



U.S. Department
of Transportation

Urban Mass
Transportation
Administration

Light Rail Transit Capital Cost Study

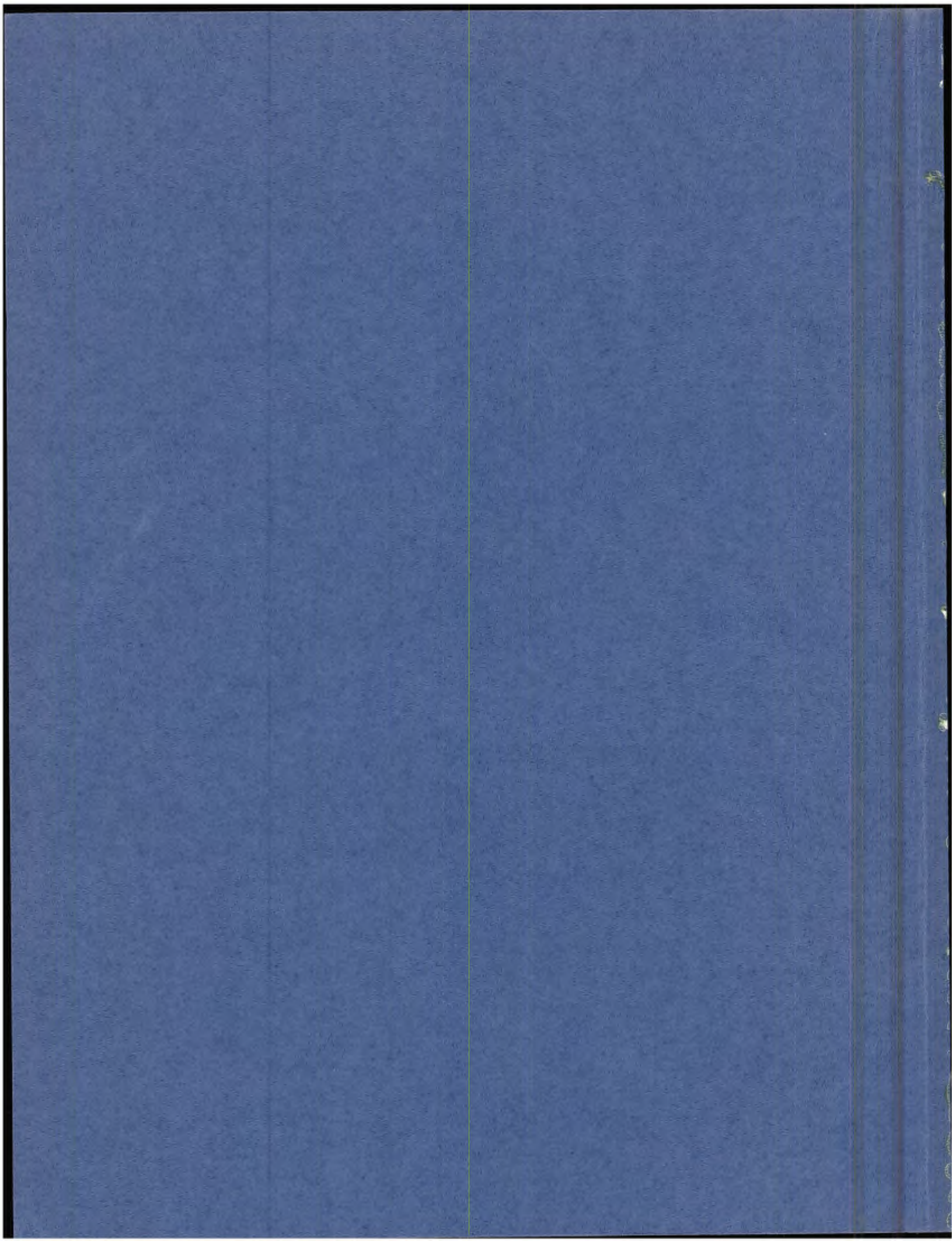
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16. Abstract This report presents the results of the study to document actual construction and related developmental costs for the most recently-constructed light rail transit systems in the United States. This fixed guideway capital cost study intended 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 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 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.					
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Light Rail Transit Capital Cost Study

Prepared by

**Transportation Consulting Division
Booz•Allen & Hamilton Inc.**

with assistance from

**Gibbs & Hill
and
Parsons, Brinckerhoff, Quade & Douglas**

April 5, 1991

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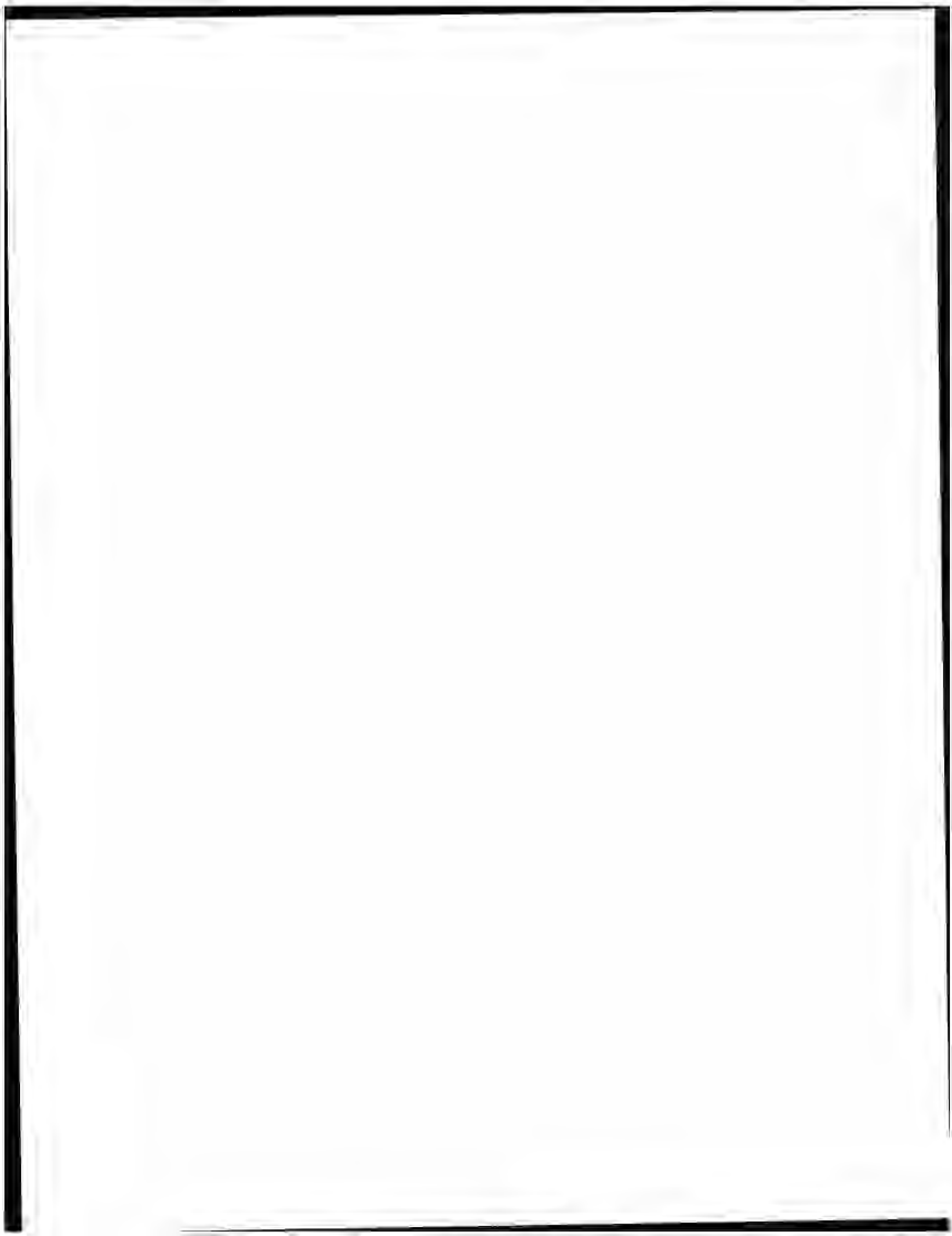
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PREFACE

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				
		COUNTS	MINIMUM	MEAN	MAXIMUM	RANGE
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	\$3,714	\$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						
EMBEDDED		2	\$506	\$1,936	\$3,365	\$2,859
1.03 GUIDEWAY - ELEVATED, RETAINED FILL	Linear Feet	2	\$847	\$1,009	\$1,172	\$325
DIRECT FIXATION						
BALLASTED		2	\$847	\$1,009	\$1,172	\$325
IN-PAVEMENT BALLASTED						
EMBEDDED						
1.04 GUIDEWAY - ELEVATED FILL	Linear Feet	1	\$616	\$616	\$616	\$0
DIRECT FIXATION						
BALLASTED		1	\$616	\$616	\$616	\$0
IN-PAVEMENT BALLASTED						
EMBEDDED						
1.05 GUIDEWAY - SUBWAY	Linear Feet	2	\$6,329	\$7,443	\$8,557	\$2,228
DIRECT FIXATION		2	\$6,329	\$13,530	\$20,730	
BALLASTED						
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						
BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
IN-PAVEMENT BALLASTED						
EMBEDDED						
1.07 POCKET TRACK	L.F. Guideway	2	\$2.81	\$34.11	\$65.41	\$62.61
1.08 STORAGE TRACK	L.F. Guideway					
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	<i>Linear Feet</i>	5	\$179	\$482	\$878	\$699
3.01 SIGNAL SYSTEM	<i>L.F. Guideway</i>	5	\$54	\$198	\$443	\$388
3.02 ELECTRIFICATION	<i>L.F. Guideway</i>	5	\$92	\$241	\$448	\$356
3.03 COMMUNICATIONS	<i>Total</i>	4	\$196,121	\$7,477,427	\$17,348,680	\$17,152,559
3.04 FARE COLLECTION	<i>Total</i>	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	<i>Each</i>	5	\$180,861	\$1,431,936	\$3,205,143	\$3,024,282
4.01 AT-GRADE	<i>Each</i>	5	\$180,861	\$800,732	\$1,961,305	\$1,780,443
4.02 SUBWAY	<i>Each</i>	2	\$6,936,659	\$16,046,881	\$25,157,102	\$18,220,444
4.03 ELEVATED	<i>Each</i>	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
4.04 PARKING LOTS	<i>Total</i>	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
4.05 PARKING GARAGES	<i>Total</i>					
4.06 PEDESTRIAN OVERPASSES	<i>Total</i>	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	<i>Each</i>	5	\$968,562	\$1,159,567	\$1,345,218	\$376,657
5.01 REVENUE VEHICLES -- ORDER A	<i>Each</i>	5	\$806,202	\$1,119,800	\$1,314,877	\$508,676
5.02 REVENUE VEHICLES -- ORDER B	<i>Each</i>	1	\$1,255,800	\$1,255,800	\$1,255,800	\$0
5.03 REVENUE VEHICLES -- ORDER C	<i>Each</i>					
5.04 NON-REVENUE VEHICLES	<i>Each</i>	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	<i>Linear feet</i>	5	\$81	\$337	\$1,263	\$1,182
6.01 UTILITY RELOCATION - AS IS	<i>Total</i>	5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
6.02 UTILITY RELOCATION - BETMTS.	<i>Total</i>	3	\$495,549	\$41,497,095	\$118,409,923	\$117,914,373
6.03 UTILITY RELOCATION - OTHER	<i>Total</i>					
6.04 DEMOLITIONS	<i>Total</i>	5	\$112,628	\$511,718	\$956,912	\$844,284
6.05 ROADWAY CHANGES	<i>Total</i>	2	\$2,220,974	\$7,086,721	\$11,952,468	\$9,731,494
6.06 ENVIRONMENTAL	<i>Total</i>	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	<i>Linear Feet</i>	5	\$160	\$346	\$600	\$440
7.01 LAND ACQUISITION - PURCHASED	<i>Total</i>	5	\$15,470,477	\$30,823,677	\$50,376,726	\$34,906,250
7.02 LAND ACQUISITION - DONATED	<i>Total</i>					
7.0 ACQUISITION-RELATED COST	<i>Total</i>	4	\$813,454	\$2,296,128	\$4,083,215	\$3,269,761
7.04 RELOCATION	<i>Total</i>	3	\$139,942	\$267,577	\$471,332	\$331,390
7.05 OTHER	<i>Total</i>					

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

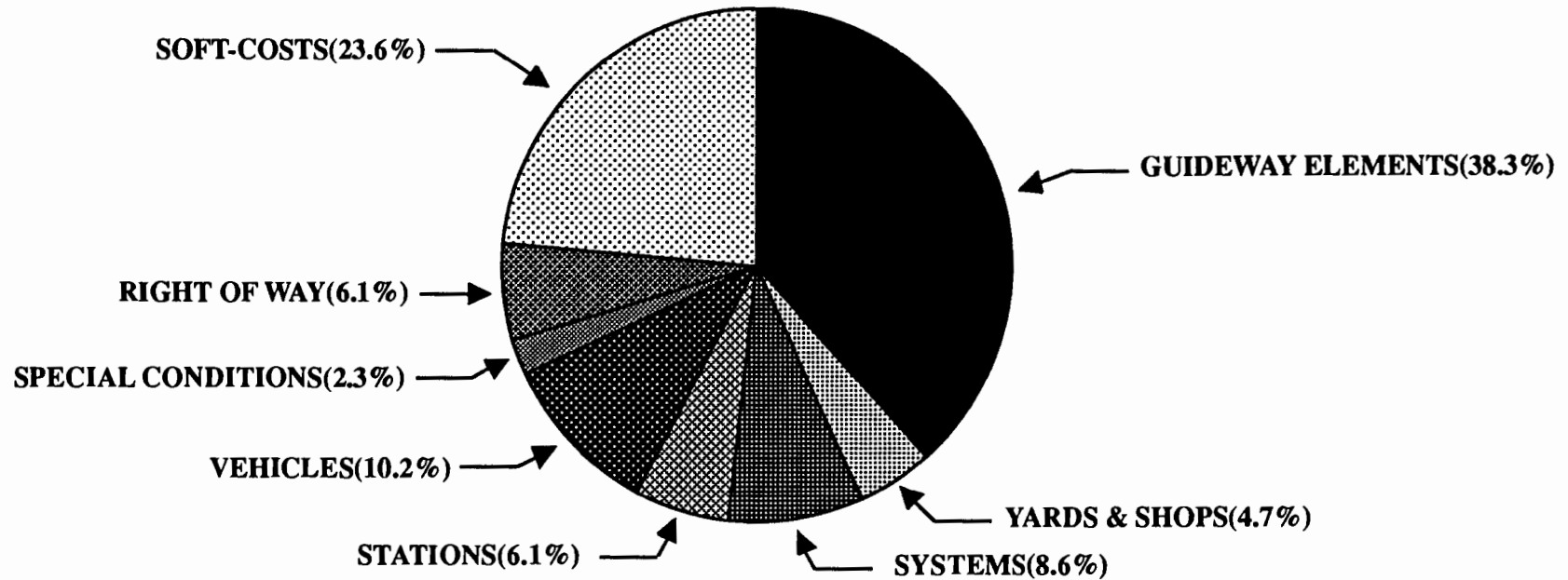
Total project cost per route mile averaged \$27.5 million with a range from \$9.746 million to \$41.748 million. Reasons for these variations are more evident from the sub-category data presented in the following sections.

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.

**EXHIBIT 12
TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT
CAPITAL COSTS BY PROJECT CATEGORY**

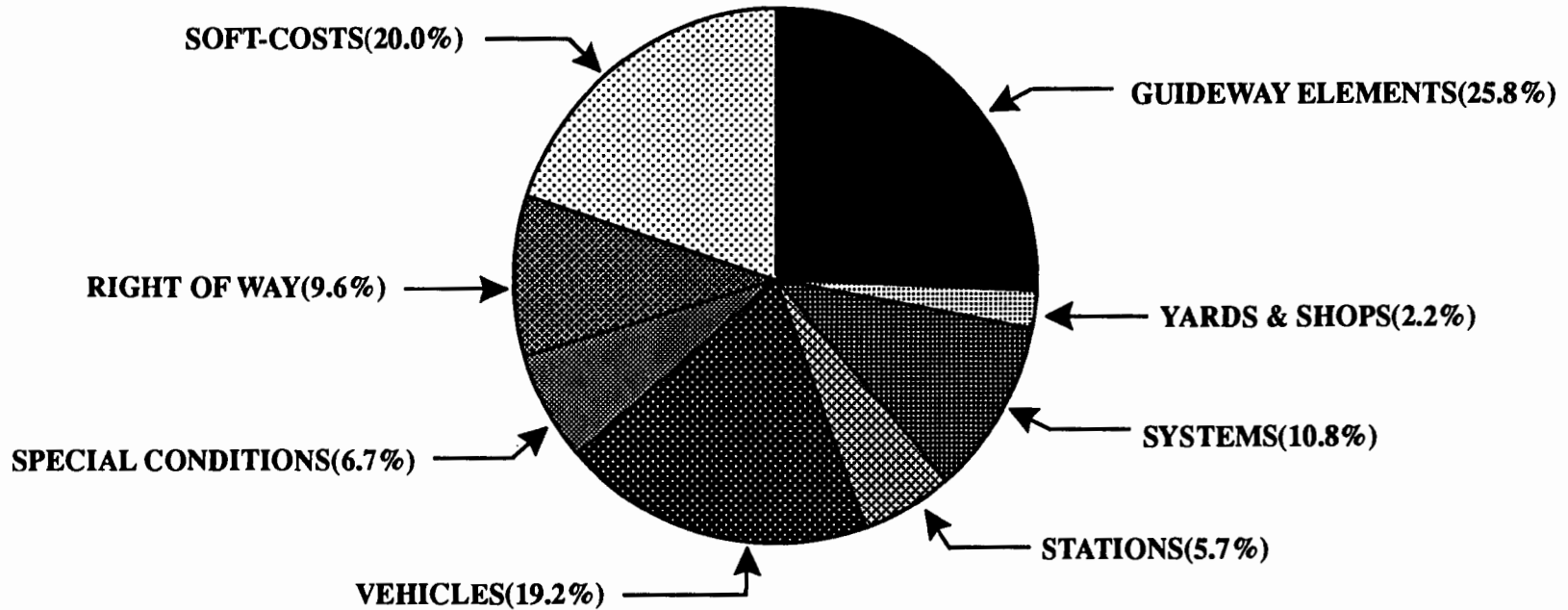


	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	38.3%	\$94,599,637	\$107,600,218	\$106,600,218
2.00 YARDS & SHOPS	4.7%	\$11,602,000	\$13,490,698	\$13,355,791
3.00 SYSTEMS	8.6%	\$21,167,000	\$24,503,700	\$23,813,163
4.00 STATIONS	6.1%	\$15,107,000	\$17,050,800	\$16,880,275
5.00 VEHICLES	10.2%	\$25,218,000	\$33,579,234	\$33,243,444
6.00 SPECIAL CONDITIONS	2.3%	\$5,756,000	\$6,574,678	\$6,494,499
7.00 RIGHT OF WAY	6.1%	\$15,070,000	\$17,158,306	\$16,997,948
TOTAL HARD COSTS	76.4%	\$188,519,637	\$219,957,634	\$217,385,338
8.00 SOFT-COSTS	23.6%	\$58,278,000	\$65,758,780	\$65,105,348
TOTAL PROJECT COST	100.0%	\$246,797,637	\$285,716,414	\$282,490,686

- *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.

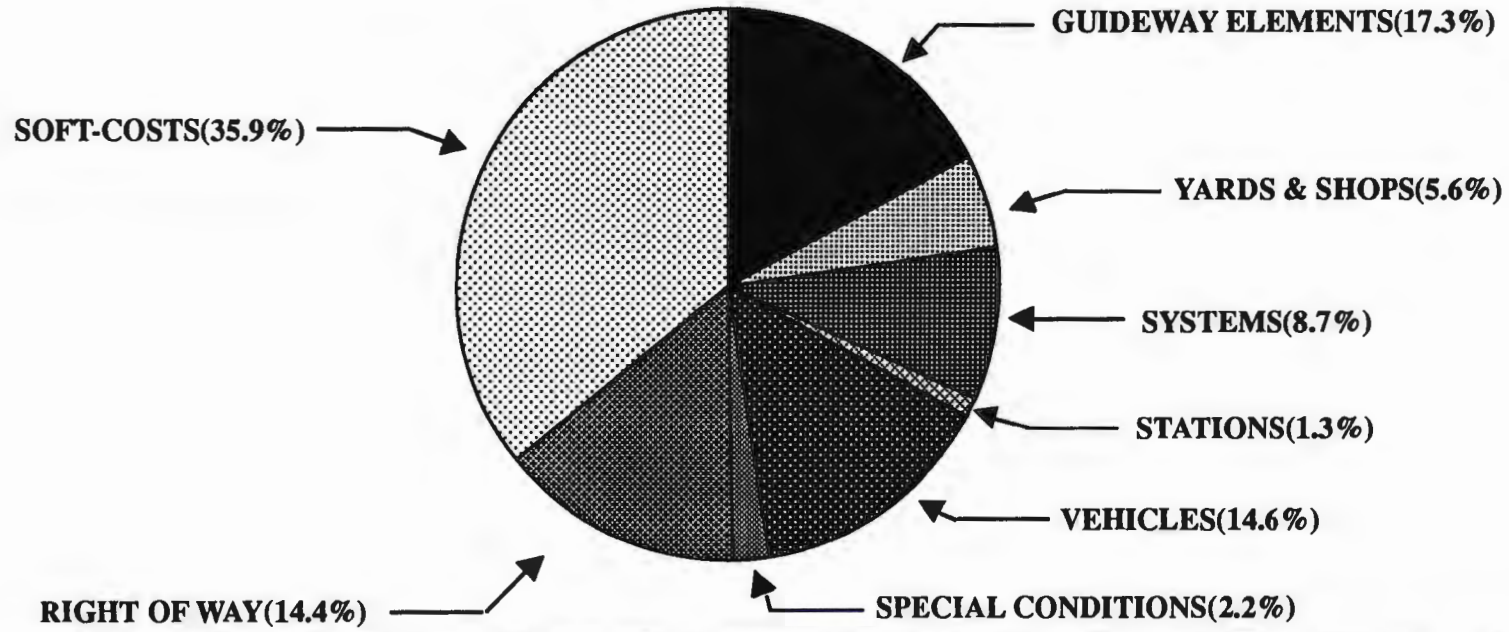
- *San Jose*, Exhibit 14, is the initial line of a planned larger light rail system which includes some higher unit costs and additional facilities that relate to the expanded system base, such as yards and shops and other systems capacity. These particular component unit costs would be more representative 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	25.8%	\$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**

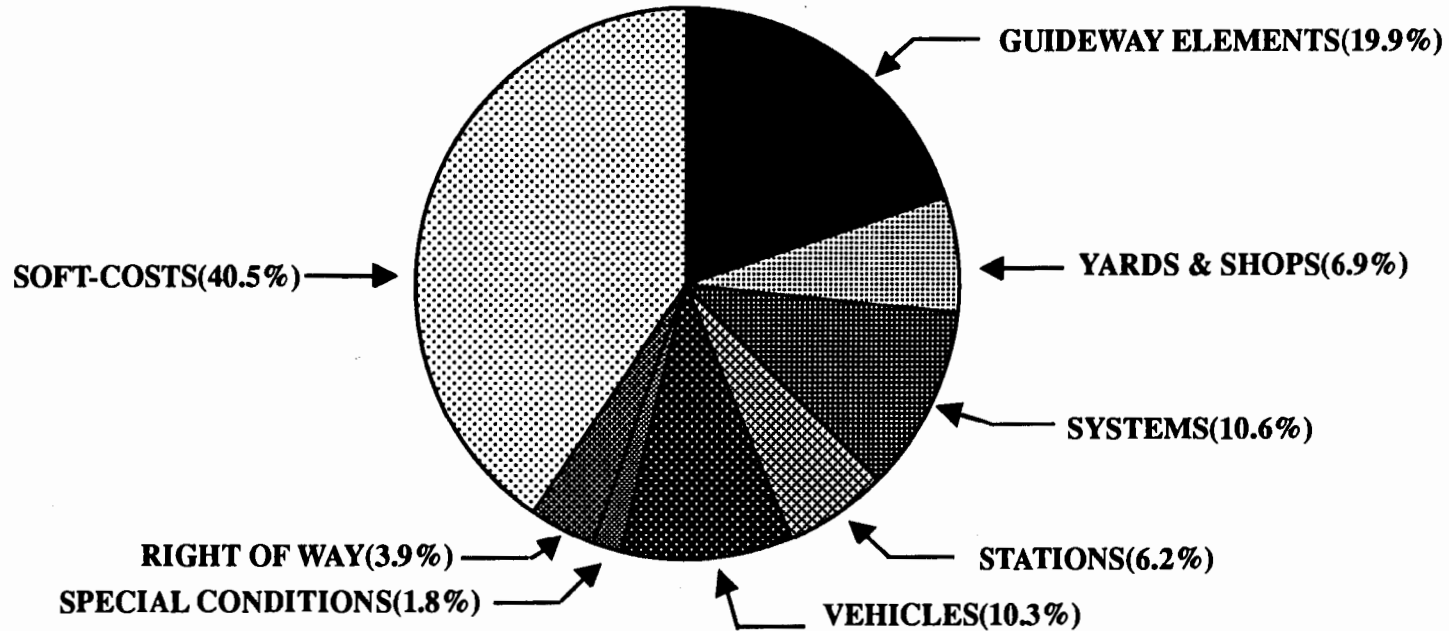


	"AS BUILT" COSTS AS % OF TOTAL COST	"AS BUILT" COSTS (Y-O-E) DOLLARS	CITY COSTS 1990 DOLLARS	NATIONAL COSTS 1990 DOLLARS
1.00 GUIDEWAY ELEMENTS	17.3%	\$65,887,000	\$70,078,704	\$56,095,864
2.00 YARDS & SHOPS	5.6%	\$21,291,136	\$23,578,224	\$18,862,579
3.00 SYSTEMS	8.7%	\$33,124,742	\$33,158,400	\$26,505,600
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.

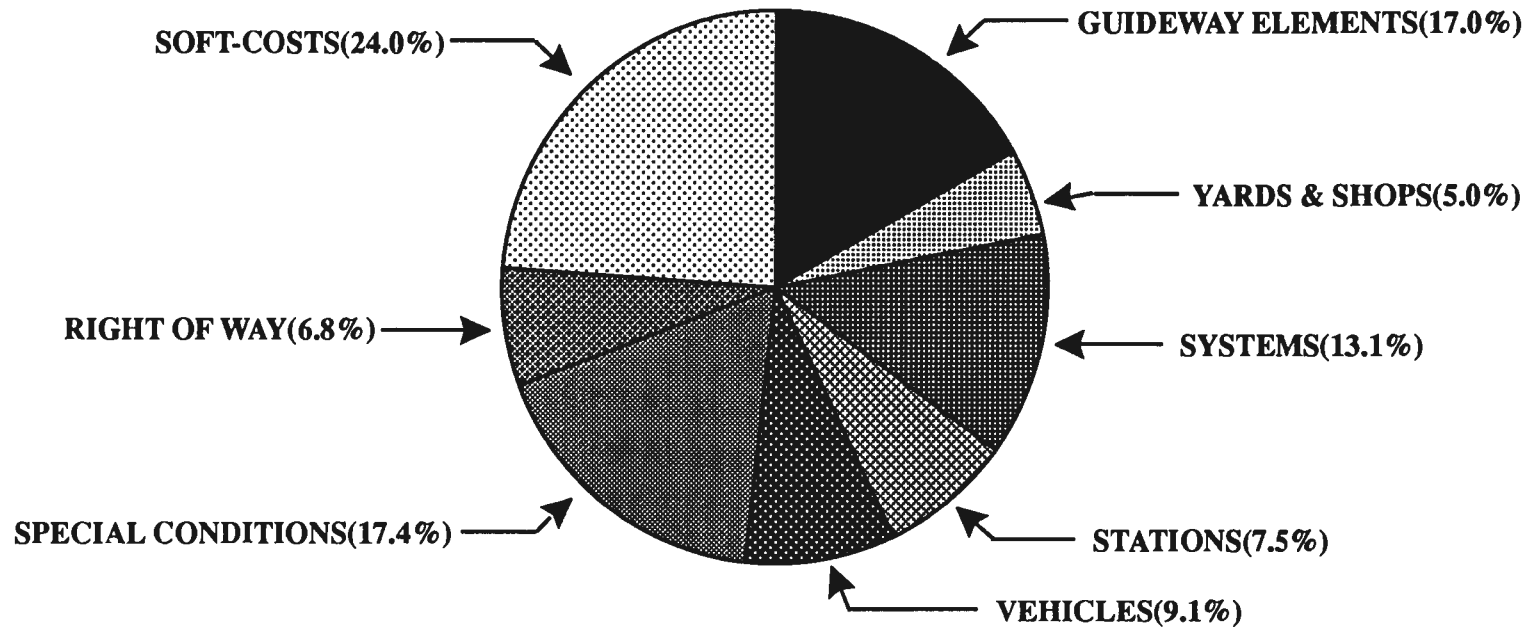
These "as built", city, and national costs by component category form the basis for the comparative unit cost analysis using the normalized national unit cost calculations.

**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	<u>3.9%</u>	<u>\$21,511,920</u>	<u>\$24,988,192</u>	<u>\$24,823,796</u>
TOTAL HARD COSTS	59.6%	\$330,773,882	\$375,273,469	\$371,904,382
8.00 SOFT-COSTS	<u>40.5%</u>	<u>\$224,751,180</u>	<u>\$253,663,028</u>	<u>\$252,183,464</u>
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

	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
At-Grade Avg.	\$1,205	\$413	\$609	\$460	\$636	\$665
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

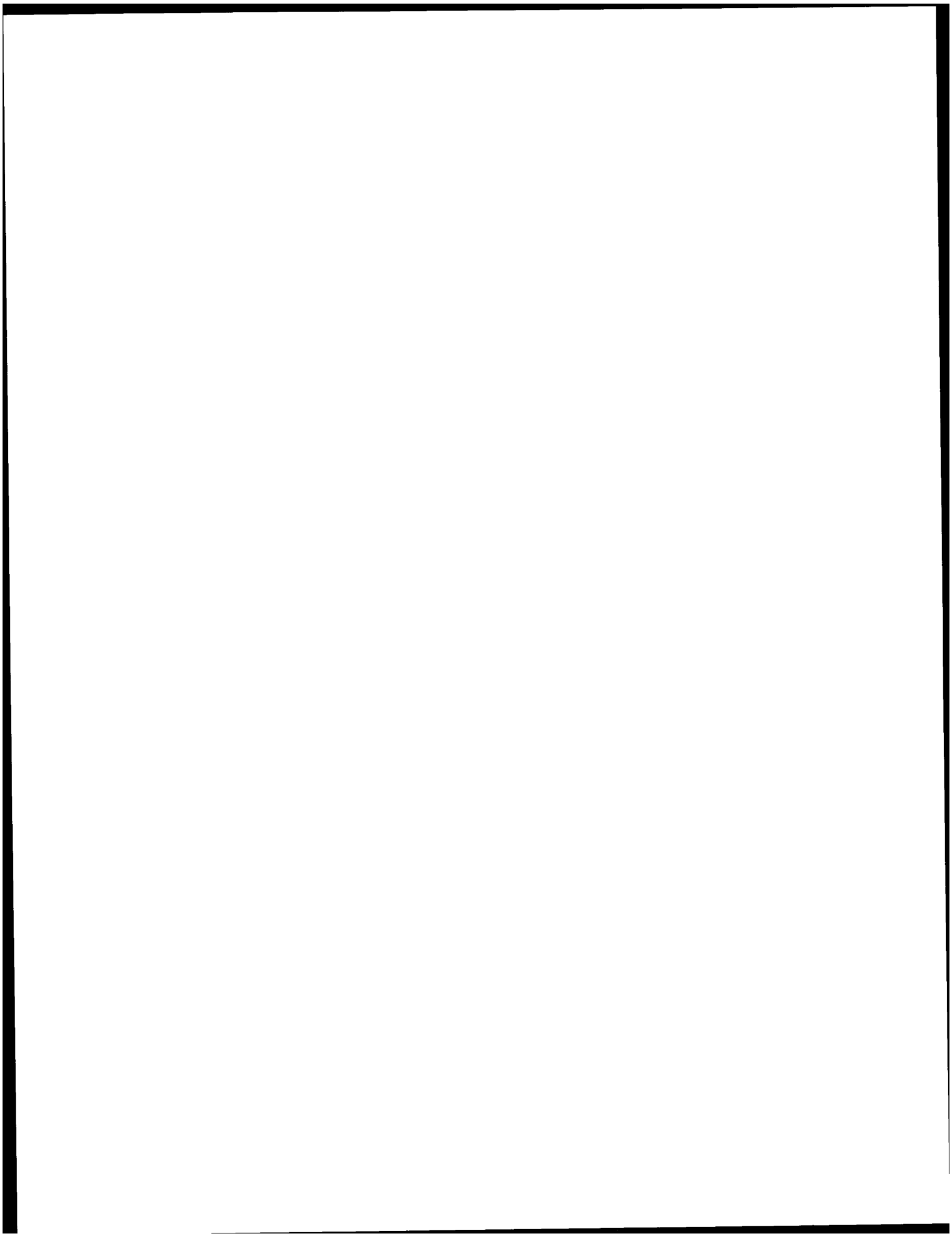
Cost per Linear Foot of Guideway	<u>Portland</u>	<u>Sacramento</u>	<u>San Jose</u>	<u>Pittsburgh</u>	<u>Los Angeles</u>	<u>Average</u>
• Land	\$192.95	\$152.46	\$563.41	\$302.48	\$422.34	\$326.73
• Legal & Consulting	\$33.99	\$4.41	\$10.14	NR	\$16.89	\$16.36
• Appraisal	\$33.99	\$2.78	\$10.14	NR	\$0.31	\$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.

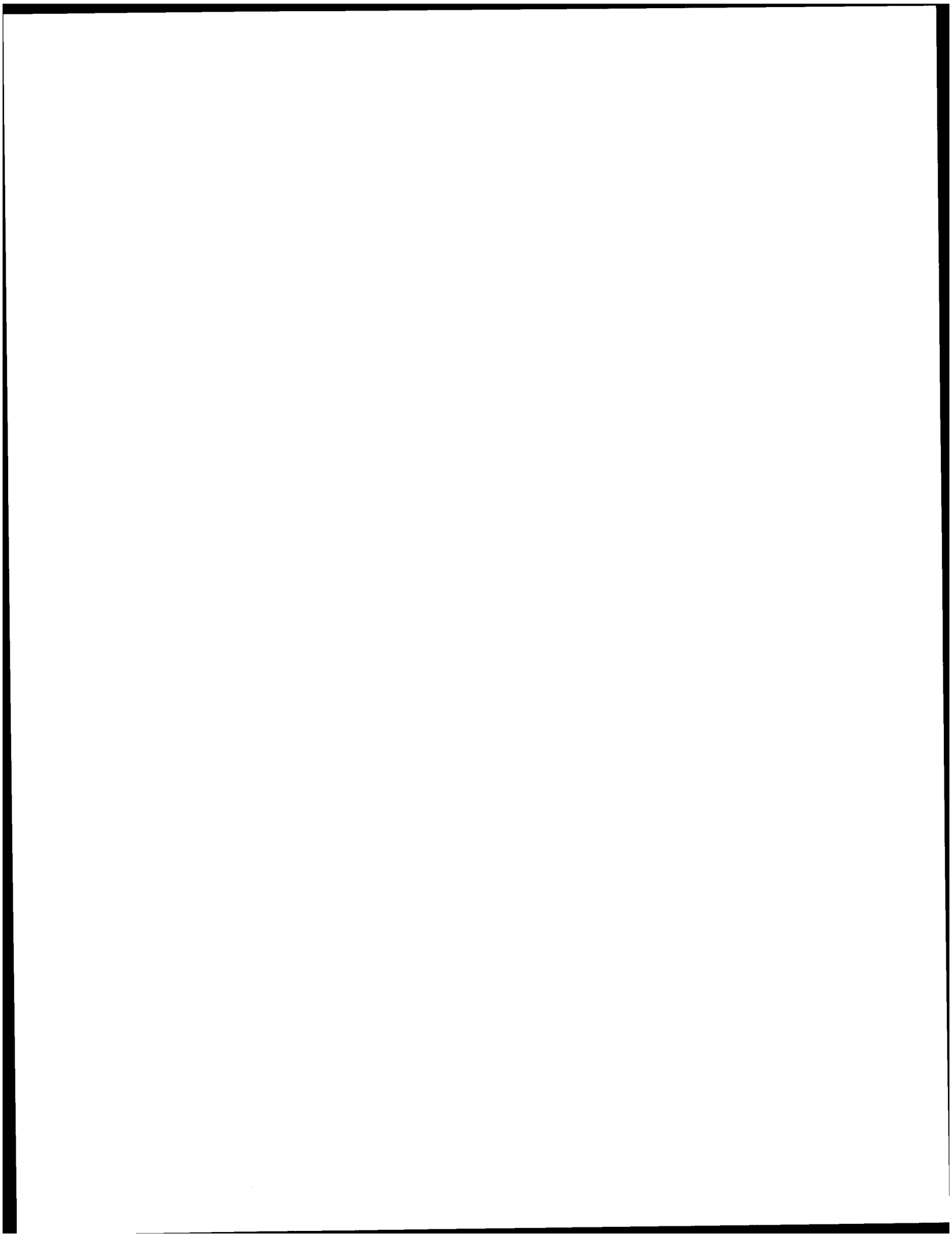
Exhibit 23
Summary of Project Soft Costs
1990 National Dollars
All Costs Per Linear Foot of Guideway

	<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						
• Insurance	\$73.02	\$11.79			\$295.75	
• Mobilization			\$75.58			
• Maintenance of Traffic			\$5.40			
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

	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

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	1.00 GUIDEWAY ELEMENTS	<i>Linear Feet</i>	80,179	\$1,180	\$94,599,637		1984	\$1,342	\$1,329
2	1.01 GUIDEWAY AT-GRADE	<i>Linear Feet</i>	52,212	\$1,070	\$55,869,000		1984	\$1,217	\$1,205
3	DIRECT FIXATION								
4	BALLASTED		42,949	\$590		\$25,327,000	1983	\$686	\$679
5	IN-PAVEMENT BALLASTED								
6	EMBEDDED		9,263	\$3,297		\$30,542,000	1984	\$3,751	\$3,714
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	<i>Linear Feet</i>	4,032	\$2,700	\$10,886,000		1984	\$3,072	\$3,041
8	DIRECT FIXATION								
9	BALLASTED		1,713	\$2,310		\$3,957,000	1984	\$2,628	\$2,602
10	IN-PAVEMENT BALLASTED								
11	EMBEDDED		2,319	\$2,988		\$6,929,000	1984	\$3,399	\$3,365
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	<i>Linear Feet</i>	23,665	\$1,018	\$24,089,000		1983	\$1,184	\$1,172
13	DIRECT FIXATION								
14	BALLASTED		23,665	\$1,018		\$24,089,000	1983	\$1,184	\$1,172
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	1.04 GUIDEWAY - ELEVATED FILL	<i>Linear Feet</i>							
18	DIRECT FIXATION								
19	BALLASTED								
20	IN-PAVEMENT BALLASTED								
21	EMBEDDED								
22	1.05 GUIDEWAY - SUBWAY	<i>Linear Feet</i>							
23	DIRECT FIXATION								
24	BALLASTED								
25	IN-PAVEMENT BALLASTED								
26	EMBEDDED								
27	1.06 GUIDEWAY - RETAINED CUT	<i>Linear Feet</i>	270	\$4,804	\$1,297,000		1984	\$5,465	\$5,410
28	DIRECT FIXATION								
29	BALLASTED		270	\$4,804		\$1,297,000	1984	\$5,465	\$5,410
30	IN-PAVEMENT BALLASTED								
31	EMBEDDED								
32	1.07 POCKET TRACK	<i>L.F. Guideway</i>	80,179	\$2.49	\$200,000		1984	\$2.84	\$2.81
33	1.08 STORAGE TRACK	<i>L.F. Guideway</i>							
34	1.09 SPECIAL TRACKWORK	<i>L.F. Guideway</i>	80,179	\$28.17	\$2,258,637		1983	\$32.76	\$32.43
35	TURNOUTS	Each	58	\$21,163	\$1,227,445		1983	\$24,608	\$24,362
36	#5		31	\$18,458		\$572,198	1982		
37	#4								
38	#6		7	\$19,237		\$134,659	1983	\$22,369	\$22,145
39	#8		17	\$21,551		\$366,367	1983	\$25,059	\$24,809
40	#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
41	1.00 GUIDEWAY ELEMENTS (continued)								
42	#20		3	\$51,407		\$154,221	1983	\$59,776	\$59,178
43	OTHER - SPECIFY		20	\$51,560	\$1,031,192		1982	\$63,108	\$62,477
44	GIRDER,25 METER		1	\$112,546		\$112,546	1982		
45	GIRDER,50 METER		9	\$46,804		\$421,236	1982		
46	#4, GIRDER		10	\$49,741		\$497,410	1982		
47	#8 SINGLE CROSSOVER								
48	#4,DOUBLE CROSSOVER								
49	#5,DOUBLE CROSSOVER								
50	INTERSECTION								
51	1.10 GUIDEWAY-SPECIAL STRUCTURES	Linear Feet							
52	BRIDGES	Each							
53	OVERPASSES	Each							
54	OTHER	Each							
55	2.00 YARDS & SHOPS	Total	1	\$11,602,000	\$11,602,000		1983	\$13,490,698	\$13,355,791
56	2.01 BUILDING	Each	1	\$9,201,000	\$9,201,000		1983	\$10,698,837	\$10,591,849
57	DESCRIPTION	Each				\$9,201,000			
58	SHOP CAPACITY *	Revenue Vehicles	100	\$116,020			1983	\$134,907	\$133,558
59	YARD STORAGE CAPACITY	Revenue Vehicles	26						
60	WORKSTATIONS	Each	12						
61	TRACK LENGTH	Linear Feet	7,728						
62	PARKING	Spaces							
63	2.02 OFFICE FURNITURE & EQUIP.	All							
64	2.03 HEAVY REPAIR		1	\$60,000	\$60,000		1983	\$69,767	\$69,070
65	BODY	(Y/N)	Y						
66	TRUCK	(Y/N)	Y						
67	EQUIPMENT	(Y/N)	Y			\$60,000	1983		
68	2.04 MOTOR SHOPS		1	\$10,000	\$10,000		1983	\$11,628	\$11,512
69	VARIABLE TEST LOAD	(Y/N)	N						
70	REWIND	(Y/N)							
71	OTHER	(Y/N)				\$10,000	1983		
72	2.05 WHEEL SHOP		1	\$676,000	\$676,000		1983	\$786,047	\$778,186
73	WHEEL PRESS	Each				\$124,000			
74	WHEEL TRUING	Each				\$552,000			
75	2.06 MACHINE SHOP		1	\$205,000	\$205,000		1983	\$238,372	\$235,988
76	LATHE	Each				\$55,000			
77	DRILL PRESS	Each				\$150,000			
78	2.07 AIR CONDITIONING	(Y/N)							
79	2.08 ELECTRONICS	(Y/N)	1	\$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		1983	\$6,977	\$6,907
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	1						
83	2.11 MAINTENANCE OF WAY SHOPS		1	\$137,000	\$137,000		1983	\$159,302	\$157,709
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		1984	\$57,110	\$56,539
89	TRUCK	Each	10	\$51,900		\$519,000	1984		
90	CRANE	Each	1	\$54,000		\$54,000	1984		
91	OTHER	Each	4	\$45,000		\$180,000	1984		
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 SYSTEMC	Linear Feet	80,179	\$264.00	\$21,167,000		1984	\$300	\$297
107	3.01 SIGNAL SYSTEM	L.F. Guideway	80,179	\$92.99	\$7,456,000		1984	\$106	\$105
108	TRAIN CONTROL - WAYSIDE		80,179	\$85.52	\$6,857,000		1984	\$97	\$96
109	INSTALLATION		80,179	\$85.52		\$6,857,000	1984		
110	HARDWARE								
111	DESIGN								
112	CROSSING PROTECTION	Each	21	\$28,524	\$599,000		1984	\$32,450	\$32,126
113	TRAFFIC SIGNALS	Each	21	\$28,524		\$599,000	1984	\$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		1984	\$149	\$147
118	SUBSTATIONS	Each	15	\$236,667	\$3,550,000		1984	\$269,245	\$266,553

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		
119	3.00 SYSTEMS (continued)							
120	PURCHASE	Each	15	\$220,000		\$3,300,000	1984	
121	INSTALLATION	Each				\$250,000		
122	CATENARY	L.F. Guideway	80,179	\$86.52	\$6,937,000		1984	\$98
123	INSTALLATION	Each	80,179	\$6.24		\$500,000	1984	
124	POLES AND COMPONENTS	Each	1,000	\$6,000		\$6,000,000	1984	\$6,826
125	WIRE		330,000	\$1.32		\$437,000	1984	\$1.51
126	TROLLEY		330,000	\$1.32		\$437,000	1984	
127	MESSENGER							
128	FEEDER							
129	RETURN							
130	3.03 COMMUNICATIONS	Total						
131	3.04 FARE COLLECTION	Total	1	\$3,224,000	\$3,224,000		1984	\$3,667,804
132	FAREBOX							
133	VENDING MACHINE		68	\$35,632		\$2,423,000	1984	
134	OTHER		88	\$9,102		\$801,000	1984	
135	4.00 STATIONS	Each	25	\$604,280	\$15,107,000		1985	\$682,032
136	4.01 AT-GRADE	Each	25	\$473,400	\$11,835,000		1985	\$534,312
137	CENTER PLATFORM	Each	5	\$440,200	\$2,201,000		1985	\$496,840
138	PLATFORM LENGTH	Linear Feet	1,000	\$80,000		\$2,000,000		\$491,871
139	ESCALATOR/ELEVATOR	(Y/N)	0/3					
140	HANDICAP ACCESS MODE	Type	WAYSIDE LIFT	\$40,200		\$201,000	1985	
141	WEATHER COVERAGE	Percent						
142	SIDE PLATFORM	Each	20	\$481,700	\$9,634,000		1985	\$543,679
143	PLATFORM LENGTH	Linear Feet	8,000	\$1,104		\$8,831,000		\$538,243
144	ESCALATOR/ELEVATOR	(Y/N)						
145	HANDICAP ACCESS MODE	Type	WAYSIDE LIFT	\$40,150		\$803,000	1985	
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						

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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
158	4.00 STATIONS (continued)								
159	4.03 ELEVATED	<i>Each</i>							
160	CENTER PLATFORM	<i>Each</i>							
161	PLATFORM LENGTH	<i>Linear Feet</i>							
162	ESCALATOR/ELEVATOR	<i>(Y/N)</i>							
163	HANDICAP ACCESS MODE	<i>Type</i>							
164	WEATHER COVERAGE	<i>Percent</i>							
165	SIDE PLATFORM	<i>Each</i>							
166	PLATFORM LENGTH	<i>Linear Feet</i>							
167	ESCALATOR/ELEVATOR	<i>(Y/N)</i>							
168	HANDICAP ACCESS MODE	<i>Type</i>							
169	WEATHER COVERAGE	<i>Percent</i>							
170	4.04 PARKING LOTS	<i>Total</i>	5	\$654,400	\$3,272,000		1985	\$738,600	\$731,214
171	NUMBER OF LOTS		5	\$654,400					
172	NUMBER OF SPACES		1,636	\$2,000		\$3,272,000	1985		
173	4.05 PARKING GARAGES	<i>Total</i>							
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	<i>Total</i>							
177	5.00 VEHICLES	<i>Each</i>	26	\$969,923	\$25,218,000		1981	\$1,291,509	\$1,278,594
178	5.01 REVENUE VEHICLES -- ORDER A	<i>Each</i>	26	\$965,269	\$25,097,000		1981	\$1,285,312	\$1,272,459
179	MAKE/MANUFACTURER	<i>Name</i>	BOMBARDIER	\$883,000		\$22,958,000	1981	\$1,175,766	\$1,164,008
180	BODY TYPE (RIGID,ARTIC)	<i>Type</i>	ARTIC						
181	LENGTH OVER COUPLERS	<i>Linear Feet</i>	89						
182	WIDTH	<i>Linear Feet</i>	8.7						
183	NUMBER SEATS	<i>Each</i>	76						
184	AIR CONDITIONING	<i>(Y/N)</i>	N						
185	CAB SIGNAL EQUIPMENT	<i>(Y/N)</i>	N						
186	BRAKING SYSTEM (AIR,ELEC)	<i>Type</i>	HYDRAULIC						
187	TYPE OF STEPS (HIGH,LOW)	<i>Type</i>	HIGH						
188	HANDICAPED (LIFT,RAMP)	<i>Type</i>	WAYSIDE LIFT						
189	ON-BOARD FAREBOX	<i>(Y/N)</i>	N						
190	PROCUREMENT COST	<i>Total</i>	26						
191	SPARE PARTS	<i>Total</i>	26	\$34,615		\$900,000	1981	\$46,092	\$45,631
192	SPECIAL EQUIPMENT COST	<i>Total</i>	26	\$47,654		\$1,239,000	1981	\$63,454	\$62,819
193	5.02 REVENUE VEHICLES -- ORDER B	<i>Each</i>							
194	MAKE/MANUFACTURER	<i>Name</i>							
195	BODY TYPE (RIGID,ARTIC)	<i>Type</i>							
196	LENGTH OVER COUPLERS	<i>Linear Feet</i>							

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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
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	12	\$10,083	\$121,000		1985	\$11,381	\$11,267
225	SERVICE TRUCKS		2	\$10,500		\$21,000	1985		
226	AUTOMOBILES		10	\$10,000		\$100,000	1985		
227	OTHER								
228	6.00 SPECIAL CONDITIONS	Linear feet	80,179	\$72	\$5,756,000		1984	\$82	\$81
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$5,656,000	\$5,656,000		1984	\$6,434,585	\$6,370,239
230	NEW INSTALLATION								
231	GAS								
232	TELEPHONE								
233	ELECTRIC		1	\$985,000		\$985,000	1984	\$1,120,592	\$1,109,386
234	WATER		1	\$4,671,000		\$4,671,000	1984	\$5,313,993	\$5,260,853
235	PIPELINE								

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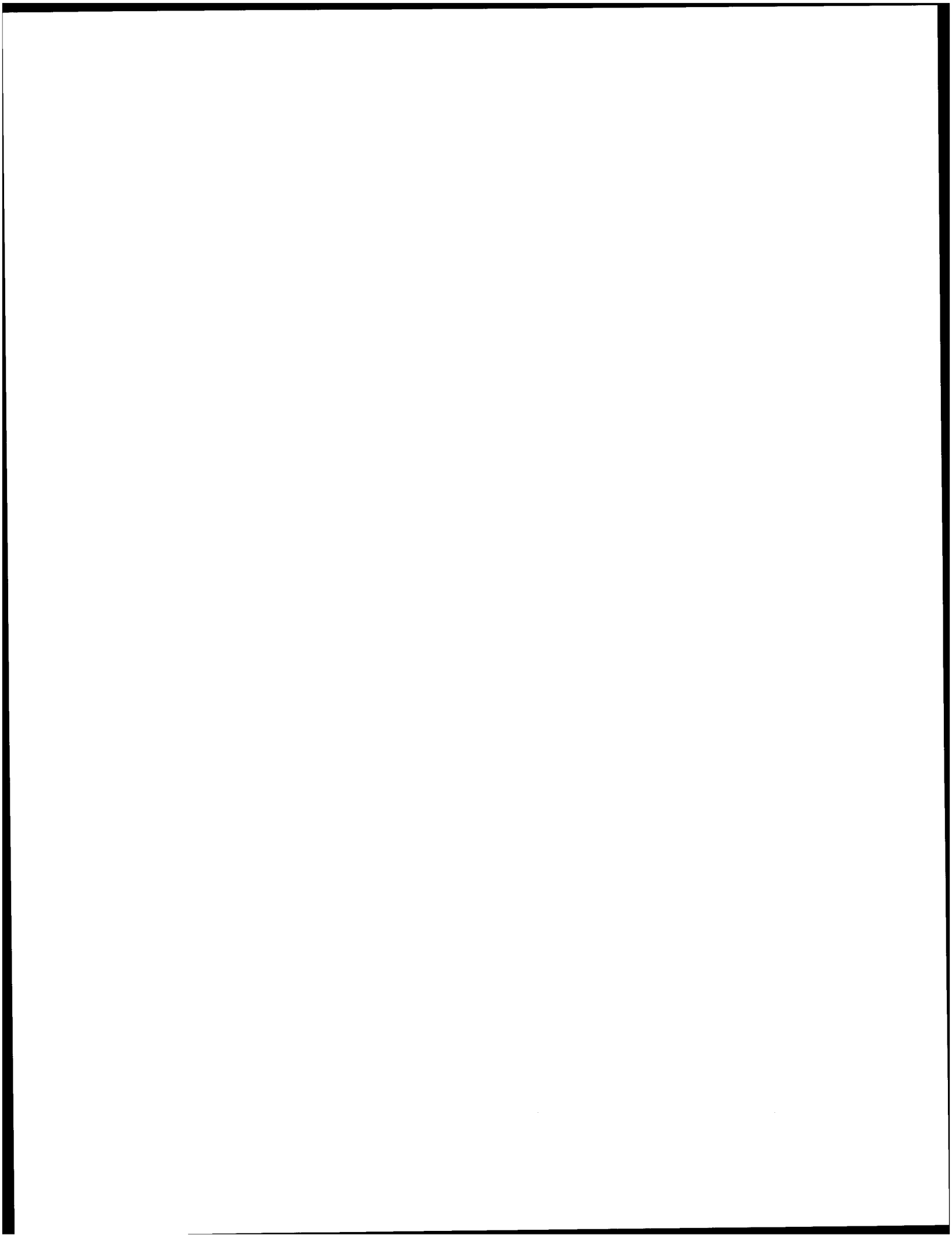
TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT

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
236	6.00 SPECIAL CONDITIONS (continued)								
237	RAILROAD								
238	OTHER								
239	6.02 UTILITY RELOCATION - BETTERMENTS	<i>Total</i>							
240	NEW INSTALLATION								
241	GAS								
242	TELEPHONE								
243	ELECTRIC								
244	WATER								
245	PIPELINE								
246	RAILROAD								
247	OTHER								
248	6.03 UTILITY RELOCATION - OTHER	<i>Total</i>							
249	NEW INSTALLATION								
250	GAS								
251	TELEPHONE								
252	ELECTRIC								
253	WATER								
254	PIPELINE								
255	RAILROAD								
256	OTHER								
257	6.04 DEMOLITIONS	<i>Total</i>	1	\$100,000	\$100,000		1984	\$113,766	\$112,628
258	BUILDINGS		6	\$16,667			1984		
259	REMOVALS								
260	6.05 ROADWAY CHANGES	<i>Total</i>							
261	BRIDGES								
262	STREETS								
263	OTHER								
264	6.06 ENVIRONMENTAL	<i>Total</i>							
265	NOISE								
266	VISUAL								
267	VIBRATION								
268	OTHER								
269	7.00 RIGHT-OF-WAY	<i>Linear Feet</i>	80,179	\$188	\$15,070,000		1984	\$214	\$212
270	7.01 LAND ACQUISITION - PURCHASED	<i>Total</i>	1	\$13,439,000	\$13,439,000		1983	\$15,626,744	\$15,470,477
271	MAINLINE	Acres	100	\$90,560					
272	STATION	Acres	10	\$100,000				\$1,000,000	
273	YARD	Acres	12	\$103,333				\$1,240,000	
274	PARKING	Acres	20	\$107,150				\$2,143,000	

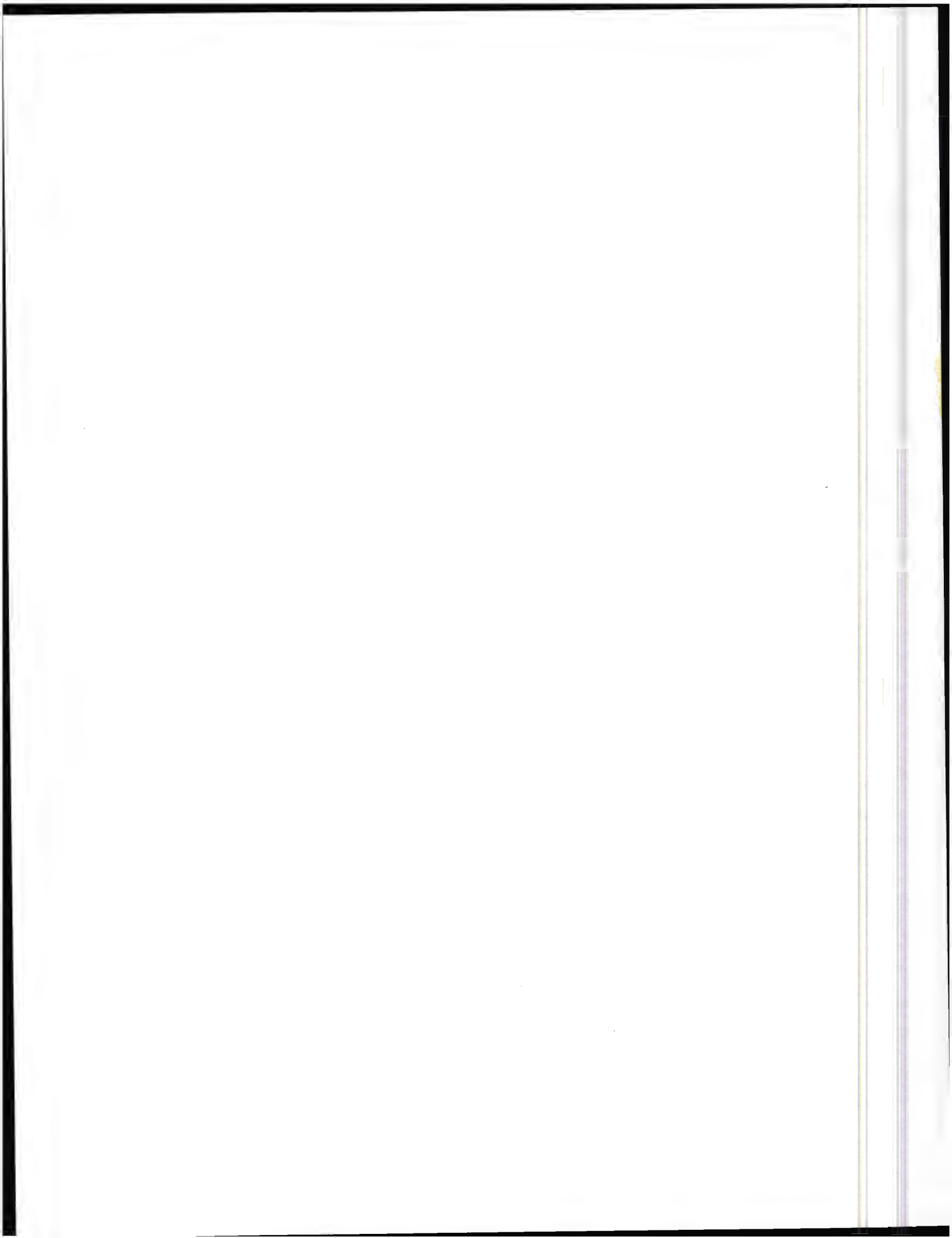
CAPITAL COST DATA BASE

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)							
276	7.02 LAND ACQUISITION - DONATED	<i>Total</i>						
277	MAINLINE							
278	STATION							
279	YARD							
280	PARKING							
281	7.03 ACQUISITION-RELATED COST	<i>Total</i>	1	\$1,473,000	\$1,473,000	1982	\$1,802,938	\$1,784,908
282	LEGAL & CONSULTING		1			1982	\$615,000	
283	APPRAISAL		1			1982	\$615,000	
284	PROPERTY MANAGEMENT		1			1982	\$243,000	
285	7.04 RELOCATION	<i>Total</i>	1	\$158,000	\$158,000	1982	\$193,390	\$191,457
286	BUSINESS		1	\$79,000		1982	\$79,000	
287	RESIDENCE		1	\$79,000		1982	\$79,000	
288	7.05 OTHER	<i>Total</i>						
289	8.00 SOFT-COSTS	<i>Linear Feet</i>	80,179	\$727	\$58,278,000	1985	\$820	\$812
290	8.01 FEASIBILITY STUDIES	<i>Total</i>	1	\$2,535,000	\$2,535,000	1980	\$3,755,556	\$3,718,000
291	8.02 ENGINEERING & DESIGN	<i>Total</i>	1	\$13,212,000	\$13,212,000	1982	\$16,171,359	\$16,009,645
292	8.03 CONSTRUCTION MANAGEMENT	<i>Total</i>	1	\$17,000,000	\$17,000,000	1984	\$19,340,159	\$19,146,758
293	8.04 PROJECT MANAGEMENT	<i>Total</i>	1	\$13,172,000	\$13,172,000	1985	\$14,866,817	\$14,718,149
294	8.05 PROJECT MANAGEMENT OVERSIGHT	<i>Total</i>						
295	8.06 PROJECT INITIATION	<i>Total</i>	1	\$5,240,000	\$5,240,000	1985	\$5,914,221	\$5,855,079
296	INSURANCE		1	\$5,240,000		1985	\$5,914,221	\$5,855,079
297	MOBILIZATION							
298	MAINTENANCE OF TRAFFIC							
299	8.07 FINANCE CHARGES							
300	8.08 TRAINING/START-UP/TESTING		1	\$7,119,000	\$7,119,000	1985	\$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

	<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

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			YEAR
1	1.00 GUIDEWAY ELEMENTS	<i>Linear Feet</i>	111,936	\$417	\$46,678,400		1985	\$471	\$428
2	1.01 GUIDEWAY AT-GRADE	<i>Linear Feet</i>	106,920	\$402	\$42,966,000		1985	\$454	\$413
3	DIRECT FIXATION								
4	BALLASTED		68,904	\$341		\$23,489,000	1985	\$385	\$350
5	IN-PAVEMENT BALLASTED		38,016	\$512		\$19,477,000	1985	\$578	\$526
6	EMBEDDED								
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	<i>Linear Feet</i>	5,016	\$399	\$2,000,000		1985	\$450	\$410
8	DIRECT FIXATION		5,016	\$399		\$2,000,000	1985	\$450	\$410
9	BALLASTED								
10	IN-PAVEMENT BALLASTED								
11	EMBEDDED								
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	<i>Linear Feet</i>							
13	DIRECT FIXATION								
14	BALLASTED								
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	1.04 GUIDEWAY - ELEVATED FILL	<i>Linear Feet</i>							
18	DIRECT FIXATION								
19	BALLASTED								
20	IN-PAVEMENT BALLASTED								
21	EMBEDDED								
22	1.05 GUIDEWAY - SUBWAY	<i>Linear Feet</i>							
23	DIRECT FIXATION								
24	BALLASTED								
25	IN-PAVEMENT BALLASTED								
26	EMBEDDED								
27	1.06 GUIDEWAY - RETAINED CUT	<i>Linear Feet</i>							
28	DIRECT FIXATION								
29	BALLASTED								
30	IN-PAVEMENT BALLASTED								
31	EMBEDDED								
32	1.07 POCKET TRACK	<i>L.F. Guideway</i>							
33	1.08 STORAGE TRACK	<i>L.F. Guideway</i>							
34	1.09 SPECIAL TRACKWORK	<i>L.F. Guideway</i>	111,936	\$15.30	\$1,712,400		1985	\$17.27	\$15.71
35	TURNOUTS	Each	25	\$34,248		\$856,200	1985	\$38,655	\$35,176
36	#5								
37	#4								
38	#6		4	\$25,000		\$100,000	1985	\$28,217	\$25,677
39	#8		8	\$30,000		\$240,000	1985	\$33,860	\$30,813
40	#10		5	\$33,000		\$165,000	1985	\$37,246	\$33,894

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			YEAR
41	1.00 GUIDEWAY ELEMENTS (continued)								
42	#20		8	\$43,900		\$351,200	1985	\$49,549	\$45,089
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>			<i>N.R.</i>				
52	BRIDGES	Each	1						
53	OVERPASSES	Each	2						
54	OTHER	Each							
55	2.00 YARDS & SHOPS	Total	1	\$3,979,000	\$3,979,000		1985	\$4,490,971	\$4,086,783
56	2.01 BUILDING	Each	1	\$3,979,000	\$3,979,000		1985	\$4,490,971	\$4,086,783
57	DESCRIPTION	Each				\$3,979,000			
58	SHOP CAPACITY *	Revenue Vehicles	50	\$79,580			1985	\$89,819	\$81,736
59	YARD STORAGE CAPACITY	Revenue Vehicles	26						
60	WORKSTATIONS	Each	3						
61	TRACK LENGTH	Linear Feet	2,080						
62	PARKING	Spaces							
63	2.02 OFFICE FURNITURE & EQUIP.	All	76						
64	2.03 HEAVY REPAIR								
65	BODY	(Y/N)	N						
66	TRUCK	(Y/N)	N						
67	EQUIPMENT	(Y/N)	N						
68	2.04 MOTOR SHOPS								
69	VARIABLE TEST LOAD	(Y/N)	N						
70	REWIND	(Y/N)	N						
71	OTHER	(Y/N)	N						
72	2.05 WHEEL SHOP		2						
73	WHEEL PRESS	Each	1						
74	WHEEL TRUING	Each	1						
75	2.06 MACHINE SHOP		10						
76	LATHE	Each	4						
77	DRILL PRESS	Each	6						
78	2.07 AIR CONDITIONING	(Y/N)	Y						
79	2.08 ELECTRONICS	(Y/N)	Y						

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			YEAR
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		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)	N						
103	SEISMIC OR GAS DETECTION	(Y/N)	N						
104	OTHER								
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity								
106	3.00 SYSTEMS	Linear Feet	111,936	\$174.33	\$19,514,037		1985	\$197	\$179
107	3.01 SIGNAL SYSTEM	L.F. Guideway	111,936	\$73.58	\$8,236,632		1985	\$83	\$76
108	TRAIN CONTROL - WAYSIDE		111,936	\$61.67		\$6,903,484	1985	\$70	\$63
109	INSTALLATION					\$311,989			
110	HARDWARE								
111	DESIGN					\$6,591,495			
112	CROSSING PROTECTION	Each	90	\$14,813		\$1,333,148	1985	\$16,719	\$15,214
113	TRAFFIC SIGNALS	Each	90	\$14,369		\$1,293,217	1985	\$16,218	\$14,758
114	INSTALLATION					\$39,931	1985		
115	GATES	Each							
116	OTHER								
117	3.02 ELECTRIFICATION	L.F. Guideway	111,936	\$89.64	\$10,034,456		1985	\$101	\$92
118	SUBSTATIONS	Each	14	\$346,886		\$4,856,409	1985	\$391,520	\$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 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST		
119	3.00 SYSTEMS (continued)							
120	PURCHASE	Each			\$3,618,472			
121	INSTALLATION	Each			\$1,237,937			
122	CATENARY	L.F. Guideway	111,936	\$46.26	\$5,178,047	1985	\$52.21	\$47.51
123	INSTALLATION	Each			\$2,475,877			
124	POLES AND COMPONENTS	Each	1,000	\$1,520	\$1,520,025	1985	\$1,716	
125	WIRE		438,000	\$2.70	\$1,182,145	1985	\$3.05	
126	TROLLEY		194,000					
127	MESSENGER		142,000					
128	FEEDER		102,000					
129	RETURN							
130	3.03 COMMUNICATIONS	Total	1	\$190,949	\$190,949	1985	\$215,518	\$196,121
131	3.04 FARE COLLECTION	Total	1	\$1,052,000	\$1,052,000	1985	\$1,187,359	\$1,080,497
132	FAREBOX				\$66,000			
133	VENDING MACHINE							
134	OTHER				\$986,000			
135	4.00 STATIONS	Each	28	\$366,786	\$10,270,000	1985	\$413,979	\$376,721
136	4.01 AT-GRADE	Each	28	\$366,786	\$10,270,000	1985	\$413,979	\$376,721
137	CENTER PLATFORM	Each						
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	\$413,979	\$376,721
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 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	<i>Each</i>							
160	CENTER PLATFORM	<i>Each</i>							
161	PLATFORM LENGTH	<i>Linear Feet</i>							
162	ESCALATOR/ELEVATOR	<i>(Y/N)</i>							
163	HANDICAP ACCESS MODE	<i>Type</i>							
164	WEATHER COVERAGE	<i>Percent</i>							
165	SIDE PLATFORM	<i>Each</i>							
166	PLATFORM LENGTH	<i>Linear Feet</i>							
167	ESCALATOR/ELEVATOR	<i>(Y/N)</i>							
168	HANDICAP ACCESS MODE	<i>Type</i>							
169	WEATHER COVERAGE	<i>Percent</i>							
170	4.04 PARKING LOTS	<i>Total</i>			<i>N.R.</i>				
171	NUMBER OF LOTS		8						
172	NUMBER OF SPACES		3,850						
173	4.05 PARKING GARAGES	<i>Total</i>							
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	<i>Total</i>							
177	5.00 VEHICLES	<i>Each</i>	36	\$961,111	\$34,600,000		1986	\$1,064,353	\$968,562
178	5.01 REVENUE VEHICLES -- ORDER A	<i>Each</i>	26	\$800,000	\$20,800,000		1986	\$885,936	\$806,202
179	MAKE/MANUFACTURER	<i>Name</i>	Siemens/Duewag			\$20,800,000			
180	BODY TYPE (RIGID,ARTIC)	<i>Type</i>	Artic						
181	LENGTH OVER COUPLERS	<i>Linear Feet</i>	79.50						
182	WIDTH	<i>Linear Feet</i>	8.75						
183	NUMBER SEATS	<i>Each</i>							
184	AIR CONDITIONING	<i>(Y/N)</i>	Y						
185	CAB SIGNAL EQUIPMENT	<i>(Y/N)</i>	N						
186	BRAKING SYSTEM (AIR,ELEC)	<i>Type</i>	Spring/Elec						
187	TYPE OF STEPS (HIGH,LOW)	<i>Type</i>	Low						
188	HANDICAPED (LIFT,RAMP)	<i>Type</i>	Ramp						
189	ON-BOARD FAREBOX	<i>(Y/N)</i>	N						
190	PROCUREMENT COST	<i>Total</i>							
191	SPARE PARTS	<i>Total</i>							
192	SPECIAL EQUIPMENT COST	<i>Total</i>							
193	5.02 REVENUE VEHICLES -- ORDER B	<i>Each</i>	10	\$1,380,000	\$13,800,000		1990	\$1,380,000	\$1,255,800
194	MAKE/MANUFACTURER	<i>Name</i>							
195	BODY TYPE (RIGID,ARTIC)	<i>Type</i>							
196	LENGTH OVER COUPLERS	<i>Linear Feet</i>							

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			YEAR
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	Linear feet	111,936	\$109	\$12,153,425		1985	\$123	\$112
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$4,850,611	\$4,850,611		1985	\$5,474,730	\$4,982,005
230	NEW INSTALLATION		1	\$386,933		\$386,933			
231	GAS								
232	TELEPHONE		1	\$44,833		\$44,833			
233	ELECTRIC		1	\$2,574,580		\$2,574,580			
234	WATER								
235	PIPELINE		1	\$1,230,854		\$1,230,854			

CAPITAL COST DATA BASE

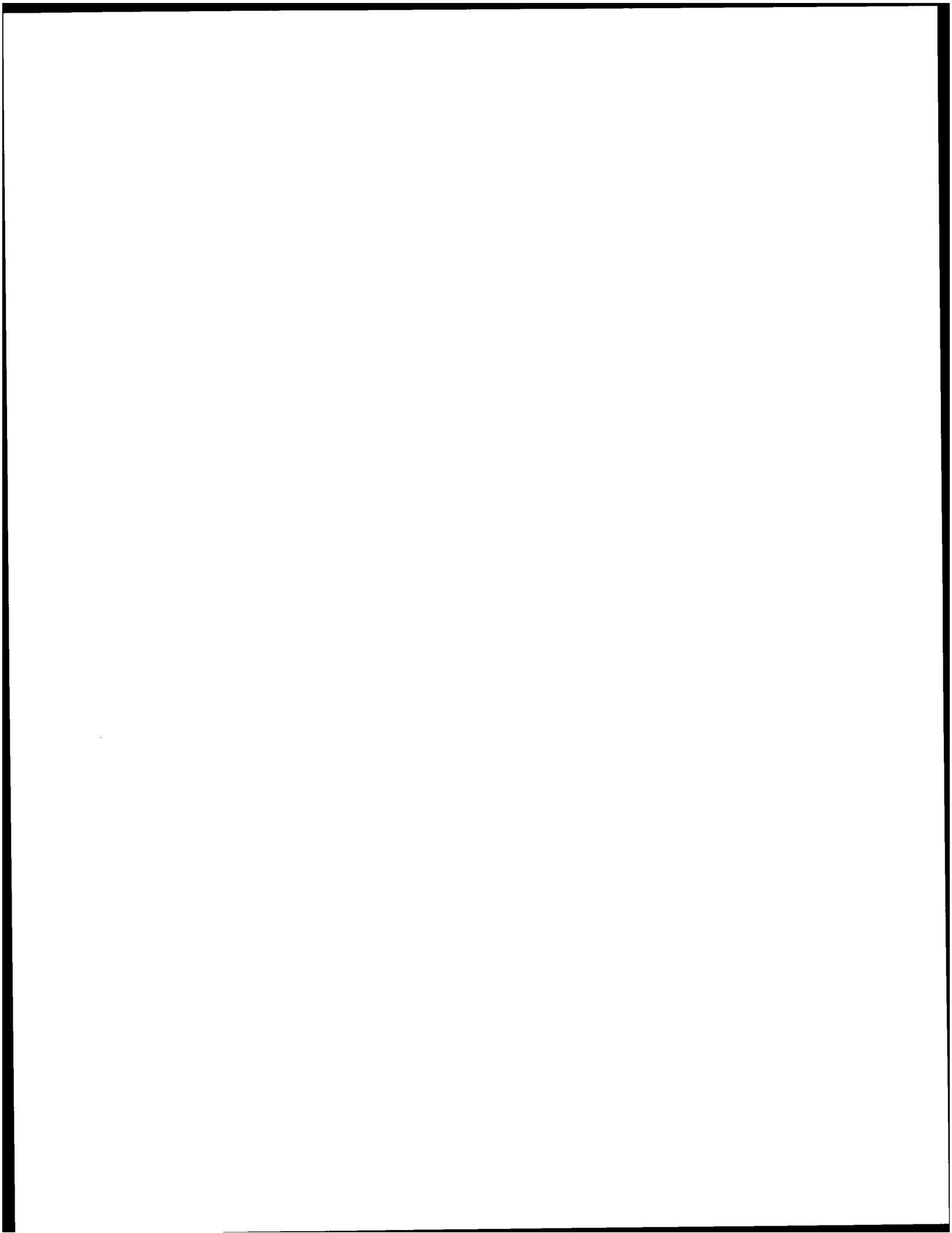
SACRAMENTO REGIONAL TRANSIT DISTRICT

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			YEAR
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		1985	\$544,560	\$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		1985	\$188,000	\$171,080
258	BUILDINGS								
259	REMOVALS		2			\$333,136			
260	6.05 ROADWAY CHANGES	Total	3	\$2,162,399	\$6,487,198		1985	\$2,440,631	\$2,220,974
261	BRIDGES								
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		1985	\$176	\$160
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$16,616,000	\$16,616,000		1985	\$18,753,950	\$17,066,095
271	MAINLINE	Acres	1			\$15,983,000			
272	STATION	Acres							
273	YARD	Acres	1	\$633,000		\$633,000			
274	PARKING	Acres							

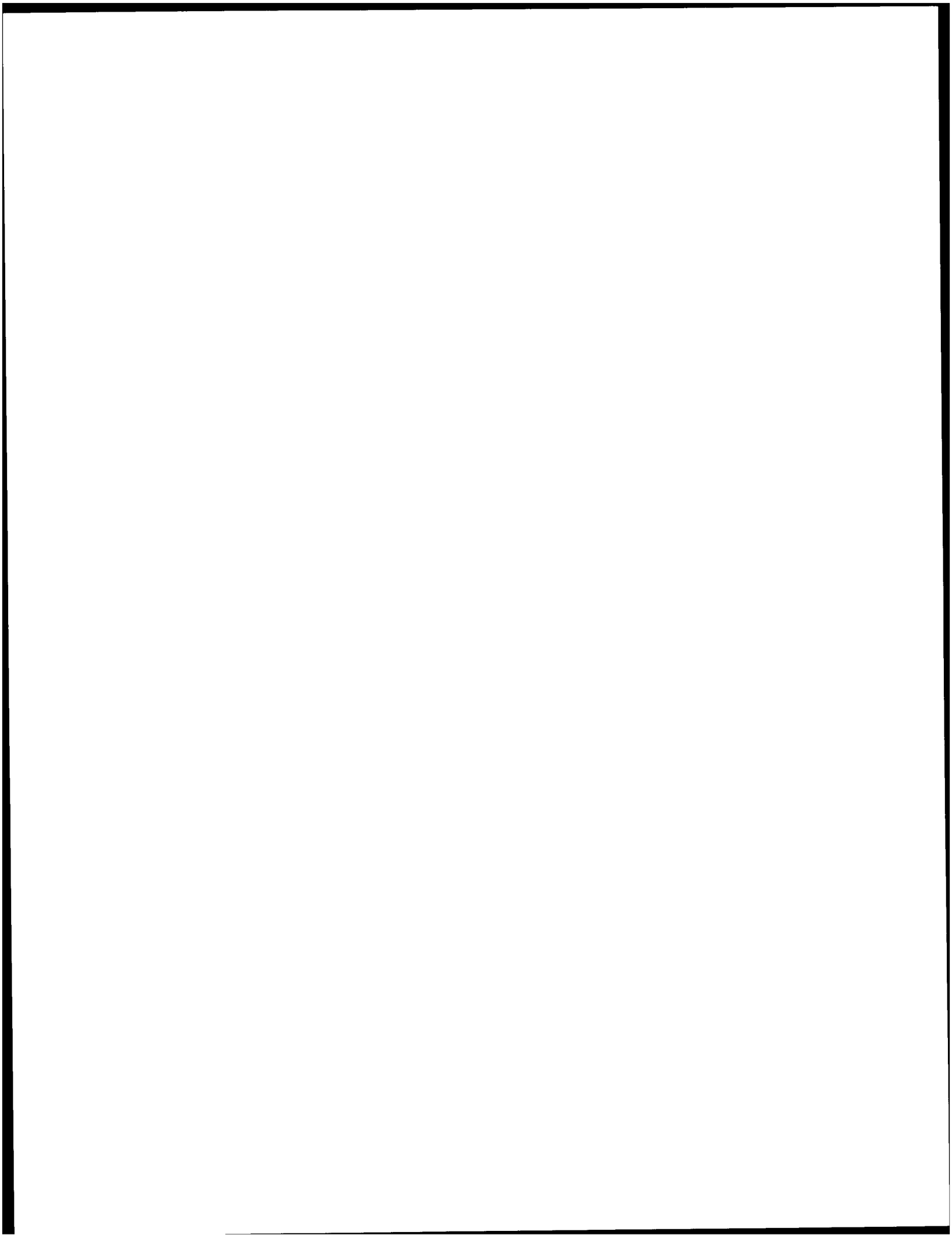
CAPITAL COST DATA BASE

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			YEAR
275	7.00 RIGHT-OF-WAY (continued)								
276	7.02 LAND ACQUISITION - DONATED	<i>Total</i>							
277	MAINLINE								
278	STATION								
279	YARD								
280	PARKING								
281	7.03 ACQUISITION-RELATED COST	<i>Total</i>	1	\$792,000	\$792,000		1985	\$893,905	\$913,454
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	<i>Total</i>							
286	BUSINESS								
287	RESIDENCE								
288	7.05 OTHER	<i>Total</i>							
289	8.00 SOFT-COSTS	<i>Linear Feet</i>	111,936	\$323	\$36,119,000		1982	\$395	\$359
290	8.01 FEASIBILITY STUDIES	<i>Total</i>	1	\$16,557,000	\$16,557,000		1980	\$24,528,889	\$22,321,289
291	8.02 ENGINEERING & DESIGN	<i>Total</i>							
292	8.03 CONSTRUCTION MANAGEMENT	<i>Total</i>	1	\$9,050,000	\$9,050,000		1983	\$10,523,256	\$9,576,163
293	8.04 PROJECT MANAGEMENT	<i>Total</i>	1	\$4,199,000	\$4,199,000		1984	\$4,777,019	\$4,347,088
294	8.05 PROJECT MANAGEMENT OVERSIGHT	<i>Total</i>					1984		
295	8.06 PROJECT INITIATION	<i>Total</i>	1	\$1,285,000	\$1,285,000		1985	\$1,450,339	\$1,319,808
296	INSURANCE		1	\$1,285,000		\$1,285,000	1985	\$1,450,339	\$1,319,808
297	MOBILIZATION								
298	MAINTENANCE OF TRAFFIC								
299	8.07 FINANCE CHARGES		1	\$528,000	\$528,000		1984	\$600,683	\$546,621
300	8.08 TRAINING/START-UP/TESTING		1	\$4,500,000	\$4,500,000		1985	\$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

	<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

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
1	1.00 GUIDEWAY ELEMENTS	<i>Linear Feet</i>	82,252	\$801	\$65,887,000		1987	\$852	\$682
2	1.01 GUIDEWAY AT-GRADE	<i>Linear Feet</i>	82,252	\$715	\$58,816,000		1987	\$761	\$609
3	DIRECT FIXATION								
4	BALLASTED		48,050	\$717		\$34,473,000	1987	\$763	\$611
5	IN-PAVEMENT BALLASTED								
6	EMBEDDED		34,202	\$712		\$24,343,000	1987	\$757	\$606
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	<i>Linear Feet</i>							
8	DIRECT FIXATION								
9	BALLASTED								
10	IN-PAVEMENT BALLASTED								
11	EMBEDDED								
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	<i>Linear Feet</i>							
13	DIRECT FIXATION								
14	BALLASTED								
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	1.04 GUIDEWAY - ELEVATED FILL	<i>Linear Feet</i>							
18	DIRECT FIXATION								
19	BALLASTED								
20	IN-PAVEMENT BALLASTED								
21	EMBEDDED								
22	1.05 GUIDEWAY - SUBWAY	<i>Linear Feet</i>							
23	DIRECT FIXATION								
24	BALLASTED								
25	IN-PAVEMENT BALLASTED								
26	EMBEDDED								
27	1.06 GUIDEWAY - RETAINED CUT	<i>Linear Feet</i>							
28	DIRECT FIXATION								
29	BALLASTED								
30	IN-PAVEMENT BALLASTED								
31	EMBEDDED								
32	1.07 POCKET TRACK	<i>L.F. Guideway</i>							
33	1.08 STORAGE TRACK	<i>L.F. Guideway</i>							
34	1.09 SPECIAL TRACKWORK	<i>L.F. Guideway</i>	82,252	\$19.51	\$1,605,000		1987	\$20.76	\$17
35	TURNOUTS	Each	36	\$8,611	\$310,000		1987	\$9,161	\$7,329
36	#5		35	\$8,000		\$280,000	1987		
37	#4								
38	#6								
39	#8		1	\$30,000		\$30,000	1987	\$31,915	\$25,532
40	#10								

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
41	1.00 GUIDEWAY ELEMENTS (continued)								
42	#20								
43	OTHER - SPECIFY		20	\$64,750	\$1,295,000		1987	\$68,883	\$55,106
44	GIRDER,25 METER								
45	GIRDER,50 METER								
46	#4, GIRDER		2	\$5,000		\$10,000	1987		
47	#8 SINGLE CROSSOVER		14	\$52,500		\$735,000	1987		
48	#4,DOUBLE CROSSOVER		3	\$100,000		\$300,000	1987		
49	#5,DOUBLE CROSSOVER								
50	INTERSECTION		1	\$250,000		\$250,000	1987		
51	1.10 GUIDEWAY-SPECIAL STRUCTURES	Linear Feet	1060	\$5,157	\$5,466,000		1987	\$5,486	\$4,389
52	BRIDGES	Each	1	\$4,822,000		\$4,822,000			
53	OVERPASSES	Each	2	\$322,000		\$644,000			
54	OTHER	Each							
55	2.00 YARDS & SHOPS	Total	1	\$21,291,136	\$21,291,136		1986	\$23,578,224	\$18,862,579
56	2.01 BUILDING	Each	1	\$13,500,000	\$13,500,000		1987	\$14,361,702	\$11,489,362
57	DESCRIPTION	Each	1	\$13,500,000		\$13,500,000	1987		
58	SHOP CAPACITY *	Revenue Vehicles	50	\$425,823			1987	\$453,003	\$362,402
59	YARD STORAGE CAPACITY	Revenue Vehicles	50						
60	WORKSTATIONS	Each	13						
61	TRACK LENGTH	Linear Feet	10,000						
62	PARKING	Spaces							
63	2.02 OFFICE FURNITURE & EQUIP.	All	1	\$279,577	\$279,577		1985	\$315,550	\$252,440
64	2.03 HEAVY REPAIR		1	\$809,989	\$809,989		1985	\$914,209	\$731,367
65	BODY	(Y/N)	YES						
66	TRUCK	(Y/N)	YES						
67	EQUIPMENT	(Y/N)	YES			\$809,989			
68	2.04 MOTOR SHOPS		1	\$50,000	\$50,000		1987	\$53,191	\$42,553
69	VARIABLE TEST LOAD	(Y/N)	YES						
70	REWIND	(Y/N)	YES						
71	OTHER	(Y/N)	YES			\$50,000			
72	2.05 WHEEL SHOP		1	\$30,000	\$30,000		1987	\$31,915	\$25,532
73	WHEEL PRESS	Each	1			\$30,000			
74	WHEEL TRUING	Each							
75	2.06 MACHINE SHOP		6	\$262	\$1,570		1985	\$295	\$236
76	LATHE	Each	0						
77	DRILL PRESS	Each	6			\$1,570			
78	2.07 AIR CONDITIONING	(Y/N)	1	\$2,680,000	\$2,680,000		1985	\$3,024,831	\$2,419,865
79	2.08 ELECTRONICS	(Y/N)	1	\$1,420,000	\$1,420,000		1985	\$1,602,709	\$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			YEAR
80	2.00 YARDS & SHOPS (continued)								
81	2.09 COMMUNICATIONS	(Y/N)	1	\$1,260,000	\$1,260,000		1985	\$1,422,122	\$1,137,698
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	1	\$160,000	\$160,000		1985	\$180,587	\$144,470
83	2.11 MAINTENANCE OF WAY SHOPS		1	\$1,100,000	\$1,100,000		1985	\$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								
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity								
106	3.00 SYSTEMS	Linear Feet	105,600	\$313.68	\$33,124,742		1990	\$314	\$250.95
107	3.01 SIGNAL SYSTEM	L.F. Guideway	105,600	\$67.89	\$7,169,292		1990	\$68	\$54.31
108	TRAIN CONTROL - WAYSIDE		105,600	\$66.28	\$6,999,292		1990	\$66	\$53.02
109	INSTALLATION					\$3,182,635			
110	HARDWARE					\$3,513,954			
111	DESIGN					\$302,703			
112	CROSSING PROTECTION	Each	6	\$28,333.33	\$170,000		1990	\$28,333	\$22,667
113	TRAFFIC SIGNALS	Each							
114	INSTALLATION								
115	GATES	Each	4			\$110,000			
116	OTHER		2			\$60,000			
117	3.02 ELECTRIFICATION	L.F. Guideway	105,600	\$177.04	\$18,694,939		1990	\$177	\$141.63
118	SUBSTATIONS	Each	30	\$256,589.30	\$7,697,679		1990	\$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		
119	3.00 SYSTEMS (continued)							
120	PURCHASE	Each	15			\$5,527,894		
121	INSTALLATION	Each	15			- \$2,169,785		
122	CATENARY	L.F. Guideway	105,600	\$104.14	\$10,997,260		1990	\$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		1990	\$2,935,448
131	3.04 FARE COLLECTION	Total	1	\$4,325,063	\$4,325,063		1990	\$4,325,063
132	FAREBOX							
133	VENDING MACHINE		93	\$43,394		\$4,035,602	1990	
134	OTHER		54	\$5,360		\$289,461	1990	
135	4.00 STATIONS	Each	22	\$223,364	\$4,914,000		1989	\$226,077
136	4.01 AT-GRADE	Each	22	\$223,364	\$4,914,000		1989	\$226,077
137	CENTER PLATFORM	Each	3	\$192,333		\$577,000	1989	\$194,669
138	PLATFORM LENGTH	Linear Feet	334					\$155,735
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	1989	\$231,036
143	PLATFORM LENGTH	Linear Feet	312					\$184,828
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 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	<i>Each</i>							
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	<i>Total</i>							
171	NUMBER OF LOTS								
172	NUMBER OF SPACES								
173	4.05 PARKING GARAGES	<i>Total</i>							
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	<i>Total</i>							
177	5.00 VEHICLES	<i>Each</i>	50	\$1,112,220	\$55,611,000		1983	\$1,293,279	\$1,034,623
178	5.01 REVENUE VEHICLES - ORDER A	<i>Each</i>	50	\$1,112,220	\$55,611,000		1983	\$1,293,279	\$1,034,623
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							
188	HANDICAPED (LIFT,RAMP)	Type	NO						
189	ON-BOARD FAREBOX	(Y/N)	NO						
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	<i>Each</i>							
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			YEAR
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	13		N.R.				
225	SERVICE TRUCKS		4						
226	AUTOMOBILES		4						
227	OTHER		5						
228	6.00 SPECIAL CONDITIONS	Linear feet	82,252	\$103	\$8,487,000		1986	\$114	\$91
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$5,822,000	\$5,822,000		1986	\$6,447,398	\$5,157,918
230	NEW INSTALLATION					\$5,086,000			
231	GAS					\$158,000			
232	TELEPHONE					\$23,000			
233	ELECTRIC					\$158,000			
234	WATER					\$353,000			
235	PIPELINE								

CAPITAL COST DATA BASE

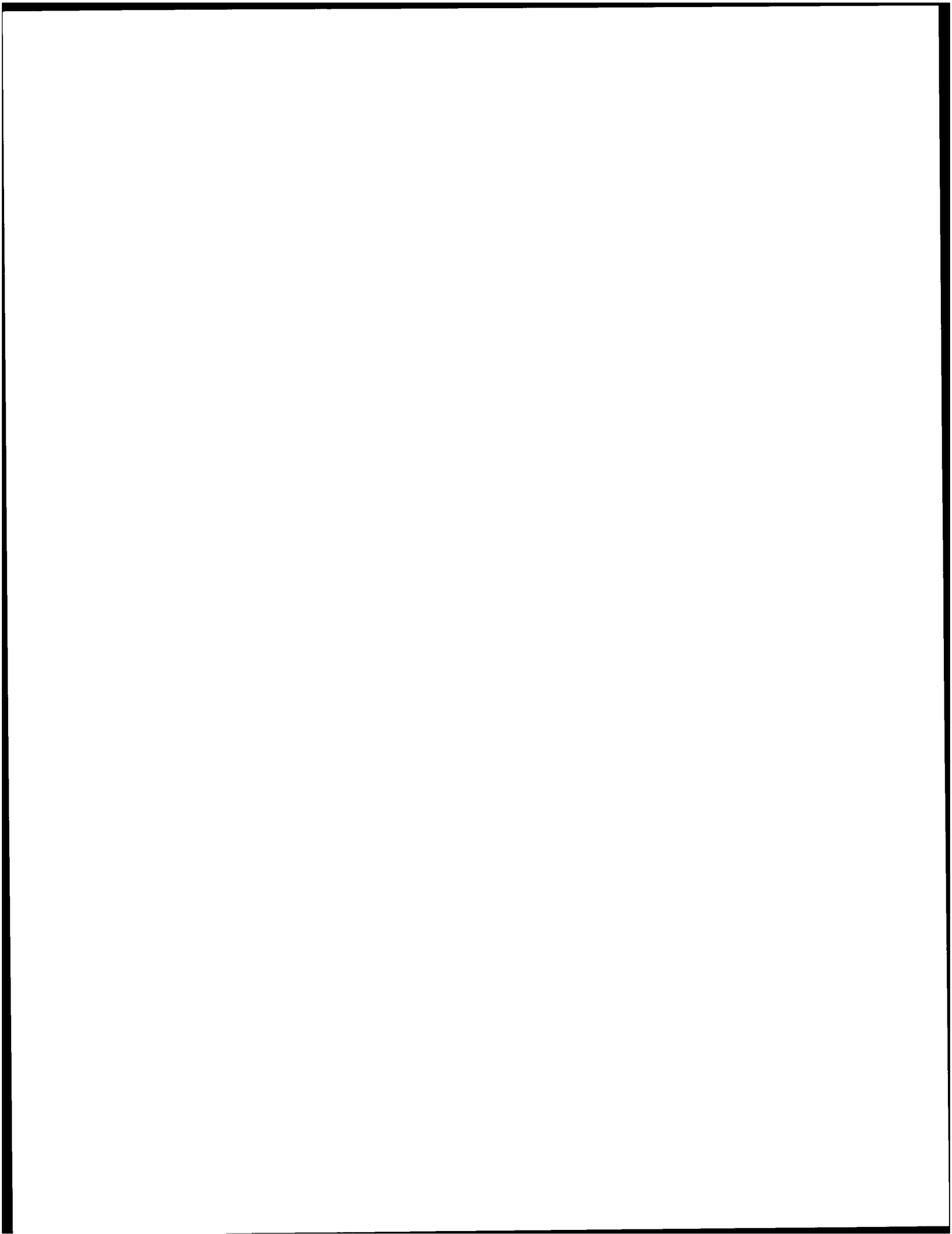
SANTA CLARA COUNTY TRANSPORTATION AGENCY

	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
236	6.00 SPECIAL CONDITIONS (continued)								
237	RAILROAD								
238	OTHER				\$44,000				
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total							
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	1	\$513,000	\$513,000		1986	\$568,106	\$454,485
258	BUILDINGS								
259	REMOVALS		1			\$513,000			
260	6.05 ROADWAY CHANGES	Total							
261	BRIDGES								
262	STREETS								
263	OTHER								
264	6.06 ENVIRONMENTAL	Total	1	\$2,152,000	\$2,152,000		1986	\$2,383,167	\$1,906,534
265	NOISE								
266	VISUAL					\$1,324,000			
267	VIBRATION								
268	OTHER					\$828,000			
269	7.00 RIGHT-OF-WAY	Linear Feet	82,252	\$664	\$54,617,000		1985	\$749	\$600
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$51,323,000	\$51,323,000		1985	\$57,926,637	\$46,341,309
271	MAINLINE	Acres	73	\$342,394		\$25,029,000			
272	STATION	Acres	23	\$312,743		\$7,068,000			
273	YARD	Acres	37	\$313,333		\$11,468,000			
274	PARKING	Acres	20	\$389,849		\$7,758,000			

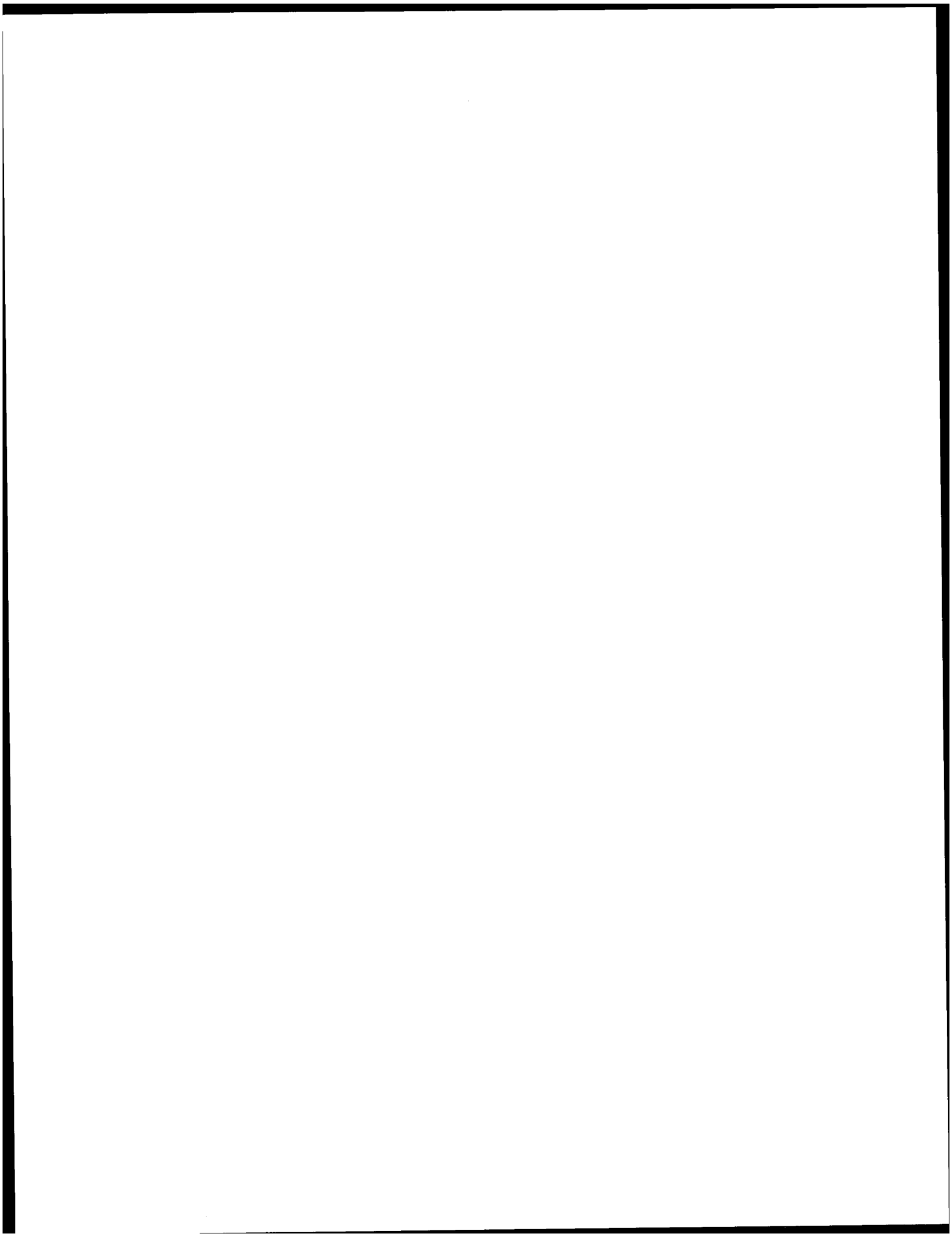
CAPITAL COST DATA BASE

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			YEAR
275	7.00 RIGHT-OF-WAY (continued)								
276	7.02 LAND ACQUISITION - DONATED	<i>Total</i>							
277	MAINLINE								
278	STATION								
279	YARD								
280	PARKING								
281	7.03 ACQUISITION-RELATED COST	<i>Total</i>	1	\$2,772,000	\$2,772,000		1985	\$3,128,668	\$2,502,935
282	LEGAL & CONSULTING					\$924,000			
283	APPRAISAL					\$924,000			
284	PROPERTY MANAGEMENT					\$924,000			
285	7.04 RELOCATION	<i>Total</i>	1	\$522,000	\$522,000		1985	\$589,165	\$471,332
286	BUSINESS		15			\$476,000			
287	RESIDENCE		86			\$46,000			
288	7.05 OTHER	<i>Total</i>							
289	8.00 SOFT-COSTS	<i>Linear Feet</i>	82,252	\$1,659	\$136,417,000		1986	\$1,837	\$1,469
290	8.01 FEASIBILITY STUDIES	<i>Total</i>	1	\$41,085,000	\$41,085,000		1986	\$45,498,339	\$36,398,671
291	8.02 ENGINEERING & DESIGN	<i>Total</i>							
292	8.03 CONSTRUCTION MANAGEMENT	<i>Total</i>	1	\$63,260,000	\$63,260,000		1986	\$70,055,371	\$56,044,297
293	8.04 PROJECT MANAGEMENT	<i>Total</i>	1	\$19,115,000	\$19,115,000		1986	\$21,168,328	\$16,934,662
294	8.05 PROJECT MANAGEMENT OVERSIGHT	<i>Total</i>	1		\$1,457,000				
295	8.06 PROJECT INITIATION	<i>Total</i>	1	\$7,500,000	\$7,500,000				
296	INSURANCE								
297	MOBILIZATION		1			\$7,000,000			
298	MAINTENANCE OF TRAFFIC		1			\$500,000			
299	8.07 FINANCE CHARGES								
300	8.08 TRAINING/START-UP/TESTING		1	\$4,000,000	\$4,000,000		1986	\$4,429,679	\$3,543,743
301	SAFETY CERTIFICATION								
302	OFF-SITE LRV TESTING								
303	8.09 OTHER								



PITTSBURGH



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

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							
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	
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST			YEAR
1	1.00 GUIDEWAY ELEMENTS	<i>Linear Feet</i>	82,198	\$1,344	\$110,472,428		1985	\$1,517	\$1,508
2	1.01 GUIDEWAY AT-GRADE	<i>Linear Feet</i>	54,627	\$410	\$22,416,945		1985	\$463	\$460
3	DIRECT FIXATION		5,131	\$620		\$3,183,075	1985	\$700	\$696
4	BALLASTED		34,933	\$334		\$11,666,125	1985	\$377	\$375
5	IN-PAVEMENT BALLASTED								
6	EMBEDDED		14,563	\$520		\$7,567,746	1985	\$587	\$583
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	<i>Linear Feet</i>	5,012	\$567	\$2,841,209		1985	\$640	\$636
8	DIRECT FIXATION		2,141	\$477		\$1,020,441	1985	\$538	\$535
9	BALLASTED		963	\$997		\$960,077	1985	\$1,126	\$1,119
10	IN-PAVEMENT BALLASTED								
11	EMBEDDED		1,908	\$451		\$860,691	1985	\$509	\$506
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	<i>Linear Feet</i>							
13	DIRECT FIXATION								
14	BALLASTED								
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	1.04 GUIDEWAY - ELEVATED FILL	<i>Linear Feet</i>							
18	DIRECT FIXATION								
19	BALLASTED								
20	IN-PAVEMENT BALLASTED								
21	EMBEDDED								
22	1.05 GUIDEWAY - SUBWAY	<i>Linear Feet</i>	10,721	\$7,627	\$81,770,847		1985	\$8,609	\$8,557
23	DIRECT FIXATION		3,462	\$18,478		\$63,976,786	1985	\$20,855	\$20,730
24	BALLASTED								
25	IN-PAVEMENT BALLASTED		3,856	\$4,216		\$16,259,569	1985	\$4,759	\$4,730
26	EMBEDDED		3,402	\$451		\$1,534,493	1985	\$509	\$506
27	1.06 GUIDEWAY - RETAINED CUT	<i>Linear Feet</i>	11,838	\$291	\$3,443,427		1984	\$331	\$329
28	DIRECT FIXATION								
29	BALLASTED		11,838	\$291		\$3,443,427	1984	\$331	\$329
30	IN-PAVEMENT BALLASTED								
31	EMBEDDED								
32	1.07 POCKET TRACK	<i>L.F. Guideway</i>							
33	1.08 STORAGE TRACK	<i>L.F. Guideway</i>							
34	1.09 SPECIAL TRACKWORK	<i>L.F. Guideway</i>							
35	TURNOUTS	Each							
36	#5								
37	#4								
38	#6								
39	#8								
40	#10								

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			YEAR
41	1.00 GUIDEWAY ELEMENTS (continued)								
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	Linear Feet							
52	BRIDGES	Each							
53	OVERPASSES	Each							
54	OTHER	Each							
55	2.00 YARDS & SHOPS	Total	1	\$38,183,186	\$38,183,186		1985	\$43,096,147	\$42,837,570
56	2.01 BUILDING	Each	1	\$32,090,648	\$32,090,648		1985	\$36,219,693	\$36,002,375
57	DESCRIPTION	Each	1	\$32,090,648		\$32,090,648	1985		
58	SHOP CAPACITY *	Revenue Vehicles	97	\$393,641			1985	\$444,290	\$441,624
59	YARD STORAGE CAPACITY	Revenue Vehicles							
60	WORKSTATIONS	Each							
61	TRACK LENGTH	Linear Feet							
62	PARKING	Spaces							
63	2.02 OFFICE FURNITURE & EQUIP.	All							
64	2.03 HEAVY REPAIR								
65	BODY	(Y/N)							
66	TRUCK	(Y/N)							
67	EQUIPMENT	(Y/N)							
68	2.04 MOTOR SHOPS								
69	VARIABLE TEST LOAD	(Y/N)							
70	REWIND	(Y/N)							
71	OTHER	(Y/N)							
72	2.05 WHEEL SHOP								
73	WHEEL PRESS	Each							
74	WHEEL TAPPING	Each							
75	2.06 MACHINE SHOP								
76	LATHE	Each							
77	DRILL PRESS	Each							
78	2.07 AIR CONDITIONING	(Y/N)							
79	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	COMPONENT COST			YEAR
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		1987	\$5,346,678	\$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		1984	\$1,213,494	\$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								
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity								
106	3.00 SYSTEMS	<i>Linear Feet</i>	82,198	\$716.38	\$58,885,157		1985	\$809	\$804
107	3.01 SIGNAL SYSTEM	<i>L.F. Guideway</i>	58,083	\$394.49	\$22,913,020		1985	\$445	\$443
108	TRAIN CONTROL - WAYSIDE		58,083	\$394.49	\$22,913,020		1985	\$445	\$443
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	<i>L.F. Guideway</i>	68,219	\$396.43	\$27,043,907		1984	\$451	\$448
118	SUBSTATIONS	Each	4	\$3,007,949	\$12,031,797		1984	\$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			YEAR
119	3.00 SYSTEMS (continued)								
120	PURCHASE	Each							
121	INSTALLATION	Each							
122	CATENARY	L.F. Guideway	68,219	\$220	\$15,012,110		1984	\$250	\$249
123	INSTALLATION	Each	1	\$181,509	\$181,509		1984		
124	POLES AND COMPONENTS	Each	1	\$1,113,906	\$1,113,906		1984	\$1,267,242	\$1,259,639
125	WIRE		1	\$1,066,033	\$1,066,033		1984	\$1,212,779	\$1,205,503
126	TROLLEY								
127	MESSENGER								
128	FEEDER								
129	RETURN								
130	3.03 COMMUNICATIONS	Total	1	\$8,928,230	\$8,928,230		1985	\$10,077,009	\$10,016,547
131	3.04 FARE COLLECTION	Total							
132	FAREBOX								
133	VENDING MACHINE								
134	OTHER								
135	4.00 STATIONS	Each	12	\$2,856,898	\$34,282,779		1985	\$3,224,490	\$3,205,143
136	4.01 AT-GRADE	Each	9	\$1,748,205	\$15,733,846		1985	\$1,973,143	\$1,961,305
137	CENTER PLATFORM	Each							
138	PLATFORM LENGTH	Linear Feet							
139	ESCALATOR/ELEVATOR	(Y/N)							
140	HANDICAP ACCESS MODE	Type							
141	WEATHER COVERAGE	Percent							
142	SIDE PLATFORM	Each	9	\$1,748,205	\$15,733,846		1985	\$1,973,143	\$1,961,305
143	PLATFORM LENGTH	Linear Feet							
144	ESCALATOR/ELEVATOR	(Y/N)							
145	HANDICAP ACCESS MODE	Type							
146	WEATHER COVERAGE	Percent							
147	4.02 SUBWAY	Each	3	\$6,182,978	\$18,548,933		1985	\$6,978,530	\$6,936,659
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	3	\$6,182,978	\$18,548,933		1985	\$6,978,530	\$6,936,659
154	PLATFORM LENGTH	Linear Feet							
155	ESCALATOR/ELEVATOR	(Y/N)							
156	HANDICAP ACCESS MODE	Type							
157	WEATHER COVERAGE	Percent							

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			YEAR
158	4.00 STATIONS (continued)								
159	4.03 ELEVATED	<i>Each</i>							
160	CENTER PLATFORM	<i>Each</i>							
161	PLATFORM LENGTH	Linear Feet							
162	ESCALATOR/ELEVATOR	(Y/N)							
163	HANDICAP ACCESS MODE	Type							
164	WEATHER COVERAGE	Percent							
165	SIDE PLATFORM	<i>Each</i>							
166	PLATFORM LENGTH	Linear Feet							
167	ESCALATOR/ELEVATOR	(Y/N)							
168	HANDICAP ACCESS MODE	Type							
169	WEATHER COVERAGE	Percent							
170	4.04 PARKING LOTS	<i>Total</i>							
171	NUMBER OF LOTS								
172	NUMBER OF SPACES								
173	4.05 PARKING GARAGES	<i>Total</i>							
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	<i>Total</i>							
177	5.00 VEHICLES	<i>Each</i>	55	\$1,043,626	\$57,399,440		1985	\$1,177,908	\$1,170,840
178	5.01 REVENUE VEHICLES -- ORDER A	<i>Each</i>	55	\$1,043,626	\$57,399,440		1985	\$1,177,908	\$1,170,840
179	MAKE/MANUFACTURER	Name							
180	BODY TYPE (RIGID,ARTIC)	Type							
181	LENGTH OVER COUPLERS	Linear Feet							
182	WIDTH	Linear Feet							
183	NUMBER SEATS	<i>Each</i>							
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	<i>Each</i>							
194	MAKE/MANUFACTURER	Name							
195	BODY TYPE (RIGID,ARTIC)	Type							
196	LENGTH OVER COUPLERS	Linear Feet							

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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			YEAR
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	Linear feet	82,198	\$122	\$10,038,972		1984	\$139	\$138
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$4,034,435	\$4,034,435		1984	\$4,589,801	\$4,562,262
230	NEW INSTALLATION								
231	GAS		2		\$578,064				
232	TELEPHONE		1		\$248,253				
233	ELECTRIC		4		\$2,939,444				
234	WATER		1		\$268,674				
235	PIPELINE								

CAPITAL COST DATA BASE

PORT AUTHORITY OF ALLEGHENY COUNTY

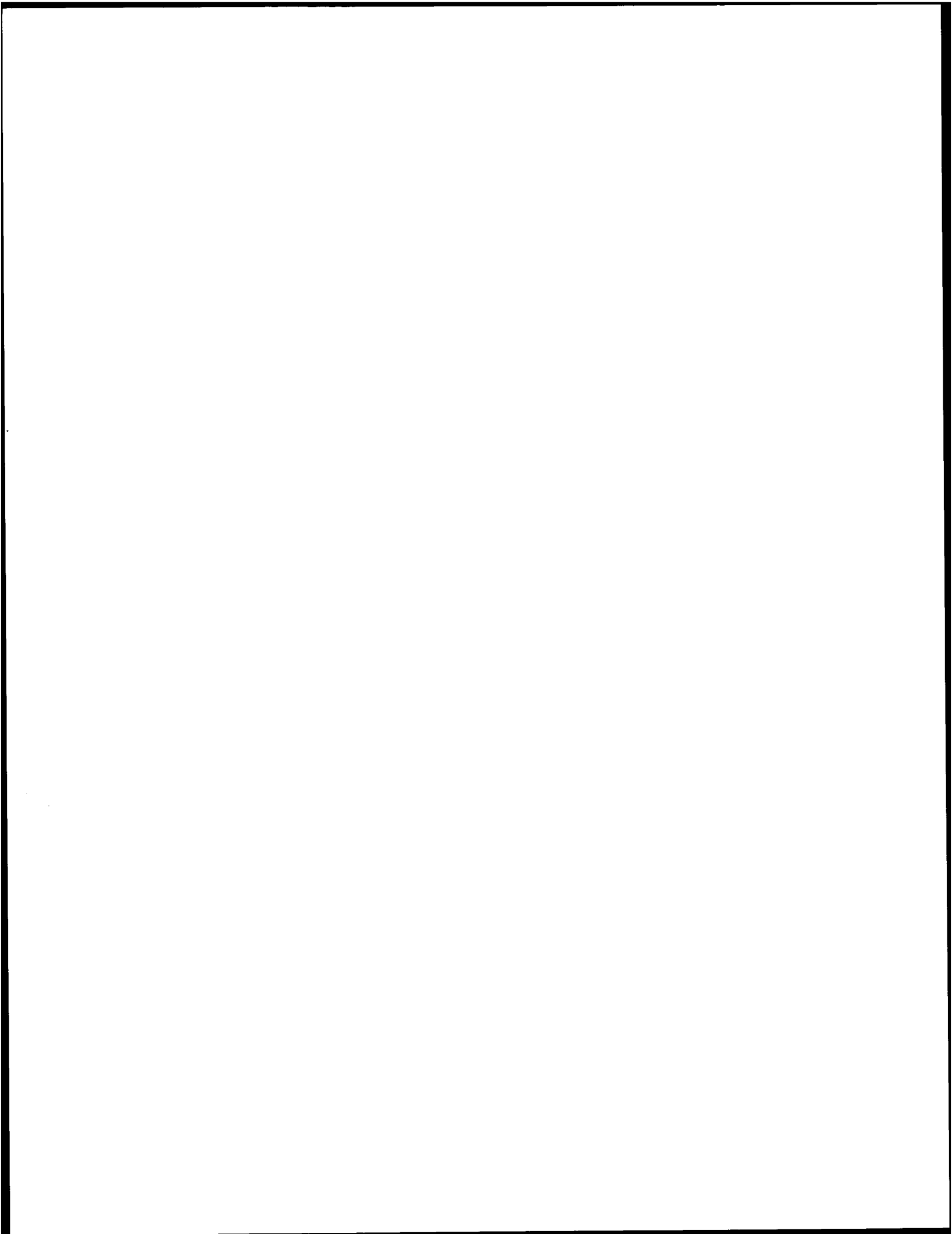
	UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS	UNITS OF MEASURE	PORT AUTHORITY OF ALLEGHENY COUNTY				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES	
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST			YEAR
236	6.00 SPECIAL CONDITIONS (continued)								
237	RAILROAD								
238	OTHER								
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total	1	\$4,939,567	\$4,939,567		1984	\$5,619,530	\$5,585,813
240	NEW INSTALLATION		1		\$560,596				
241	GAS		1		\$664,702				
242	TELEPHONE		1		\$767,687				
243	ELECTRIC		1		\$2,857,500				
244	WATER								
245	PIPELINE								
246	RAILROAD								
247	OTHER		1		\$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		1983	\$868,698	\$863,485
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		1985	\$358,792	\$356,640
265	NOISE								
266	VISUAL		1		\$317,890		1985		
267	VIBRATION								
268	OTHER								
269	7.00 RIGHT-OF-WAY	Linear Feet	82,198	\$262	\$21,511,920		1983	\$304	\$302
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$21,511,920	\$21,511,920		1983	\$25,013,860	\$24,863,777
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			YEAR
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							
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		1985	\$3,086	\$3,068
290	8.01 FEASIBILITY STUDIES	Total							
291	8.02 ENGINEERING & DESIGN	Total	1	\$106,746,730	\$106,746,730		1985	\$120,481,637	\$119,758,747
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$11,236,750	\$11,236,750		1985	\$12,682,562	\$12,606,467
293	8.04 PROJECT MANAGEMENT	Total	1	\$14,821,100	\$14,821,100		1985	\$16,728,104	\$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	\$97,815,532	\$97,228,639

LOS ANGELES



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

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	1.00 GUIDEWAY ELEMENTS	<i>Linear Feet</i>	119,283	\$1,247	\$148,719,104		1988	\$1,293	\$1,133
2	1.01 GUIDEWAY AT-GRADE	<i>Linear Feet</i>	96,253	\$700	\$67,408,808		1988	\$726	\$636
3	DIRECT FIXATION								
4	BALLASTED		61,869	\$487		\$30,145,147	1988	\$505	\$443
5	IN-PAVEMENT BALLASTED		1,618	\$2,848		\$4,608,103	1988	\$2,954	\$2,588
6	EMBEDDED		32,766	\$997		\$32,655,558	1988	\$1,034	\$906
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	<i>Linear Feet</i>	10,785	\$3,286	\$35,437,638		1988	\$3,409	\$2,986
8	DIRECT FIXATION		9,376	\$3,033		\$28,435,174	1988	\$3,146	\$2,756
9	BALLASTED		1,409	\$4,970		\$7,002,464	1988	\$5,155	\$4,516
10	IN-PAVEMENT BALLASTED								
11	EMBEDDED								
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	<i>Linear Feet</i>	6,407	\$932	\$5,973,099		1988	\$967	\$847
13	DIRECT FIXATION								
14	BALLASTED		6,407	\$932		\$5,973,099	1988	\$967	\$847
15	IN-PAVEMENT BALLASTED								
16	EMBEDDED								
17	1.04 GUIDEWAY - ELEVATED FILL	<i>Linear Feet</i>	2,052	\$678	\$1,390,912		1988	\$703	\$616
18	DIRECT FIXATION								
19	BALLASTED		2,052	\$678		\$1,390,912	1988	\$703	\$616
20	IN-PAVEMENT BALLASTED								
21	EMBEDDED								
22	1.05 GUIDEWAY - SUBWAY	<i>Linear Feet</i>	3,296	\$6,965	\$22,955,679		1988	\$7,225	\$6,329
23	DIRECT FIXATION		3,296	\$6,965		\$22,955,679	1988	\$7,225	\$6,329
24	BALLASTED								
25	IN-PAVEMENT BALLASTED								
26	EMBEDDED								
27	1.06 GUIDEWAY - RETAINED CUT	<i>Linear Feet</i>	490	\$4,756	\$2,330,510		1988	\$4,934	\$4,322
28	DIRECT FIXATION		490	\$4,756		\$2,330,510	1988		
29	BALLASTED								
30	IN-PAVEMENT BALLASTED								
31	EMBEDDED								
32	1.07 POCKET TRACK	<i>L.F. Guideway</i>	119,283	\$71.99	\$8,586,709		1988	\$74.67	\$65.41
33	1.08 STORAGE TRACK	<i>L.F. Guideway</i>	119,283						
34	1.09 SPECIAL TRACKWORK	<i>L.F. Guideway</i>	119,283	\$38.86	\$4,635,749		1988	\$40.31	\$35.32
35	TURNOUTS	<i>Each</i>	57	\$38,938		\$2,219,465	1988	\$40,392	\$35,383
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		
41	1.00 GUIDEWAY ELEMENTS (continued)							
42	#20							
43	OTHER - SPECIFY							
44	GIRDER,25 METER							
45	GIRDER,50 METER							
46	#4, GIRDER							
47	#8 SINGLE CROSSOVER		12	\$93,340	\$1,120,080	1988	\$96,826	\$84,819
48	#4,DOUBLE CROSSOVER		1	\$205,473	\$205,473	1988	\$213,146	\$186,716
49	#5,DOUBLE CROSSOVER		2	\$329,791	\$659,582	1988	\$342,107	\$299,686
50	INTERSECTION		4	\$107,787	\$431,149	1988	\$111,813	\$97,948
51	1.10 GUIDEWAY-SPECIAL STRUCTURES	Linear Feet						
52	BRIDGES	Each						
53	OVERPASSES	Each						
54	OTHER	Each						
55	2.00 YARDS & SHOPS	Total	1	\$44,204,740	\$44,204,740	1988	\$45,855,539	\$40,169,453
56	2.01 BUILDING	Each	1	\$25,229,864	\$25,229,864	1988	\$26,172,058	\$22,926,723
57	DESCRIPTION	Each			\$13,724,388	1988		
58	SHOP CAPACITY *	Revenue Vehicles	54	\$818,606		1988	\$849,177	\$743,879
59	YARD STORAGE CAPACITY	Revenue Vehicles	54		\$11,505,476	1988		
60	WORKSTATIONS	Each						
61	TRACK LENGTH	Linear Feet						
62	PARKING	Spaces						
63	2.02 OFFICE FURNITURE & EQUIP.	All						
64	2.03 HEAVY REPAIR		11	\$272,383	\$2,996,208	1988	\$282,555	\$247,518
65	BODY	(Y/N)	2		\$1,858,720			
66	TRUCK	(Y/N)	2		\$347,413			
67	EQUIPMENT	(Y/N)	7		\$790,075			
68	2.04 MOTOR SHOPS							
69	VARIABLE TEST LOAD	(Y/N)						
70	REWIND	(Y/N)						
71	OTHER	(Y/N)						
72	2.05 WHEEL SHOP		1	\$1,144,662	\$1,144,662	1988	\$1,187,409	\$1,040,170
73	WHEEL PRESS	Each						
74	WHEEL TRUNG	Each			\$1,144,662			
75	2.06 MACHINE SHOP							
76	LATHE	Each						
77	DRILL PRESS	Each						
78	2.07 AIR CONDITIONING	(Y/N)						
79	2.08 ELECTRONICS	(Y/N)	1	\$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)							
82	2.10 CAR WASH/CAR CLEANING	(Y/N)	1	\$959,396	\$959,396		1988	\$995,224	\$871,816
83	2.11 MAINTENANCE OF WAY SHOPS		10	\$73,400	\$734,000		1988	\$76,141	\$66,700
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		1988	\$31,120	\$27,261
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)	1	\$11,179,919	\$11,179,919	\$6,106,054	1988	\$11,597,426	\$10,159,345
97	MIMIC BOARD	(Y/N)	1	\$4,432,019		\$4,432,019	1988	\$4,597,530	\$4,027,436
98	PUBLIC ADDRESS	(Y/N)							
99	COMPUTER	(Y/N)	1	\$641,846		\$641,846	1988	\$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								
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity								
106	3.00 SYSTEMS	Linear Feet	119,282	\$966.39	\$115,273,245		1988	\$1,002	\$878
107	3.01 SIGNAL SYSTEM	L.F. Guideway	119,282	\$341.59	\$40,745,221		1988	\$354	\$310
108	TRAIN CONTROL - WAYSIDE		119,282	\$232.35	\$27,715,247		1988	\$241	\$211
109	INSTALLATION					\$116,349			
110	HARDWARE					\$1,034,481			
111	DESIGN		119,282	\$222.70		\$26,564,417	1988	\$231	\$202.37
112	CROSSING PROTECTION	Each	28	\$465,356	\$13,029,974		1988	\$482,735	\$422,876
113	TRAFFIC SIGNALS	Each	28	\$433,001		\$12,124,025	1988	\$449,171	\$393,474
114	INSTALLATION					\$552,641			
115	GATES	Each				\$353,308			
116	OTHER								
117	3.02 ELECTRIFICATION	L.F. Guideway	119,282	\$414.41	\$49,432,018		1988	\$430	\$377
118	SUBSTATIONS	Each	19	\$1,108,399		\$21,059,588	1988	\$1,149,792	\$1,007,218

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		
119	3.00 SYSTEMS (continued)							
120	PURCHASE	Each			\$15,991,760			
121	INSTALLATION	Each			\$5,067,828			
122	CATENARY	L.F. Guideway	119,282	\$237.86	\$28,372,430	1988	\$247	
123	INSTALLATION	Each						
124	POLES AND COMPONENTS	Each	994	\$14,301	\$14,214,975	1988	\$14,835	
125	WIRE		119,282	\$118.69	\$14,157,455	1988	\$123	
126	TROLLEY				\$1,905,017			
127	MESSENGER				\$2,565,811			
128	FEEDER				\$9,686,627			
129	RETURN							
130	3.03 COMMUNICATIONS	Total	1	\$19,091,470	\$19,091,470	1988	\$19,804,429	
131	3.04 FARE COLLECTION	Total	1	\$6,004,536	\$6,004,536	1988	\$6,228,772	
132	FAREBOX							
133	VENDING MACHINE		74	\$57,288	\$4,239,307	1988	\$59,427	
134	OTHER				\$1,765,229		\$52,058	
135	4.00 STATIONS	Each	22	\$2,995,158	\$65,893,479	1988	\$3,107,011	
136	4.01 AT-GRADE	Each	18	\$1,051,819	\$18,932,742	1988	\$1,091,099	
137	CENTER PLATFORM	Each	15	\$1,079,409	\$16,191,134	1988	\$1,119,719	
138	PLATFORM LENGTH	Linear Feet						
139	ESCALATOR/ELEVATOR	(Y/N)						
140	HANDICAP ACCESS MODE	Type						
141	WEATHER COVERAGE	Percent						
142	SIDE PLATFORM	Each	3	\$913,869	\$2,741,608	1988	\$947,997	
143	PLATFORM LENGTH	Linear Feet						
144	ESCALATOR/ELEVATOR	(Y/N)						
145	HANDICAP ACCESS MODE	Type						
146	WEATHER COVERAGE	Percent						
147	4.02 SUBWAY	Each	1	\$27,684,300	\$27,684,300	1988	\$28,718,154	
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	1	\$27,684,300	\$27,684,300	1988	\$28,718,154	
154	PLATFORM LENGTH	Linear Feet						
155	ESCALATOR/ELEVATOR	(Y/N)						
156	HANDICAP ACCESS MODE	Type						
157	WEATHER COVERAGE	Percent						

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	<i>Each</i>	3	\$2,928,894	\$8,786,682		1988	\$3,038,272	\$2,661,526
160	CENTER PLATFORM	<i>Each</i>	3	\$2,928,894		\$8,786,682	1988	\$3,038,272	\$2,661,526
161	PLATFORM LENGTH	<i>Linear Feet</i>							
162	ESCALATOR/ELEVATOR	<i>(Y/N)</i>							
163	HANDICAP ACCESS MODE	<i>Type</i>							
164	WEATHER COVERAGE	<i>Percent</i>							
165	SIDE PLATFORM	<i>Each</i>							
166	PLATFORM LENGTH	<i>Linear Feet</i>							
167	ESCALATOR/ELEVATOR	<i>(Y/N)</i>							
168	HANDICAP ACCESS MODE	<i>Type</i>							
169	WEATHER COVERAGE	<i>Percent</i>							
170	4.04 PARKING LOTS	<i>Total</i>	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	<i>Total</i>							
174	NUMBER OF LOTS								
175	NUMBER OF SPACES								
176	4.06 PEDESTRIAN OVERPASSES	<i>Total</i>	2	\$999,611	\$1,999,222		1988	\$1,036,941	\$908,360
177	5.00 VEHICLES	<i>Each</i>	54	\$1,480,354	\$79,939,129		1988	\$1,535,637	\$1,345,218
178	5.01 REVENUE VEHICLES - ORDER A	<i>Each</i>	54	\$1,446,965	\$78,136,129		1988	\$1,501,001	\$1,314,877
179	MAKE/MANUFACTURER	<i>Name</i>							
180	BODY TYPE (RIGID,ARTIC)	<i>Type</i>							
181	LENGTH OVER COUPLERS	<i>Linear Feet</i>							
182	WIDTH	<i>Linear Feet</i>							
183	NUMBER SEATS	<i>Each</i>							
184	AIR CONDITIONING	<i>(Y/N)</i>							
185	CAB SIGNAL EQUIPMENT	<i>(Y/N)</i>							
186	BRAKING SYSTEM (AIR,ELEC)	<i>Type</i>							
187	TYPE OF STEPS (HIGH,LOW)	<i>Type</i>							
188	HANDICAPED (LIFT,RAMP)	<i>Type</i>							
189	ON-BOARD FAREBOX	<i>(Y/N)</i>							
190	PROCUREMENT COST	<i>Total</i>							
191	SPARE PARTS	<i>Total</i>							
192	SPECIAL EQUIPMENT COST	<i>Total</i>							
193	5.02 REVENUE VEHICLES - ORDER B	<i>Each</i>							
194	MAKE/MANUFACTURER	<i>Name</i>							
195	BODY TYPE (RIGID,ARTIC)	<i>Type</i>							
196	LENGTH OVER COUPLERS	<i>Linear Feet</i>							

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
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	19	\$94,895	\$1,803,000		1988	\$98,439	\$86,232
225	SERVICE TRUCKS		5		\$136,000	\$680,000			
226	AUTOMOBILES		12		\$28,333	\$340,000			
227	OTHER		2		\$391,500	\$783,000			
228	6.00 SPECIAL CONDITIONS	Linear feet	119,282	\$1,277	\$152,349,392		1985	\$1,442	\$1,263
229	6.01 UTILITY RELOCATION - AS IS	Total	1	\$2,553,505	\$2,553,505		1985	\$2,882,060	\$2,524,684
230	NEW INSTALLATION								
231	GAS					\$397,776			
232	TELEPHONE					\$179,117			
233	ELECTRIC					\$52,175			
234	WATER					\$130,065			
235	PIPELINE					\$1,006,224			

CAPITAL COST DATA BASE

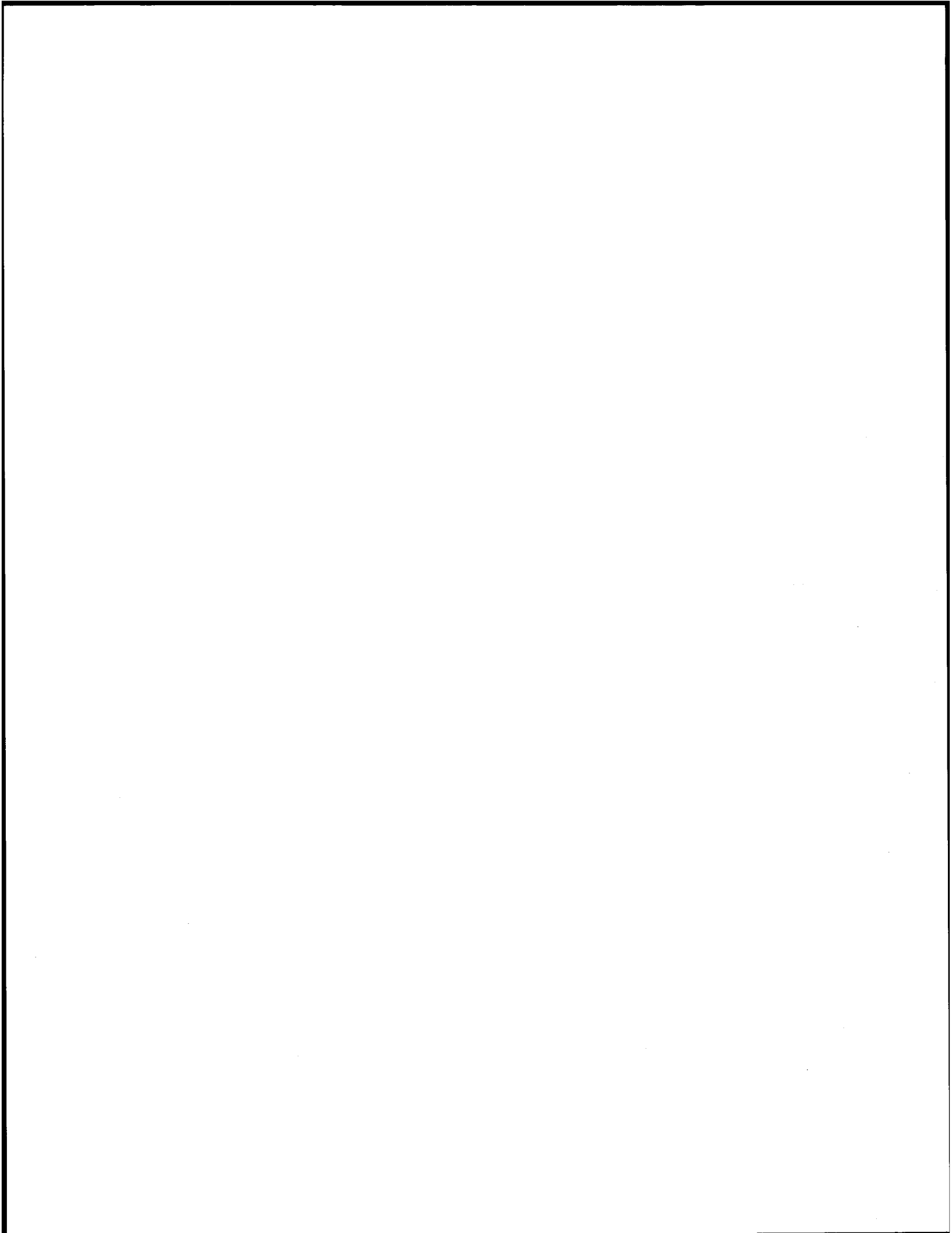
LOS ANGELES COUNTY TRANSPORTATION COMMISSION

UMTA FIXED GUIDEWAY CAPITAL COSTING SYSTEM LIGHT RAIL SYSTEMS		UNITS OF MEASURE	LOS ANGELES COUNTY TRANSPORTATION COMMISSION				1990 CITY UNIT COST ESTIMATES	1990 NATIONAL UNIT COST ESTIMATES	
			QUANTITY	UNIT COST	TOTAL COST	COMPONENT COST			YEAR
236	6.00 SPECIAL CONDITIONS (continued)								
237	RAILROAD								
238	OTHER				\$788,148				
239	6.02 UTILITY RELOCATION - BETTERMENTS	Total	1	\$119,761,634	\$119,761,634		1985	\$135,171,144	\$118,409,923
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	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	\$967,836	\$967,836		1985	\$1,092,366	\$956,912
258	BUILDINGS				\$384,438				
259	REMOVALS				\$583,398				
260	6.05 ROADWAY CHANGES	Total	1	\$12,088,912	\$12,088,912		1985	\$13,644,370	\$11,952,468
261	BRIDGES								
262	STREETS				\$400,000				
263	OTHER				\$11,688,912				
264	6.06 ENVIRONMENTAL	Total	1	\$16,977,505	\$16,977,505		1985	\$19,161,970	\$16,785,885
265	NOISE								
266	VISUAL				\$10,124,905				
267	VIBRATION								
268	OTHER				\$6,852,600				
269	7.00 RIGHT-OF-WAY	Linear Feet	119,282	\$504	\$60,084,803		1988	\$523	\$458
270	7.01 LAND ACQUISITION - PURCHASED	Total	1	\$55,437,402	\$55,437,402		1988	\$57,507,678	\$50,376,726
271	MAINLINE	Acres	1	\$55,437,402		\$55,437,402			
272	STATION	Acres							
273	YARD	Acres							
274	PARKING	Acres							

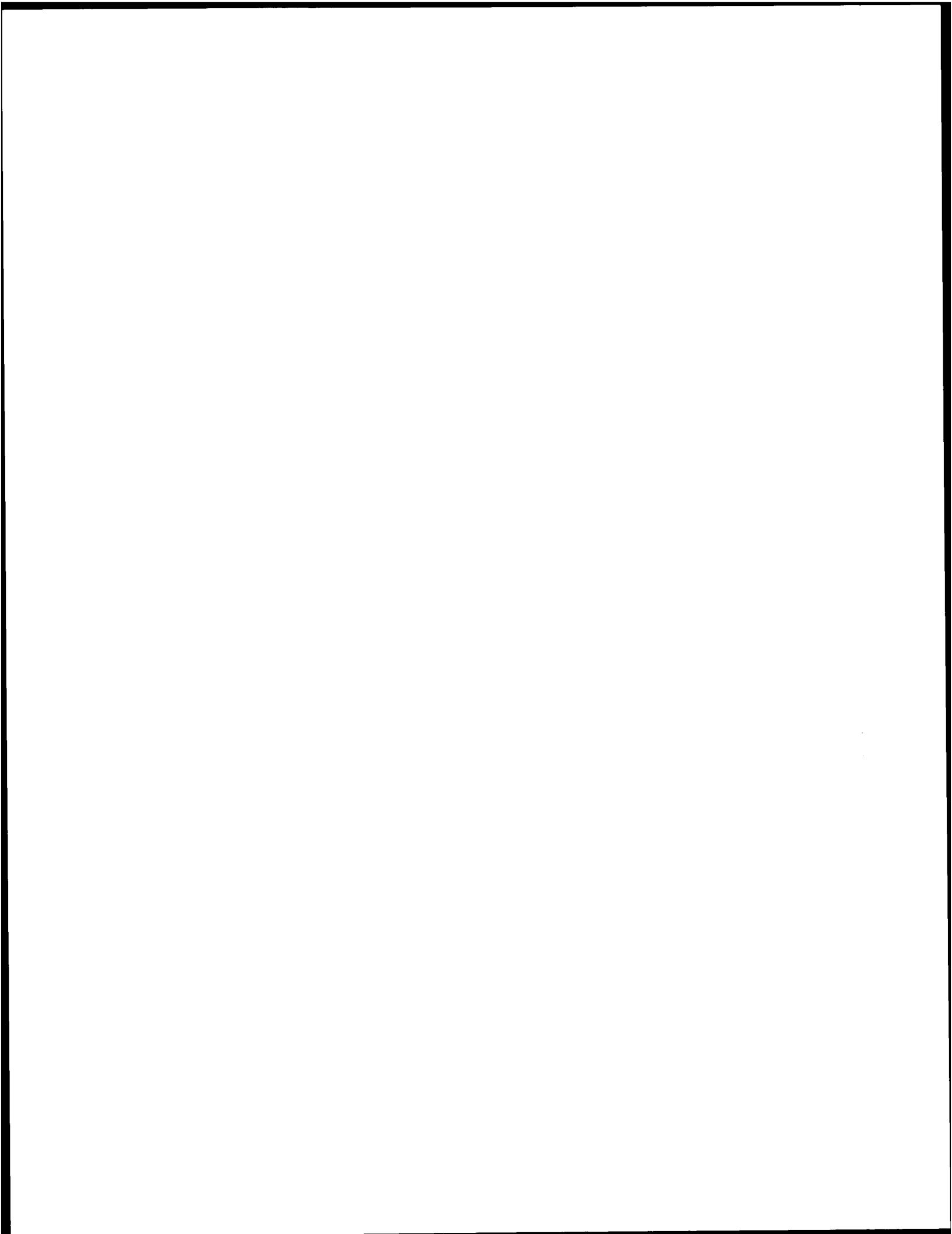
CAPITAL COST DATA BASE

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
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	1	\$4,493,401	\$4,493,401		1988	\$4,661,204	\$4,083,215
282	LEGAL & CONSULTING					\$2,211,075			
283	APPRAISAL					\$40,500			
284	PROPERTY MANAGEMENT					\$2,241,826			
285	7.04 RELOCATION	Total	1	\$154,000	\$154,000		1988	\$159,751	\$139,942
286	BUSINESS		1			\$77,000			
287	RESIDENCE		1			\$77,000			
288	7.05 OTHER	Total							
289	8.00 SOFT-COSTS	Linear Feet	119,282	\$1,767	\$210,805,963		1985	\$1,995	\$1,747
290	8.01 FEASIBILITY STUDIES	Total							
291	8.02 ENGINEERING & DESIGN	Total	1	\$69,586,796	\$69,586,796		1985	\$78,540,402	\$68,801,392
292	8.03 CONSTRUCTION MANAGEMENT	Total	1	\$86,130,800	\$86,130,800		1985	\$97,213,093	\$85,158,669
293	8.04 PROJECT MANAGEMENT	Total	1	\$23,200,000	\$23,200,000		1985	\$26,185,102	\$22,938,149
294	8.05 PROJECT MANAGEMENT OVERSIGHT	Total	1	\$4,591,000	\$4,591,000		1985	\$5,181,716	\$4,539,183
295	8.06 PROJECT INITIATION	Total	1	\$35,638,000	\$35,638,000		1985	\$40,223,476	\$35,235,765
296	INSURANCE					\$35,638,000			
297	MOBILIZATION								
298	MAINTENANCE OF TRAFFIC								
299	8.07 FINANCE CHARGES								
300	8.08 TRAINING/START-UP/TESTING		1	\$9,915,093	\$9,915,093		1985	\$11,190,850	\$9,803,185
301	SAFETY CERTIFICATION								
302	OFF-SITE LRV TESTING								
303	8.09 OTHER		1	(\$18,255,726)	(\$18,255,726)		1988	(\$18,937,475)	(\$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				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
1	0.00 SYSTEM DESCRIPTION						
2	0.01 SERVICE						
3	ROUTE MILES	Route Miles	5	0	18	30	30
4	TRACK MILES	Track Miles	5	26	40	62	37
5	STATIONS	Each	5	13	22	28	15
6	VEHICLES IN SERVICE	Revenue Vehicles	5	26	51	97	71
7	PEAK	Revenue Vehicles	5	15	31	70	55
8	MIDDAY	Revenue Vehicles	5	8	15	28	20
9	HEADWAY						0
10	PEAK	Minutes	4	0	9	15	15
11	MIDDAY	Minutes	4	0	13	30	30
12	0.02 STAFFING - TOTAL	Total	5	83	231	503	420
13	ADMINISTRATIVE	FTE's	4	0	14	28	28
14	OPERATORS	FTE's	5	32	62	112	80
15	MAINTENANCE						0
16	VEHICLE	FTE's	4	0	29	55	55
17	FACILITY	FTE's	4	0	27	53	53
18	OTHER (eg Fare Inspection)	FTE's	5	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	<i>Linear Feet</i>	5	\$428	\$1,016	\$1,508	\$1,079
2	1.01 GUIDEWAY AT-GRADE	<i>Linear Feet</i>	5	\$413	\$665	\$1,205	\$792
3	DIRECT FIXATION		1	\$696	\$696	\$696	\$0
4	BALLASTED		5	\$350	\$491	\$679	\$329
5	IN-PAVEMENT BALLASTED		2	\$526	\$1,557	\$2,588	\$2,062
6	EMBEDDED		4	\$583	\$1,452	\$3,714	\$3,131
7	1.02 GUIDEWAY - ELEVATED STRUCTURE	<i>Linear Feet</i>	4	\$410	\$1,768	\$3,041	\$2,631
8	DIRECT FIXATION		3	\$410	\$1,233	\$2,756	\$2,346
9	BALLASTED		3	\$1,119	\$2,746	\$4,516	\$3,397
10	IN-PAVEMENT BALLASTED						
11	EMBEDDED		2	\$506	\$1,936	\$3,365	\$2,859
12	1.03 GUIDEWAY - ELEVATED, RETAINED FILL	<i>Linear Feet</i>	2	\$847	\$1,009	\$1,172	\$325
13	DIRECT FIXATION						
14	BALLASTED		2	\$847	\$1,009	\$1,172	\$325
15	IN-PAVEMENT BALLASTED						
16	EMBEDDED						
17	1.04 GUIDEWAY - ELEVATED FILL	<i>Linear Feet</i>	1	\$616	\$616	\$616	\$0
18	DIRECT FIXATION						
19	BALLASTED		1	\$616	\$616	\$616	\$0
20	IN-PAVEMENT BALLASTED						
21	EMBEDDED						
22	1.05 GUIDEWAY - SUBWAY	<i>Linear Feet</i>	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	<i>Linear Feet</i>	3	\$329	\$3,354	\$5,410	\$5,081
28	DIRECT FIXATION						
29	BALLASTED		2	\$329	\$2,870	\$5,410	\$5,081
30	IN-PAVEMENT BALLASTED						
31	EMBEDDED						
32	1.07 POCKET TRACK	<i>L.F. Guideway</i>	2	\$2.81	\$34.11	\$65.41	\$62.61
33	1.08 STORAGE TRACK	<i>L.F. Guideway</i>					
34	1.09 SPECIAL TRACKWORK	<i>L.F. Guideway</i>	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	RANGE
41	1.00 GUIDEWAY ELEMENTS (continued)						
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>	1	\$4,389	\$4,389	\$4,389	\$0
52	BRIDGES	Each					
53	OVERPASSES	Each					
54	OTHER	Each					
55	2.00 YARDS & SHOPS	<i>Total</i>	5	\$4,086,783	\$23,862,435	\$42,837,570	\$38,750,787
56	2.01 BUILDING	<i>Each</i>	5	\$4,086,783	\$17,019,418	\$36,002,375	\$31,915,592
57	DESCRIPTION	Each					
58	SHOP CAPACITY *	Revenue Vehicles					
59	YARD STORAGE CAPACITY	Revenue Vehicles					
60	WORKSTATIONS	Each					
61	TRACK LENGTH	Linear Feet					
62	PARKING	Spaces					
63	2.02 OFFICE FURNITURE & EQUIP.	<i>All</i>	1	\$252,440	\$252,440	\$252,440	\$0
64	2.03 HEAVY REPAIR		3	\$69,070	\$349,318	\$731,367	\$662,297
65	BODY	(Y/N)					
66	TRUCK	(Y/N)					
67	EQUIPMENT	(Y/N)					
68	2.04 MOTOR SHOPS		2	\$11,512	\$27,032	\$42,553	\$31,042
69	VARIABLE TEST LOAD	(Y/N)					
70	REWIND	(Y/N)					
71	OTHER	(Y/N)					
72	2.05 WHEEL SHOP		3	\$25,532	\$614,629	\$1,040,170	\$1,014,638
73	WHEEL PRESS	Each					
74	WHEEL TRUING	Each					
75	2.06 MACHINE SHOP		2	\$236	\$118,112	\$235,988	\$235,752
76	LATHE	Each					
77	DRILL PRESS	Each					
78	2.07 AIR CONDITIONING	(Y/N)	1	\$2,419,865	\$2,419,865	\$2,419,865	\$0
79	2.08 ELECTRONICS	(Y/N)	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	Each	1	\$1,206,213	\$1,206,213	\$1,206,213	\$0
93	CASH COUNTING MACHINE						
94	VAULT						
95	OTHER						
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	OTHER						
105	* Line 58 - Unit Cost calculated by dividing total cost by shop capacity						
106	3.00 SYSTEMS	Linear Feet	5	\$179	\$482	\$878	\$699
107	3.01 SIGNAL SYSTEM	L.F. Guideway	5	\$54	\$198	\$443	\$388
108	TRAIN CONTROL - WAYSIDE						
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	RANGE
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	4	\$196,121	\$7,477,427	\$17,348,680	\$17,152,559
131	3.04 FARE COLLECTION	Total	4	\$1,080,497	\$3,407,019	\$5,456,404	\$4,375,907
132	FAREBOX						
133	VENDING MACHINE						
134	OTHER						
135	4.00 STATIONS	Each	5	\$180,861	\$1,431,936	\$3,205,143	\$3,024,282
136	4.01 AT-GRADE	Each	5	\$180,861	\$800,732	\$1,961,305	\$1,780,443
137	CENTER PLATFORM	Each	3	\$155,735	\$542,827	\$980,874	\$825,139
138	PLATFORM LENGTH	Linear Feet					
139	ESCALATOR/ELEVATOR	(Y/N)					
140	HANDICAP ACCESS MODE	Type					
141	WEATHER COVERAGE	Percent					
142	SIDE PLATFORM	Each	5	\$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	2	\$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	2	\$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		UNITS OF MEASURE	UNIT COST SUMMARY				
			OBSERVATIONS	MINIMUM	MEAN	MAXIMUM	RANGE
158	4.00 STATIONS (continued)						
159	4.03 ELEVATED	<i>Each</i>	1	\$2,661,526	\$2,661,526	\$2,661,526	\$0
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	<i>Total</i>	2	\$731,214	\$1,137,154	\$1,543,093	\$811,878
171	NUMBER OF LOTS						
172	NUMBER OF SPACES						
173	4.05 PARKING GARAGES	<i>Total</i>					
174	NUMBER OF LOTS						
175	NUMBER OF SPACES						
176	4.06 PEDESTRIAN OVERPASSES	<i>Total</i>	1	\$908,360	\$908,360	\$908,360	\$0
177	5.00 VEHICLES	<i>Each</i>	5	\$968,562	\$1,159,567	\$1,345,218	\$376,657
178	5.01 REVENUE VEHICLES -- ORDER A	<i>Each</i>	5	\$806,202	\$1,119,800	\$1,314,877	\$508,676
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	<i>Each</i>	1	\$1,255,800	\$1,255,800	\$1,255,800	\$0
194	MAKE/MANUFACTURER	Name					
195	BODY TYPE (RIGID,ARTIC)	Type					
196	LENGTH OVER COUPLERS	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	2	\$11,267	\$48,750	\$86,232	\$74,965
225	SERVICE TRUCKS						
226	AUTOMOBILES						
227	OTHER						
228	6.00 SPECIAL CONDITIONS	Linear feet	5	\$81	\$337	\$1,263	\$1,182
229	6.01 UTILITY RELOCATION - AS IS	Total	5	\$2,524,684	\$4,719,422	\$6,370,239	\$3,845,555
230	NEW INSTALLATION						
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	\$118,409,923	\$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	5	\$160	\$346	\$600	\$440
270	7.01 LAND ACQUISITION - PURCHASED	Total	5	\$15,470,477	\$30,823,677	\$50,376,726	\$34,906,250
271	MAINLINE	Acres					
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	<i>Total</i>					
277	MAINLINE						
278	STATION						
279	YARD						
280	PARKING						
281	7.03 ACQUISITION-RELATED COST	<i>Total</i>	4	\$813,454	\$2,296,128	\$4,083,215	\$3,269,761
282	LEGAL & CONSULTING						
283	APPRAISAL						
284	PROPERTY MANAGEMENT						
285	7.04 RELOCATION	<i>Total</i>	3	\$139,942	\$267,577	\$471,332	\$331,390
286	BUSINESS						
287	RESIDENCE						
288	7.05 OTHER	<i>Total</i>					
289	8.00 SOFT-COSTS	<i>Linear Feet</i>	5	\$359	\$1,491	\$3,068	\$2,708
290	8.01 FEASIBILITY STUDIES	<i>Total</i>	3	\$3,718,000	\$20,812,653	\$36,398,671	\$32,680,671
291	8.02 ENGINEERING & DESIGN	<i>Total</i>	3	\$16,009,645	\$68,189,928	\$119,758,747	\$103,749,102
292	8.03 CONSTRUCTION MANAGEMENT	<i>Total</i>	5	\$9,576,163	\$36,506,471	\$85,158,669	\$75,582,506
293	8.04 PROJECT MANAGEMENT	<i>Total</i>	5	\$4,347,088	\$15,113,157	\$22,938,149	\$18,591,061
294	8.05 PROJECT MANAGEMENT OVERSIGHT	<i>Total</i>	1	\$4,539,183	\$4,539,183	\$4,539,183	\$0
295	8.06 PROJECT INITIATION	<i>Total</i>	3	\$1,319,808	\$14,136,884	\$35,235,765	\$33,915,957
296	INSURANCE						
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

