/MANUFACTURER	Name						
211	BODY TYPE (RIGID,ARTIC)	Type						
212	LENGTH OVER COUPLERS	Linear Feet						
213	WIDTH	Linear Feet						
214	NUMBER SEATS	Each						
215	AIR CONDITIONING	(Y/N)						
216	CAB SIGNAL EQUIPMENT	(Y/N)						
217	BRAKING SYSTEM (AIR,ELEC)	Type						
218	TYPE OF STEPS (HIGH,LOW)	Type						
219	HANDICAPED (LIFT,RAMP)	Type						
220	ON-BOARD FAREBOX	(Y/N)						
221	PROCUREMENT COST	Total						
222	SPARE PARTS	Total						
223	SPECIAL EQUIPMENT COST	Total						
224	5.04 NON-REVENUE VEHICLES	Each						
225	SERVICE TRUCKS							
226	AUTOMOBILES							
227	OTHER							
228	6.00 SPECIAL CONDITIONS							
229	6.01 UTILITY RELOCATION - AS IS							
230	NEW INSTALLATION	Linear feet	82,198	\$122	\$10,038,972	1984	\$138	
231	GAS	Total	1	\$4,034,435	\$4,034,435	1984	\$4,589,801	
232	TELEPHONE		2		\$578,064			
233	ELECTRIC		1		\$248,253			
234	WATER		4		\$2,939,444			
235	PIPELINE		1		\$268,674			

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
236	6.00 SPECIAL CONDITIONS (continued)							
237	RAILROAD							
238	OTHER							
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total	1	\$4,939,567	\$4,939,567		\$5,585,813	1984
240	NEW INSTALLATION		1	\$560,596	\$560,596			
241	GAS		1	\$664,702	\$664,702			
242	TELEPHONE		1	\$767,687	\$767,687			
243	ELECTRIC		1	\$2,857,500	\$2,857,500			
244	WATER							
245	PIPELINE							
246	RAILROAD							
247	OTHER		1	\$89,082	\$89,082			
248	6.03 UTILITY RELOCATION - OTHER	Total						
249	NEW INSTALLATION							
250	GAS							
251	TELEPHONE							
252	ELECTRIC							
253	WATER							
254	PIPELINE							
255	RAILROAD							
256	OTHER							
257	6.04 DEMOLITIONS	Total	1	\$747,080	\$747,080		\$863,485	1983
258	BUILDINGS							
259	REMOVALS							
260	6.05 ROADWAY CHANGES	Total						
261	BRIDGES							
262	STREETS							
263	OTHER							
264	6.06 ENVIRONMENTAL	Total	1	\$317,890	\$317,890		\$356,792	1985
265	NOISE							
266	VISUAL		1	\$317,890	\$317,890			1985
267	VIBRATION							
268	OTHER							
269	7.00 RIGHT-OF-WAY	Linear Feet	82,198	\$262	\$21,511,920		\$304	1983
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$21,511,920	\$21,511,920		\$25,013,860	1983
271	MAINLINE	Acres						
272	STATION	Acres						
273	YARD	Acres						
274	PARKING	Acres						

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	Total						
282	LEGAL & CONSULTING							
283	APPRAISAL							
284	PROPERTY MANAGEMENT							
285	7.04 RELOCATION	Total						
286	BUSINESS							
287	RESIDENCE							
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	82,198	\$2,734	\$224,751,180	\$3,068	\$3,068	
290	8.01 FEASIBILITY STUDIES	Total						
291	8.02 ENGINEERING & DESIGN	Total	1	\$106,746,730	\$106,746,730	1985	\$119,758,747	
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$11,236,750	\$11,236,750	1985	\$12,606,467	
293	8.04 PROJECT MANAGEMENT	Total	1	\$14,821,100	\$14,821,100	1985	\$16,627,735	
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total						
295	8.06 PROJECT INITIATION	Total						
296	INSURANCE							
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES							
300	8.08 TRAINING/START-UP/TESTING							
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER		1	\$91,946,600	\$91,946,600	1987	\$97,228,639	

LOS ANGELES

Summary of Light Rail System Characteristics

	Portland	Sacramento	San Jose	Pittsburgh	Los Angeles
Opening Date	1986	1987	1987	1988	1990
Route Length (miles)	15.2	18.3	19.9	41.1	22.6
At-Grade	9.9	17.6	19.7	27.1	18.3
Elevated	5.2	0.7	0.2	2.9	3.6
Subway	0	0	0	5.3	0.6
Open Cut	0.2	0	0	5.8	0.1
Track Miles	29.3	25.6	40.8	62.4*	43.6
Stations	25	26	22	13	22
Parking Lots	5	8	NR	NR	5
Parking Spaces	1636	3850	NR	NR	1051
Total Revenue Vehicles	26	26	50	97*	54
Peak Vehicles	22	23	15	70*	26
Midday Vehicles	12	8	15	28*	13
Peak Headway (minutes)	7.5	15	10	NR	10
Midday Headway (minutes)	15	30	10	NR	10
Staff					
• Administrative	16	15	11	NR	28
• Operators	36	32	58	112	73
• Vehicle Maintenance	28	15	55	NR	47
• Facility Maintenance	19	16	53	NR	45
• Other	11	5	20	NR	68
• Total	110	83	197	503	261
Percent of Route Miles					
• At-Grade	65%	96%	99%	66%	81%
• Elevated	34%	4%	1%	7%	16%
• Subway	0	0	0	13%	3%
Open Cut	1%	0	0	14%	<1%

* Total system statistics; not project-specific.

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
LINEAR FEET	QUANTITY		UNIT COST	TOTAL COST	COMPONENT COST	YEAR		
1	1.00 GUIDEWAY ELEMENTS	Linear Feet	119,283	\$1,247	\$148,719,104	\$1,293	\$1,133	
2	1.01 GUIDEWAY AT-GRADE	Linear Feet	96,253	\$700	\$67,408,808	\$726	\$636	
3	DIRECT FIXATION							
4	BALLASTED		61,869	\$487	\$30,145,147	\$505	\$443	
5	IN-PAVEMENT BALLASTED		1,618	\$2,848	\$4,608,103	\$2,954	\$2,588	
6	EMBEDDED		32,766	\$997	\$32,655,558	\$1,034	\$906	
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	10,785	\$3,286	\$35,437,638	\$3,409	\$2,986	
8	DIRECT FIXATION		9,376	\$3,033	\$28,435,174	\$3,146	\$2,756	
9	BALLASTED		1,409	\$4,970	\$7,002,464	\$5,155	\$4,516	
10	IN-PAVEMENT BALLASTED							
11	EMBEDDED							
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	6,407	\$932	\$5,973,099	\$967	\$847	
13	DIRECT FIXATION							
14	BALLASTED		6,407	\$932	\$5,973,099	\$967	\$847	
15	IN-PAVEMENT BALLASTED							
16	EMBEDDED							
17	1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	2,052	\$678	\$1,390,912	\$703	\$616	
18	DIRECT FIXATION							
19	BALLASTED		2,052	\$678	\$1,390,912	\$703	\$616	
20	IN-PAVEMENT BALLASTED							
21	EMBEDDED							
22	1.05 GUIDEWAY - SUBWAY	Linear Feet	3,296	\$6,965	\$22,955,679	\$7,225	\$6,329	
23	DIRECT FIXATION		3,296	\$6,965	\$22,955,679	\$7,225	\$6,329	
24	BALLASTED							
25	IN-PAVEMENT BALLASTED							
26	EMBEDDED							
27	1.06 GUIDEWAY - RETAINED CUT	Linear Feet	490	\$4,756	\$2,330,510	\$4,934	\$4,322	
28	DIRECT FIXATION		490	\$4,756	\$2,330,510	\$4,934	\$4,322	
29	BALLASTED							
30	IN-PAVEMENT BALLASTED							
31	EMBEDDED							
32	1.07 POCKET TRACK	L.F. Guideway	119,283	\$71.99	\$8,586,709	\$74.67	\$65.41	
33	1.08 STORAGE TRACK	L.F. Guideway	119,283	\$38.86	\$4,635,749	\$40.31	\$35.32	
34	1.09 SPECIAL TRACKWORK	L.F. Guideway	119,283	\$38.938	\$4,635,749	\$40.392	\$35.383	
35	TURNOUTS	Each	57					
36	#5							
37	#4							
38	#6							
39	#8							
40	#10							

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
QUANTITY	UNIT COST		TOTAL COST	COMPONENT COST	YEAR			
1.00 GUIDEWAY ELEMENTS (continued)								
41	#20	Linear Feet						
42	OTHER - SPECIFY							
43	GIRDER,25 METER		12	\$93,340	\$1,120,080	1988	\$96,826	\$84,819
44	GIRDER,50 METER		1	\$205,473	\$205,473	1988	\$213,146	\$186,716
45	#4, GIRDER		2	\$329,791	\$659,582	1988	\$342,107	\$299,686
46	#8 SINGLE CROSSOVER	4	\$107,787	\$431,149	1988	\$111,813	\$97,948	
47	#4,DOUBLE CROSSOVER							
48	#5,DOUBLE CROSSOVER							
49	INTERSECTION							
50	1.10 GUIDEWAY-SPECIAL STRUCTURES							
51	BRIDGES	Each						
52	OVERPASSES	Each						
53	OTHER	Each						
54								
2.00 YARDS & SHOPS								
55	2.01 BUILDING	Total	\$44,204,740	\$44,204,740	1988	\$45,855,539	\$40,169,453	
56	DESCRIPTION	Each	\$25,229,864	\$25,229,864	1988	\$26,172,058	\$22,926,723	
57	SHOP CAPACITY *	Revenue Vehicles			1988		\$743,879	
58	YARD STORAGE CAPACITY	Revenue Vehicles	\$818,606		1988	\$849,177		
59	WORKSTATIONS	Each			1988			
60	TRACK LENGTH	Linear Feet						
61	PARKING	Spaces						
62		All						
63	2.02 OFFICE FURNITURE & EQUIP.	(Y/N)						
64	2.03 HEAVY REPAIR	(Y/N)	\$272,383	\$2,996,208	1988	\$282,555	\$247,518	
65	BODY	(Y/N)						
66	TRUCK	(Y/N)						
67	EQUIPMENT	(Y/N)						
68	VARIABLE TEST LOAD	(Y/N)						
69	REWIND	(Y/N)						
70	OTHER	(Y/N)						
71	2.04 MOTOR SHOPS							
72	WHEEL SHOP	Each	\$1,144,662	\$1,144,662	1988	\$1,187,409	\$1,040,170	
73	WHEEL PRESS	Each						
74	WHEEL TRUING	Each						
75	2.05 MACHINE SHOP							
76	LATHIE	Each						
77	DRILL PRESS	Each						
78	2.07 AIR CONDITIONING	(Y/N)						
79	2.08 ELECTRONICS	(Y/N)	\$1,810,691	\$1,810,691	1988	\$1,878,310	\$1,645,400	

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
QUANTITY	UNIT COST		TOTAL COST	COMPONENT COST	YEAR			
80	2.00 YARDS & SHOPS (continued)							
81	2.09 COMMUNICATIONS	(Y/N)	1	\$959,396	\$959,396	\$995,224	\$871,816	
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	10	\$73,400	\$734,000	\$76,141	\$66,700	
83	2.11 MAINTENANCE OF WAY SHOPS							
84	SIGNAL	(Y/N)						
85	TRACTION POWER	(Y/N)						
86	COMPONENT REPAIR	(Y/N)						
87	TRACK	(Y/N)						
88	2.12 MAINTENANCE OF WAY EQUIPMENT		5	\$30,000	\$150,000	\$31,120	\$27,261	
89	TRUCK	Each						
90	CRANE	Each						
91	OTHER	Each						
92	2.13 REVENUE CENTER							
93	CASH COUNTING MACHINE	Each						
94	VAULT	Each						
95	OTHER	Each						
96	2.14 CENTRAL CONTROL	(Y/N)	1	\$11,179,919	\$11,179,919	\$11,597,426	\$10,159,345	
97	MIMIC BOARD	(Y/N)	1	\$4,432,019	\$4,432,019	\$4,597,530	\$4,027,436	
98	PUBLIC ADDRESS	(Y/N)						
99	COMPUTER	(Y/N)	1	\$641,846	\$641,846	\$665,815	\$583,254	
100	FIRE/INTRUSION DETECTOR	(Y/N)						
101	MAINLINE CONTROL	(Y/N)						
102	YARD CONTROL	(Y/N)						
103	SEISMIC OR GAS DETECTION	(Y/N)						
104	OTHER	(Y/N)						
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity							
106	3.00 SYSTEMS							
107	3.01 SIGNAL SYSTEM	Linear Feet	119,282	\$966.39	\$115,273,245	\$1,002	\$878	
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway	119,282	\$341.59	\$40,745,221	\$354	\$310	
109	INSTALLATION		119,282	\$232.35	\$27,715,247	\$241	\$211	
110	HARDWARE				\$116,349			
111	DESIGN				\$1,034,481			
112	CROSSING PROTECTION	Each	119,282	\$222.70	\$26,564,417	\$231	\$202.37	
113	TRAFFIC SIGNALS	Each	28	\$465,356	\$13,029,974	\$482,735	\$422,876	
114	INSTALLATION	Each	28	\$433,001	\$12,124,025	\$449,171	\$393,474	
115	GATES	Each			\$552,641			
116	OTHER	Each			\$353,308			
117	3.02 ELECTRIFICATION	L.F. Guideway	119,282	\$414.41	\$49,432,018	\$430	\$377	
118	SUBSTATIONS	Each	19	\$1,108,399	\$21,059,588	\$1,149,792	\$1,007,218	

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		LOS ANGELES COUNTY TRANSPORTATION COMMISSION			1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
UNITS OF MEASURE	QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	YEAR	
3.00 SYSTEMS (continued)						
119 PURCHASE				\$15,991,760		\$216,15
120 INSTALLATION				\$5,067,828		\$12,995
121 CATENARY	119,282	\$237.86		\$28,372,430	1988	\$107.85
122						
123 INSTALLATION				\$14,214,975	1988	
124 POLES AND COMPONENTS	994	\$14,301		\$14,157,455	1988	
125 WIRE	119,282	\$118.69		\$1,905,017		
126 TROLLEY				\$2,565,811		
127 MESSENGER				\$9,686,627		
128 FEEDER						
129 RETURN						
130 3.03 COMMUNICATIONS	1	\$19,091,470	\$19,091,470		1988	\$17,348,680
131 3.04 FARE COLLECTION	1	\$6,004,536	\$6,004,536		1988	\$5,456,404
132 FAREBOX						
133 VENDING MACHINE	74	\$57,288		\$4,239,307	1988	\$52,058
134 OTHER				\$1,765,229		
4.00 STATIONS						
4.01 AT-GRADE						
135 CENTER PLATFORM	22	\$2,995,158	\$65,893,479		1988	\$2,721,741
136 PLATFORM LENGTH	18	\$1,051,819	\$18,932,742		1988	\$955,802
137 ESCALATOR/ELEVATOR	15	\$1,079,409		\$16,191,134	1988	\$980,874
138 HANDICAP ACCESS MODE						
139 WEATHER COVERAGE						
140						
141						
142 SIDE PLATFORM	3	\$913,869		\$2,741,608	1988	\$830,446
143 PLATFORM LENGTH						
144 ESCALATOR/ELEVATOR						
145 HANDICAP ACCESS MODE						
146 WEATHER COVERAGE						
147						
148 4.02 SUBWAY	1	\$27,684,300	\$27,684,300		1988	\$25,157,102
149 CENTER PLATFORM						
150 PLATFORM LENGTH						
151 ESCALATOR/ELEVATOR						
152 HANDICAP ACCESS MODE						
153 WEATHER COVERAGE						
154 SIDE PLATFORM	1	\$27,684,300		\$27,684,300	1988	\$25,157,102
155 PLATFORM LENGTH						
156 ESCALATOR/ELEVATOR						
157 HANDICAP ACCESS MODE						
WEATHER COVERAGE						

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION			1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
		QUANTITY	UNIT COST		TOTAL COST	COMPONENT COST	YEAR		
158	4.00 STATIONS (continued)								
159	4.03 ELEVATED	3	\$2,928,894	\$8,786,682		1988	\$3,038,272	\$2,661,526	
160	CENTER PLATFORM	3	\$2,928,894		\$8,786,682	1988	\$3,038,272	\$2,661,526	
161	PLATFORM LENGTH								
162	ESCALATOR/ELEVATOR								
163	HANDICAP ACCESS MODE								
164	WEATHER COVERAGE								
165	SIDE PLATFORM								
166	PLATFORM LENGTH								
167	ESCALATOR/ELEVATOR								
168	HANDICAP ACCESS MODE								
169	WEATHER COVERAGE								
170	4.04 PARKING LOTS	5	\$1,698,107	\$8,490,533		1988	\$1,761,521	\$1,543,093	
171	NUMBER OF LOTS	5							
172	NUMBER OF SPACES	1,051	\$8,079			1988	\$8,380	\$7,341	
173	4.05 PARKING GARAGES								
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	2	\$999,611	\$1,999,222		1988	\$1,036,941	\$908,360	
177	5.00 VEHICLES	54	\$1,480,354	\$79,939,129		1988	\$1,535,637	\$1,345,218	
178	5.01 REVENUE VEHICLES -- ORDER A	54	\$1,446,965	\$78,136,129		1988	\$1,501,001	\$1,314,877	
179	MAKE/MANUFACTURER								
180	BODY TYPE (RIGID,ARTIC)								
181	LENGTH OVER COUPLERS								
182	WIDTH								
183	NUMBER SEATS								
184	AIR CONDITIONING								
185	CAB SIGNAL EQUIPMENT								
186	BRAKING SYSTEM (AIR,ELEC)								
187	TYPE OF STEPS (HIGH,LOW)								
188	HANDICAPED (LIFT,RAMP)								
189	ON-BOARD FAREBOX								
190	PROCUREMENT COST								
191	SPARE PARTS								
192	SPECIAL EQUIPMENT COST								
193	5.02 REVENUE VEHICLES -- ORDER B								
194	MAKE/MANUFACTURER								
195	BODY TYPE (RIGID,ARTIC)								
196	LENGTH OVER COUPLERS								

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
197	5.00 VEHICLES (continued)							
198	WIDTH	Linear Feet						
199	NUMBER SEATS	Each						
200	AIR CONDITIONING	(Y/N)						
201	CAB SIGNAL EQUIPMENT	(Y/N)						
202	BRAKING SYSTEM (AIR,ELEC)	Type						
203	TYPE OF STEPS (HIGH,LOW)	Type						
204	HANDICAPED (LIFT,RAMP)	Type						
205	ON-BOARD FAREBOX	(Y/N)						
206	PROCUREMENT COST	Total						
207	SPARE PARTS	Total						
208	SPECIAL EQUIPMENT COST	Total						
209		Each						
210	5.03 REVENUE VEHICLES -- ORDER C	Name						
211	MAKE/MANUFACTURER	Type						
212	BODY TYPE (RIGID,ARTIC)	Linear Feet						
213	LENGTH OVER COUPLERS	Linear Feet						
214	WIDTH	Each						
215	NUMBER SEATS	(Y/N)						
216	AIR CONDITIONING	(Y/N)						
217	CAB SIGNAL EQUIPMENT	Type						
218	BRAKING SYSTEM (AIR,ELEC)	Type						
219	TYPE OF STEPS (HIGH,LOW)	Type						
220	HANDICAPED (LIFT,RAMP)	(Y/N)						
221	ON-BOARD FAREBOX	Total						
222	PROCUREMENT COST	Total						
223	SPARE PARTS	Total						
224	SPECIAL EQUIPMENT COST	Total						
225	5.04 NON-REVENUE VEHICLES	Each						
226	SERVICE TRUCKS		19	\$94,895	\$1,803,000		\$86,232	
227	AUTOMOBILES		5		\$136,000	\$680,000		
	OTHER		12		\$28,333	\$340,000		
			2		\$391,500	\$783,000		
228	6.00 SPECIAL CONDITIONS							
229	6.01 UTILITY RELOCATION - AS IS		119,282	\$1,277	\$152,349,392		\$1,442	
230	NEW INSTALLATION	Linear feet	1	\$2,553,505	\$2,553,505		\$2,882,060	
231	GAS	Total				\$397,776		
232	TELEPHONE					\$179,117		
233	ELECTRIC					\$52,175		
234	WATER					\$130,065		
235	PIPELINE					\$1,006,224		

CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST	
6.00 SPECIAL CONDITIONS (continued)							
236	RAILROAD						
237	OTHER				\$788,148		
238							
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total	1	\$119,761,634	\$119,761,634		1985
240	NEW INSTALLATION						
241	GAS				\$4,636,851		
242	TELEPHONE				\$1,991,741		
243	ELECTRIC				\$21,311,426		
244	WATER				\$6,168,122		
245	PIPELINE				\$27,379,768		
246	RAILROAD				\$56,398,574		1988
247	OTHER				\$1,875,152		
248							
249							
250	6.03 UTILITY RELOCATION - OTHER	Total					
251	NEW INSTALLATION						
252	GAS						
253	TELEPHONE						
254	ELECTRIC						
255	WATER						
256	PIPELINE						
257	RAILROAD						
258	OTHER						
259							
260	6.04 DEMOLITIONS	Total	1	\$967,836	\$967,836		1985
261	BUILDINGS				\$384,438		
262	REMOVALS				\$583,398		
263							
264	6.05 ROADWAY CHANGES	Total	1	\$12,088,912	\$12,088,912		1985
265	BRIDGES						
266	STREETS						
267	OTHER						
268							
269	6.06 ENVIRONMENTAL	Total	1	\$16,977,505	\$16,977,505		1985
270	NOISE				\$400,000		
271	VISUAL				\$11,688,912		
272	VIBRATION				\$10,124,905		
273	OTHER				\$6,852,600		
274							
275							
276	7.00 RIGHT-OF-WAY	Linear Feet	119,282	\$504	\$60,084,803		1988
277		Total	1	\$55,437,402	\$55,437,402		1988
278	MAINLINE	Acres		\$55,437,402	\$55,437,402		
279	STATION	Acres					
280	YARD	Acres					
281	PARKING	Acres					
282							
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CAPITAL COST DATA BASE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION

	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
275	7.00 RIGHT-OF-WAY (continued)	Total						
276	7.02 LAND ACQUISITION - DONATED							
277	MAINLINE							
278	STATION							
279	YARD							
280	PARA-ING							
281	7.03 ACQUISITION-RELATED COST	Total	1	\$4,493,401	\$4,493,401	\$2,211,075	\$4,661,204	
282	LEGAL & CONSULTING					\$40,500		
283	APPRAISAL					\$2,241,826		
284	PROPERTY MANAGEMENT							
285	7.04 RELOCATION	Total	1	\$154,000	\$154,000	\$77,000	\$139,942	
286	BUSINESS		1					
287	RESIDENCE		1					
288	7.05 OTHER	Total						
289	8.00 SOFT-COSTS	Linear Feet	119,282	\$1,767	\$210,805,963		\$1,747	
290	8.01 FEASIBILITY STUDIES	Total	1	\$69,586,796	\$69,586,796		\$68,801,392	
291	8.02 ENGINEERING & DESIGN	Total	1	\$86,130,800	\$86,130,800		\$85,158,669	
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$23,200,000	\$23,200,000		\$22,938,149	
293	8.04 PROJECT MANAGEMENT	Total	1	\$4,591,000	\$4,591,000		\$4,539,183	
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$35,638,000	\$35,638,000	\$35,638,000	\$35,235,765	
295	8.06 PROJECT INITIATION							
296	INSURANCE							
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES		1	\$9,915,093	\$9,915,093		\$9,803,185	
300	8.08 TRAINING/START-UP/TESTING							
301	SAFETY CERTIFICATION							
302	OFF-SITE LRV TESTING							
303	8.09 OTHER		1	(\$18,255,726)	(\$18,255,726)		(\$16,589,228)	

UNIT COST SUMMARY

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY				
0.00 SYSTEM DESCRIPTION	OBSERVATIONS		MINIMUM	MEAN	MAXIMUM	RANGE	
1	0.01 SERVICE						
2	ROUTE MILES	Route Miles	5	18	30	30	
3	TRACK MILES	Track Miles	5	40	62	37	
4	STATIONS	Each	5	22	28	15	
5	VEHICLES IN SERVICE	Revenue Vehicles	5	51	97	71	
6	PEAK	Revenue Vehicles	5	31	70	55	
7	MIDDAY	Revenue Vehicles	5	15	28	20	
8	HEADWAY					0	
9	PEAK	Minutes	4	9	15	15	
10	MIDDAY	Minutes	4	13	30	30	
11		Total	5	237	503	420	
12	0.02 STAFFING - TOTAL						
13	ADMINISTRATIVE	FTE's	4	14	28	28	
14	OPERATORS	FTE's	5	62	112	80	
15	MAINTENANCE					0	
16	VEHICLE	FTE's	4	29	55	55	
17	FACILITY	FTE's	4	27	53	53	
18	OTHER (eg Fare Inspection)	FTE's	5	99	391	386	

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
1	1.00 GUIDEWAY ELEMENTS						
2	1.01 GUIDEWAY AT-GRADE	Linear Feet	5	\$428	\$1,016	\$1,508	\$1,079
3	DIRECT FIXATION	Linear Feet	5	\$413	\$665	\$1,205	\$792
4	BALLASTED		1	\$696	\$696	\$696	\$0
5	IN-PAVEMENT BALLASTED		5	\$350	\$491	\$679	\$329
6	EMBEDDED		2	\$526	\$1,557	\$2,588	\$2,062
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	Linear Feet	4	\$583	\$1,452	\$3,714	\$3,131
8	DIRECT FIXATION		4	\$410	\$1,768	\$3,041	\$2,631
9	BALLASTED		3	\$410	\$1,233	\$2,756	\$2,346
10	IN-PAVEMENT BALLASTED		3	\$1,119	\$2,746	\$4,516	\$3,397
11	EMBEDDED		2	\$506	\$1,936	\$3,365	\$2,859
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	2	\$847	\$1,009	\$1,172	\$325
13	DIRECT FIXATION		2	\$847	\$1,009	\$1,172	\$325
14	BALLASTED						
15	IN-PAVEMENT BALLASTED						
16	EMBEDDED						
17	1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	1	\$616	\$616	\$616	\$0
18	DIRECT FIXATION		1	\$616	\$616	\$616	\$0
19	BALLASTED						
20	IN-PAVEMENT BALLASTED						
21	EMBEDDED						
22	1.05 GUIDEWAY - SUBWAY	Linear Feet	2	\$6,329	\$7,443	\$8,557	\$2,228
23	DIRECT FIXATION		2	\$6,329	\$13,530	\$20,730	
24	BALLASTED						
25	IN-PAVEMENT BALLASTED		1	\$4,730	\$4,730	\$4,730	(\$0)
26	EMBEDDED		1	\$506	\$506	\$506	\$0
27	1.06 GUIDEWAY - RETAINED CUT	Linear Feet	3	\$329	\$3,354	\$5,410	\$5,081
28	DIRECT FIXATION		2	\$329	\$2,870	\$5,410	\$5,081
29	BALLASTED						
30	IN-PAVEMENT BALLASTED						
31	EMBEDDED						
32	1.07 POCKET TRACK	L.F. Guideway	2	\$2.81	\$34.11	\$65.41	\$62.61
33	1.08 STORAGE TRACK	L.F. Guideway					
34	1.09 SPECIAL TRACKWORK	L.F. Guideway	4	\$15.71	\$25.02	\$35.32	\$19.60
35	TURNOUTS	Each					
36	#5						
37	#4						
38	#6						
39	#8						
40	#10						

CAPITAL COST DATA BASE

UNIT COST SUMMARY

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	UNIT COST SUMMARY			
				OBSERVATIONS	MINIMUM	MEAN	MAXIMUM
41		1.00 GUIDEWAY ELEMENTS (continued)					
42	#20	OTHER - SPECIFY					
43		GIRDER,25 METER					
44		GIRDER,50 METER					
45		#4, GIRDER					
46		#8 SINGLE CROSSOVER					
47		#4,DOUBLE CROSSOVER					
48		#5,DOUBLE CROSSOVER					
49		INTERSECTION					
50		1.10 GUIDEWAY-SPECIAL STRUCTURES					
51		BRIDGES	1	\$4,389	\$4,389	\$4,389	\$0
52		OVERPASSES					
53		OTHER					
54							
55		2.00 YARDS & SHOPS					
56		2.01 BUILDING	5	\$4,086,783	\$23,862,435	\$42,837,570	\$38,750,787
57		DESCRIPTION	5	\$4,086,783	\$17,019,418	\$36,002,375	\$31,915,592
58		SHOP CAPACITY *					
59		YARD STORAGE CAPACITY					
60		WORKSTATIONS					
61		TRACK LENGTH					
62		PAP'ING					
63			1	\$252,440	\$252,440	\$252,440	\$0
64		2.02 OFFICE FURNITURE & EQUIP.	3	\$69,070	\$349,318	\$731,367	\$662,297
65		2.03 HEAVY REPAIR					
66		BODY					
67		TRUCK					
68		EQUIPMENT					
69		2.04 MOTOR SHOPS	2	\$11,512	\$27,032	\$42,553	\$31,042
70		VARIABLE TEST LOAD					
71		REWIND					
72		OTHER					
73		2.05 WHEEL SHOP	3	\$25,532	\$614,629	\$1,040,170	\$1,014,638
74		WHEEL PRESS					
75		WHEEL TRUING	2	\$236	\$118,112	\$235,988	\$235,752
76		2.06 MACHINE SHOP					
77		LATHIE					
78		DRILL PRESS					
79		2.07 AIR CONDITIONING	1	\$2,419,865	\$2,419,865	\$2,419,865	\$0
80		2.08 ELECTRONICS	3	\$230,233	\$1,052,600	\$1,645,400	\$1,415,167

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
80	2.00 YARDS & SHOPS (continued)						
81	2.09 COMMUNICATIONS	(Y/N)	2	\$6,907	\$572,302	\$1,137,698	\$1,130,791
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	2	\$144,470	\$508,143	\$871,816	\$727,347
83	2.11 MAINTENANCE OF WAY SHOPS		4	\$66,700	\$1,633,059	\$5,314,598	\$5,247,898
84	SIGNAL	(Y/N)					
85	TRACTION POWER	(Y/N)					
86	COMPONENT REPAIR	(Y/N)					
87	TRACK	(Y/N)					
88	2.12 MAINTENANCE OF WAY EQUIPMENT		2	\$27,261	\$41,900	\$56,539	\$29,278
89	TRUCK	Each					
90	CRANE	Each					
91	OTHER	Each					
92	2.13 REVENUE CENTER		1	\$1,206,213	\$1,206,213	\$1,206,213	\$0
93	CASH COUNTING MACHINE	Each					
94	VAULT	Each					
95	OTHER	Each					
96	2.14 CENTRAL CONTROL	(Y/N)	1	\$10,159,345	\$10,159,345	\$10,159,345	\$0
97	MIMIC BOARD	(Y/N)					
98	PUBLIC ADDRESS	(Y/N)					
99	COMPUTER	(Y/N)					
100	FIRE/INTRUSION DETECTOR	(Y/N)					
101	MAINLINE CONTROL	(Y/N)					
102	YARD CONTROL	(Y/N)					
103	SEISMIC OR GAS DETECTION	(Y/N)					
104	OTI :zR						
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity						
106	3.00 SYSTEMS		5	\$179	\$482	\$878	\$699
107	3.01 SIGNAL SYSTEM	Linear Feet	5	\$54	\$198	\$443	\$388
108	TRAIN CONTROL - WAYSIDE	L.F. Guideway					
109	INSTALLATION						
110	HARDWARE						
111	DESIGN						
112	CROSSING PROTECTION	Each					
113	TRAFFIC SIGNALS	Each					
114	INSTALLATION						
115	GATES	Each					
116	OTHER						
117	3.02 ELECTRIFICATION	L.F. Guideway	5	\$92	\$241	\$448	\$356
118	SUBSTATIONS	Each					

CAPITAL COST DATA BASE

UNIT COST SUMMARY

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	UNIT COST SUMMARY			
				OBSERVATIONS	MINIMUM	MEAN	MAXIMUM
119		3.00 SYSTEMS (continued)					
120	PURCHASE		Each				
121	INSTALLATION		Each				
122	CATENARY		L.F. Guideway				
123	INSTALLATION		Each				
124	POLES AND COMPONENTS		Each				
125	WIRE						
126	TROLLEY						
127	MESSENGER						
128	FEEDER						
129	RETURN						
130		3.03 COMMUNICATIONS	Total	\$196,121	\$7,477,427	\$17,348,680	\$17,152,559
131		3.04 FARE COLLECTION	Total	\$1,080,497	\$3,407,019	\$5,456,404	\$4,375,907
132	FAREBOX						
133	VENDING MACHINE						
134	OTHER						
135		4.00 STATIONS					
136		4.01 AT-GRADE	Each	\$180,861	\$1,431,936	\$3,205,143	\$3,024,282
137	CENTER PLATFORM		Each	\$180,861	\$800,732	\$1,961,305	\$1,780,443
138	PLATFORM LENGTH		Linear Feet	\$155,735	\$542,827	\$980,874	\$825,139
139	ESCALATOR/ELEVATOR		(Y/N)				
140	HANDICAP ACCESS MODE		Type				
141	WEATHER COVERAGE		Percent				
142	SIDE PLATFORM		Each	\$184,828	\$778,309	\$1,924,381	\$1,739,553
143	PLATFORM LENGTH		Linear Feet				
144	ESCALATOR/ELEVATOR		(Y/N)				
145	HANDICAP ACCESS MODE		Type				
146	WEATHER COVERAGE		Percent				
147		4.02 SUBWAY	Each	\$6,936,659	\$16,046,881	\$25,157,102	\$18,220,444
148	CENTER PLATFORM		Each				
149	PLATFORM LENGTH		Linear Feet				
150	ESCALATOR/ELEVATOR		(Y/N)				
151	HANDICAP ACCESS MODE		Type				
152	WEATHER COVERAGE		Percent				
153	SIDE PLATFORM		Each	\$6,936,659	\$16,046,881	\$25,157,102	\$18,220,443
154	PLATFORM LENGTH		Linear Feet				
155	ESCALATOR/ELEVATOR		(Y/N)				
156	HANDICAP ACCESS MODE		Type				
157	WEATHER COVERAGE		Percent				

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNIT COST SUMMARY				
UNITS OF MEASURE	OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE	
4.00 STATIONS (continued)						
4.03 ELEVATED	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0	
CENTER PLATFORM	Each					
PLATFORM LENGTH	Each					
ESCALATOR/ELEVATOR	Linear Feet					
HANDICAP ACCESS MODE	(Y/N)					
WEATHER COVERAGE	Type					
SIDE PLATFORM	Percent					
PLATFORM LENGTH	Each					
ESCALATOR/ELEVATOR	Linear Feet					
HANDICAP ACCESS MODE	(Y/N)					
WEATHER COVERAGE	Type					
WEATHER COVERAGE	Percent					
4.04 PARKING LOTS	Total	\$731,214	\$1,137,154	\$1,543,093	\$811,878	
NUMBER OF LOTS	2					
NUMBER OF SPACES						
4.05 PARKING GARAGES	Total					
NUMBER OF LOTS						
NUMBER OF SPACES						
4.06 PEDESTRIAN OVERPASSES	Total	\$908,360	\$908,360	\$908,360	\$0	
NUMBER OF SPACES	1					
5.00 VEHICLES						
5.01 REVENUE VEHICLES -- ORDER A						
MAKE/MANUFACTURER	Each	\$968,562	\$1,159,567	\$1,345,218	\$376,657	
BODY TYPE (RIGID,ARTIC)	Each	\$806,202	\$1,119,800	\$1,314,877	\$508,676	
LENGTH OVER COUPLERS	Name					
WIDTH	Type					
NUMBER SEATS	Linear Feet					
AIR CONDITIONING	Linear Feet					
CAB SIGNAL EQUIPMENT	Each					
TYPE OF STEPS (HIGH,LOW)	(Y/N)					
HANDICAPED (LIFT,RAMP)	Type					
ON-BOARD FAREBOX	Type					
PROCTUREMENT COST	(Y/N)					
SPECIAL PARTS	Total					
SPECIAL EQUIPMENT COST	Total					
5.02 REVENUE VEHICLES -- ORDER B	Total	\$1,255,800	\$1,255,800	\$1,255,800	\$0	
MAKE/MANUFACTURER	Each					
BODY TYPE (RIGID,ARTIC)	Name					
LENGTH OVER COUPLERS	Type					
	Linear Feet					

CAPITAL COST DATA BASE

UNIT COST SUMMARY

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	UNIT COST SUMMARY				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
197	5.00 VEHICLES (continued)						
198	WIDTH	Linear Feet					
199	NUMBER SEATS	Each					
200	AIR CONDITIONING	(Y/N)					
201	CAB SIGNAL EQUIPMENT	(Y/N)					
202	BRAKING SYSTEM (AIR,ELEC)	Type					
203	TYPE OF STEPS (HIGH,LOW)	Type					
204	HANDICAPED (LIFT,RAMP)	Type					
205	ON-BOARD FAREBOX	(Y/N)					
206	PROCUREMENT COST	Total					
207	SPARE PARTS	Total					
208	SPECIAL EQUIPMENT COST	Total					
209	5.03 REVENUE VEHICLES -- ORDER C	Each					
210	MAKE/MANUFACTURER	Name					
211	BODY TYPE (RIGID,ARTIC)	Type					
212	LENGTH OVER COUPLERS	Linear Feet					
213	WIDTH	Linear Feet					
214	NUMBER SEATS	Each					
215	AIR CONDITIONING	(Y/N)					
216	CAB SIGNAL EQUIPMENT	(Y/N)					
217	BRAKING SYSTEM (AIR,ELEC)	Type					
218	TYPE OF STEPS (HIGH,LOW)	Type					
219	HANDICAPED (LIFT,RAMP)	Type					
220	ON-BOARD FAREBOX	(Y/N)					
221	PROCUREMENT COST	Total					
222	SPARE PARTS	Total					
223	SPECIAL EQUIPMENT COST	Total					
224	5.04 NON-REVENUE VEHICLES	Each					
225	SERVICE TRUCKS		2	\$11,267	\$48,750	\$86,232	\$74,965
226	AUTOMOBILES						
227	OTHER						
228	6.00 SPECIAL CONDITIONS	Linear feet					
229	6.01 UTILITY RELOCATION - AS IS	Total	5	\$81	\$337	\$1,263	\$1,182
230	NEW INSTALLATION		5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
231	GAS						
232	TELEPHONE						
233	ELECTRIC						
234	WATER						
235	PIPELINE						

CAPITAL COST DATA BASE

UNIT COST SUMMARY

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	UNIT COST SUMMARY				
				OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
236	6.00	SPECIAL CONDITIONS (continued)						
237		RAILROAD						
238		OTHER						
239	6.02	UTILITY RELOCATION - BETTERMENTS	Total	3	\$495,549	\$41,497,095	\$118,408,923	\$117,914,373
240		NEW INSTALLATION						
241		GAS						
242		TELEPHONE						
243		ELECTRIC						
244		WATER						
245		PIPELINE						
246		RAILROAD						
247		OTHER						
248	6.03	UTILITY RELOCATION - OTHER	Total					
249		NEW INSTALLATION						
250		GAS						
251		TELEPHONE						
252		ELECTRIC						
253		WATER						
254		PIPELINE						
255		RAILROAD						
256		OTHER						
257	6.04	DEMOLITIONS	Total	5	\$112,628	\$511,718	\$956,912	\$844,284
258		BUILDINGS						
259		REMOVALS						
260	6.05	ROADWAY CHANGES	Total	2	\$2,220,974	\$7,086,721	\$11,952,468	\$9,731,494
261		BRIDGES						
262		STREETS						
263		OTHER						
264	6.06	ENVIRONMENTAL	Total	3	\$356,640	\$6,349,686	\$16,785,885	\$16,429,246
265		NOISE						
266		VISUAL						
267		VIBRATION						
268		OTHER						
269	7.00	RIGHT-OF-WAY	Linear Feet					
270		7.01 LAND ACQUISITION - PURCHASED	Total	5	\$160	\$346	\$600	\$440
271		MAINLINE	Acres	5	\$15,470,477	\$30,823,677	\$50,376,726	\$34,906,250
272		STATION	Acres					
273		YARD	Acres					
274		PARKING	Acres					

CAPITAL COST DATA BASE

UNIT COST SUMMARY

		UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	UNIT COST SUMMARY				
				OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
275		7.00 RIGHT-OF-WAY (continued)						
276		7.02 LAND ACQUISITION - DONATED	Total					
277		MAINLINE						
278		STATION						
279		YARD						
280		PARKING						
281		7.03 ACQUISITION-RELATED COST	Total	4	\$813,454	\$2,296,128	\$4,083,215	\$3,269,761
282		LEGAL & CONSULTING						
283		APPRAISAL						
284		PROPERTY MANAGEMENT						
285		7.04 RELOCATION	Total	3	\$139,942	\$267,577	\$471,332	\$331,390
286		BUSINESS						
287		RESIDENCE						
288		7.05 OTHER	Total					
289		8.00 SOFT-COSTS	Linear Feet					
290		8.01 FEASIBILITY STUDIES	Total	5	\$359	\$1,491	\$3,068	\$2,708
291		8.02 ENGINEERING & DESIGN	Total	3	\$3,718,000	\$20,812,653	\$36,398,671	\$32,680,671
292		8.03 CONSTRUCTION MANAGEMENT	Total	3	\$16,009,645	\$68,189,928	\$119,758,747	\$103,749,102
293		8.04 PROJECT MANAGEMENT	Total	5	\$9,576,163	\$36,506,471	\$85,158,669	\$75,582,506
294		8.05 PROJECT MANAGEMENT OVERSIGHT	Total	5	\$4,347,088	\$15,113,157	\$22,938,149	\$18,591,061
295		8.06 PROJECT INITIATION	Total	1	\$4,539,183	\$4,539,183	\$4,539,183	\$0
296		INSURANCE	Total	3	\$1,319,808	\$14,136,884	\$35,235,765	\$33,915,957
297		MOBILIZATION						
298		MAINTENANCE OF TRAFFIC						
299		8.07 FINANCE CHARGES		1	\$546,621	\$546,621	\$546,621	\$0
300		8.08 TRAINING/START-UP/TESTING		4	\$3,543,743	\$6,480,866	\$9,803,185	\$6,259,441
301		SAFETY CERTIFICATION						
302		OFF-SITE LRV TESTING						
303		8.09 OTHER		2	(\$16,589,228)	\$40,319,705	\$97,228,639	\$113,817,867

FTA Capital Cost Database
South Sacramento Corridor Project
as of December 31, 2002

FTA Code -or- RT Cost Account	RT Forecast Cost	Total Cost	FTA Cost Category
C1000	\$225,000		1.00 Guideway Elements
C1100	\$2,861,826		
C1300	\$27,349,010		
C1300A	\$3,159,125		
C1302	\$70,000		
M2100	\$1,786,787		
M2110	\$68,010		
M2200	\$1,766,569		
M2300	\$841,255		
M2400	\$471,798	\$38,599,380	
n/a	\$0	\$0	2.00 Yards & Shops
135-20	\$10,971,710		3.00 Systems
136-20	\$16,621,149	\$27,592,859	
133-30	\$23,616,039	\$23,616,039	4.00 Stations
131-30	\$62,160,034	\$62,160,034	5.00 Vehicles
U1200	\$50,000		6.00 Special Conditions
U1300	\$450,000		
U1310	\$300,000		
U1311	\$30,000		
U1312	\$91,000		
U1320	\$50,000		
U1321	\$50,000		
U1322	\$2,500,000		
U1323	\$765,923		
U1330	\$700,000		
U1331	\$519,777		
U1340	\$360,000		
U2200	\$78,200		
U2210	\$192,009		
U2230	\$9,059		
U2231	\$13,197	\$6,159,165	
137-50	\$28,429,914	\$28,429,914	7.00 Right of Way
137-10	\$22,205,070		8.00 Soft Costs
137-30	\$368,617		
137-90	\$12,517,194		
U1400	\$2,900		
U2100	\$247,737		
U2300	\$79,000		
U2400	\$22,091	\$35,442,609	
Project Total		\$222,000,000	



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