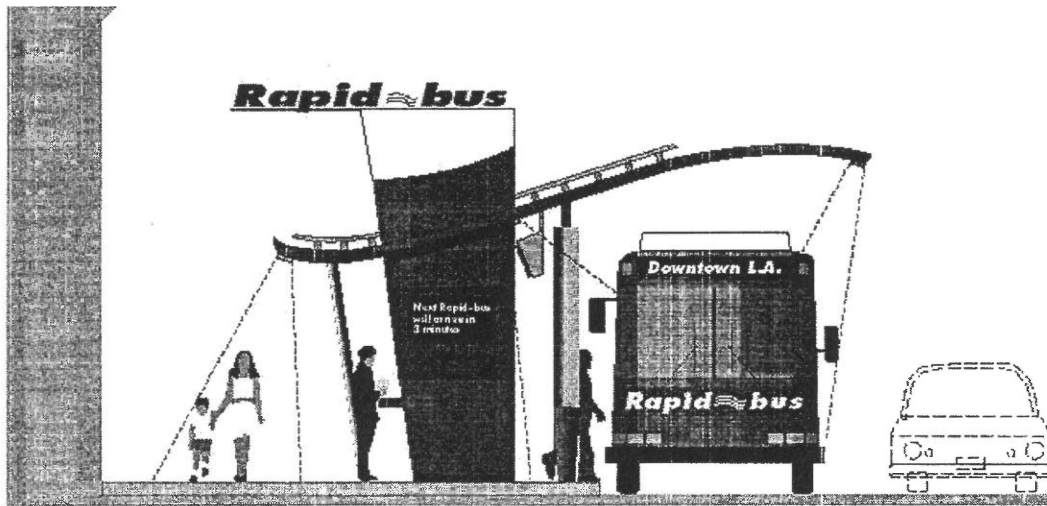


LOS ANGELES METRO RAPID BUS DEMONSTRATION PROGRAM

Implementation Plan



Prepared for:

Los Angeles County Metropolitan Transportation Authority

By:

Transportation Management & Design, Inc.

In association with
Suisman Urban Design

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LOS ANGELES METRO RAPID BUS DEMONSTRATION PROGRAM

1.0 INTRODUCTION

The Los Angeles County Metropolitan Transportation Authority (MTA) and City of Los Angeles Department of Transportation (LADOT) are working in partnership to implement a Metro Rapid Bus demonstration program, the results of which will lay the foundation for a new, fast, high quality bus service. The demonstration program will require creative thinking and an innovative approach by both agencies, and will provide the technical platform upon which the MTA and LADOT will make immediate and long-term strategic transportation decisions. The purpose of Metro Rapid Bus is to address the need for faster travel choices for bus riders, especially the transit-dependent, on an interim basis prior to the completion of the Eastside and Mid-City rail segments of the Metro Red Line. Countywide expansion of the Program is predicated on the performance and public acceptance of the demonstration project.

1.1 Background

On May 13, 1998, the MTA Board adopted a Restructuring Plan. The plan demonstrated to the Federal Transit Administration (FTA) MTA's financial capability to complete the Metro Red Line Segments 2 and 3 to Hollywood and North Hollywood. The Restructuring Plan also assumed the continued suspension of three future rail projects: the Metro Red Line Mid-City and Eastern Extensions as well as the Metro Blue Line to Pasadena. As part of the Restructuring Plan, the MTA committed to completing a Regional Transit Alternatives Analysis (RTAA) by mid-October 1998 that would analyze viable and effective options for improving transit to parts of Los Angeles County, including the corridors where MTA had suspended work on planned rail projects and where there were high concentrations of transit dependent residents.

In August 1998, the RTAA was initiated. Milestone One identified transit dependent travel patterns, potentially available funding through the year 2010, and a set of proposed evaluation criteria. Milestone Two updated the funds available, identified alternative transit options and, through a screening process, narrowed those alternatives into a smaller group for more detailed analysis. Milestone Three presented recommendations on the following issues:

- MTA investment priorities
- Funding levels for non-RTAA programs
- Funding for increasing the reliability of MTA's transit operations
- Municipal Operator allocations, and
- *Countywide service expansion by implementing rapid bus lines.*

In November 1998, the MTA Board of Directors approved the RTAA. Included in the approval of the RTAA was the adoption of a Countywide Bus System Enhancement Program that directed staff to "proceed with the preparation for presentation to the Board of a thorough plan for a Rapid Bus demonstration project of three lines, including at least one line serving each of the East Side, Mid-City, and San Fernando Valley". The Rapid Bus concept was presented as a three-phase program, with Phase One comprising the demonstration phase.

1.2 MTA/City of Los Angeles Partnership

Over the past several years, both the MTA and LADOT have independently and collaboratively pursued the objective of increasing transit demand through improved bus speeds and service reliability. Studies have been produced by both agencies which outline the benefits of improved bus speeds. The MTA has been very aware of the reduction in average bus speeds as they directly affect system operating and capital requirements. Since 1980, MTA's average bus operating speed has declined nearly 13 percent, requiring approximately 260 additional vehicles merely to maintain passenger-loading standards.

MTA BUS FLEET AVERAGE SYSTEM SPEED

Fiscal Year	Weekday Revenue Miles	Weekday Revenue Hours	Average Speed (mph)
1998	218,745	18,472	11.8
1997	220,265	18,214	12.1
1996	229,245	18,863	12.2
1995	233,116	19,442	12.0
1994	251,430	21,005	12.0
1993	249,458	20,842	12.0
1992	259,952	21,122	12.3
1991	272,860	22,312	12.2
1990	268,762	21,666	12.4
1989	266,929	21,306	12.5
1988	282,392	22,247	12.6
1987	289,409	22,644	12.8
1986	285,882	22,116	12.9
1985	289,599	22,158	13.1
1984	293,270	22,227	13.2
1983	279,884	21,082	13.3
1982	284,399	21,146	13.4
1981	291,922	21,649	13.5

The LADOT has understood the regional benefits of increasing transit ridership and has pursued bus signal priority technologies which not only increase transit speeds but also demonstrate minimal impacts to traffic. Both agencies have pursued solutions which can be replicated throughout Los Angeles County. With the advent of new signal priority technologies, low-floor buses, universal fare collection systems, and a realization that the two agencies together can make an immediate impact on improving transit ridership, the MTA and LADOT have formed a partnership in pursuit of a common goal.

2.0 METRO RAPID BUS: CORRIDOR DESCRIPTIONS

2.1 Phased Implementation

Implementation of Metro Rapid Bus in Los Angeles County will be phased. Initially, MTA and LADOT will design, build, and operate Metro Rapid Bus service in the three demonstration corridors identified in the RTAA. If the demonstration achieves the goals set forth in the program, Metro Rapid Bus will be expanded to approximately 16 corridors. The 16 corridors will be selected based on a set of program goals established during the demonstration and will consist of core regional bus service. A tiered network of connector bus routes, consisting of

inter-community and local services, will be developed to distribute Metro Rapid Bus patrons. Expansion of Metro Rapid Bus to corridors with exclusive right-of-way will also be considered. Operating designs for both on-street arterial bus lanes and transitways will be developed.

2.2 Demonstration Corridors (Phase One)

An evaluation of potential demonstration corridors in the East Side, Mid-City, and San Fernando Valley areas of Los Angeles suggests the following street alignments as candidates for Phase One of the Metro Rapid Bus Program (Figure 1). Each alignment was selected based on several criteria, including potential transit demand, proportion of transit dependents, and potential for patrons to make long distance trips.

- Whittier/West 6th/Wilshire Boulevard (East Side/Mid-City)
- Ventura Boulevard (San Fernando Valley)
- Pico/Broadway/East 1st/Cesar Chavez (Mid-City/East Side)

Transit Demand - Approximately 215,000 passengers board MTA buses each weekday in the three demonstration corridors. This includes people boarding buses traveling in the direction of the corridor within ¼ mile of the designated street.

Transit Dependency - An analysis of transit dependency in each corridor was performed to determine the potential market share of Metro Rapid Bus. Assuming corridor widths of ½ mile on either side of the alignment, residential attributes were compiled. The number and percent of population under 16 and over 65 years of age were calculated, along with zero-vehicle households and persons with incomes below the poverty level. In total, approximately 750,000 transit dependent residents were found to live along the three demonstration corridors. Approximately 32 percent of the residents were under 16 or over 65 years of age. The Whittier/West 6th/Wilshire Corridor and Pico/Broadway/East 1st/Chavez corridors were found to have particularly high proportions of zero-vehicle households and residents living below the poverty level.

Trip Distance - The three Rapid Bus demonstration lines serve dense, mixed-use corridors with numerous regionally significant destinations. These include major employment centers in Los Angeles, including Mid-Wilshire, Universal Studios, Warner Center, Westwood, Santa Monica, and downtown Los Angeles. As well, several major educational centers are also served, such as UCLA, East Los Angeles Community College, and a number of high schools and middle schools. Major commercial areas include Whittier Boulevard, Commerce Center, and most of the Wilshire and Ventura Boulevard corridors. Regional and community medical facilities are found along all portions of these three corridors. The corridors also contain many high-density residential areas with as many as 25,000 residents per square mile. While the average passenger trip length of existing service in these corridors is above the system average, or approximately five miles, it is anticipated that the attractiveness of Metro Rapid Bus will increase this average significantly with the ability to travel considerably further in the same travel time.

2.3 Expansion Corridors (Phase Two)

Phase Two of the Metro Rapid Bus program expands the concept to 16 corridors (Figure 2). Existing demand on the proposed 13 expansion routes is approximately 300,000 weekday boardings. Passengers on these routes are carried over one million miles each day. Over 400 peak buses operate the 13 routes.

Figure 1:
Metro Rapid Bus - Proposed Demonstration Routes

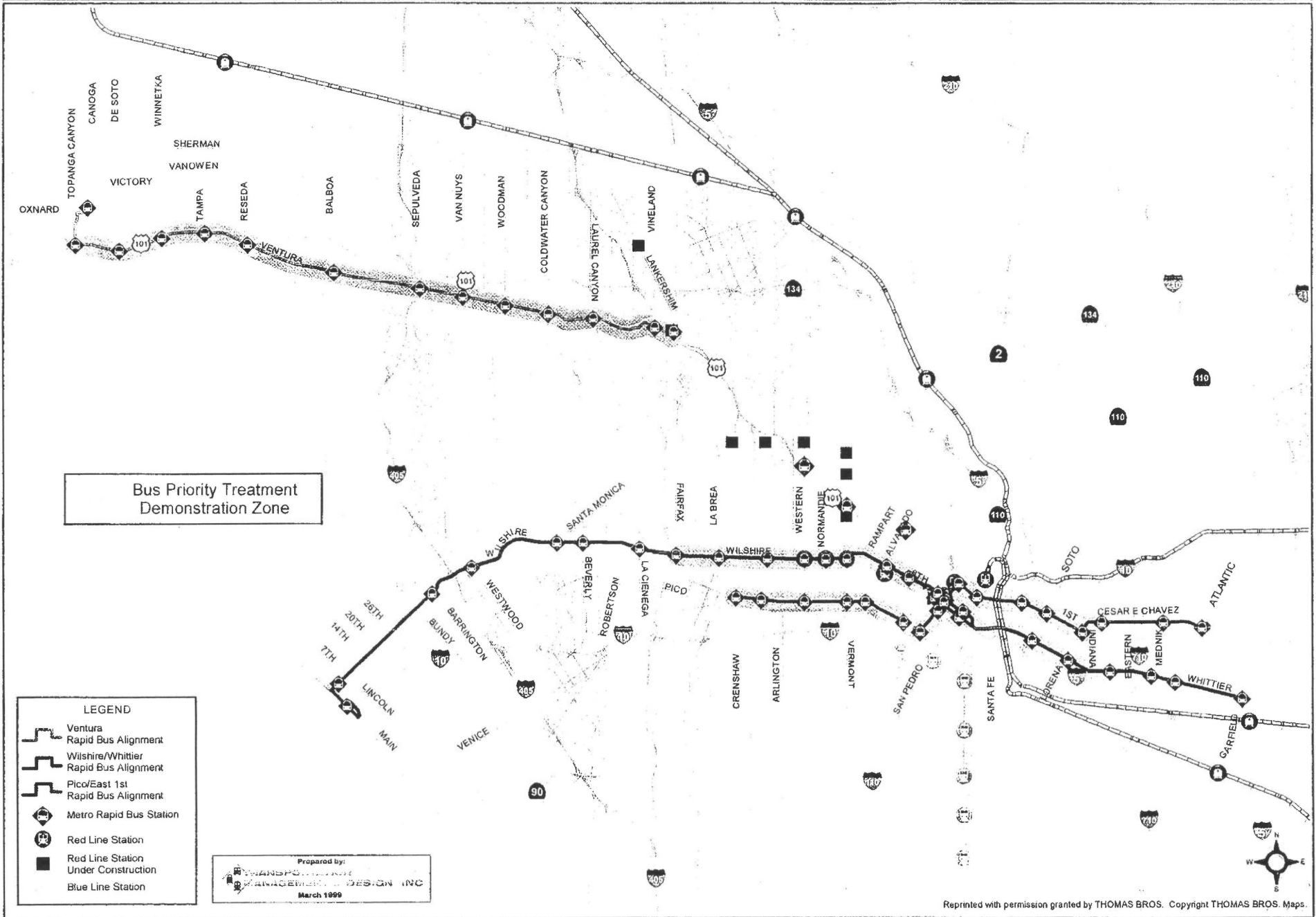
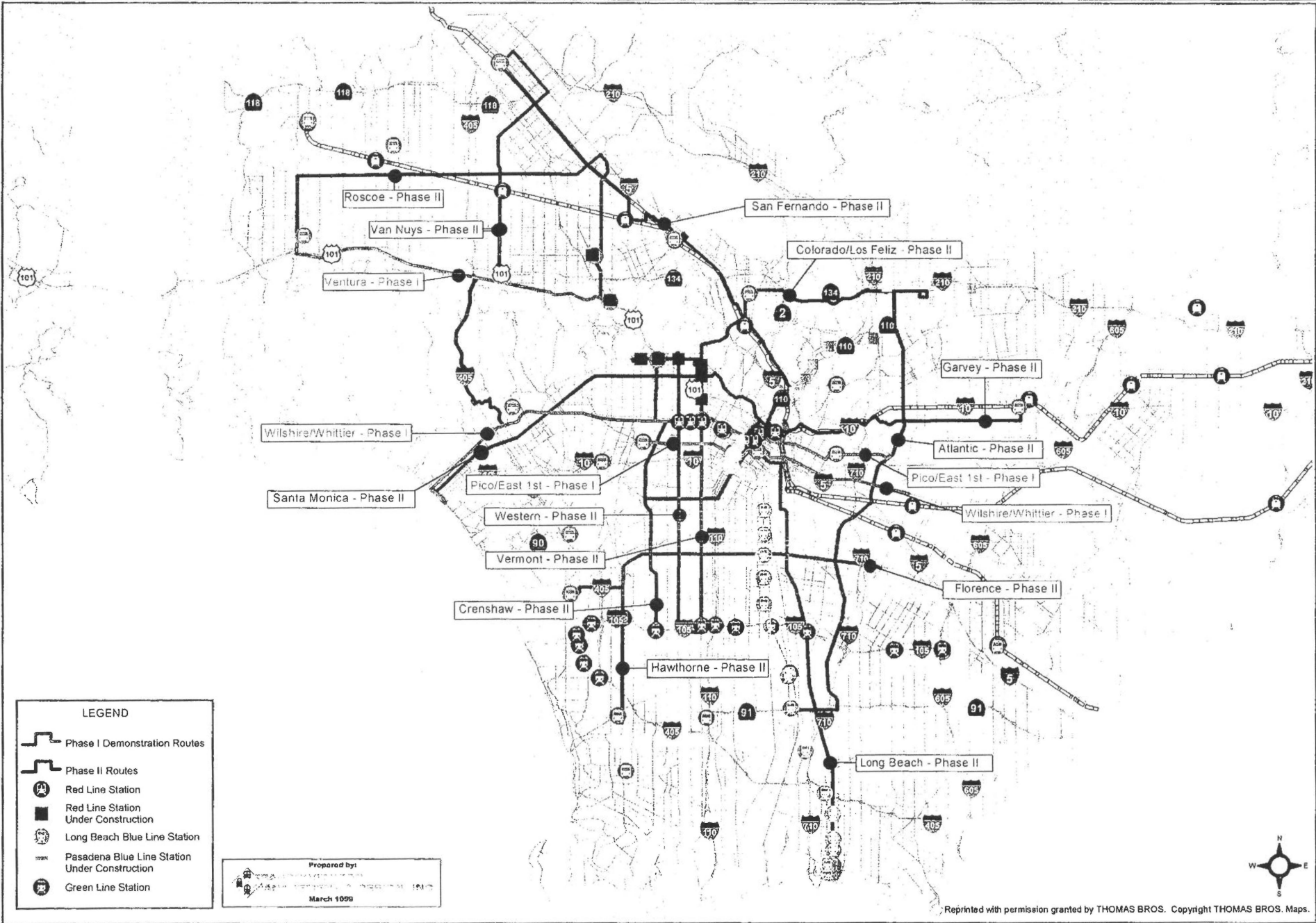


Figure 2:
Metro Rapid Bus - Proposed Implementation Phases



Metro Rapid Bus Proposed Expansion Routes

CORRIDOR	CURRENT LINES	PHASE	METRO RAPID BUS TERMINALS
Whittier/Wilshire Bl	18/20/318/320	Demo 1	Whittier/Garfield to City of Santa Monica
Ventura Bl	424/425/522	Demo 2	Universal City Red Line and Warner Center TC
Pico/East 1 st /Chavez	30/31/68	Demo 3	Pico/Rimpau to Chavez/Atlantic
Atlantic Bl	260	Expansion	Del Mar Blue Line to Artesia Blue Line
Colorado/Los Feliz Ave	180/181	Expansion	Hollywood/Highland Red Line to Pasadena CC
Crenshaw Bl	210/310	Expansion	Hollywood/Vine Red Line to Green Line
Florence Ave	111/311	Expansion	LAX TC to Bell Gardens (Florence/Garfield)
Garvey Ave	70	Expansion	LACBD to El Monte TC
Hawthorne Bl	40	Expansion	LACBD to South Bay Galleria
Long Beach Bl	60	Expansion	LACBD to Artesia Blue Line (via Artesia)
Roscoe Bl	152	Expansion	Warner Center TC to Universal City Red Line
San Fernando Rd	94/394	Expansion	LACBD to Sylmar/SF Metrolink Station
Santa Monica Bl	4/304	Expansion	LACBD to Santa Monica
Van Nuys Bl	233/561	Expansion	Westwood TC to Sylmar/SF Metrolink Station
Vermont Ave	204/354	Expansion	Hollywood/Vermont to Vermont Green Line
Western Ave	207/357	Expansion	Western/Vermont to Vermont Green Line

The average speed of buses operating in the 16 corridors is less than 11.5 miles per hour, with rush hour average speeds of less than 10 miles per hour. Every week, passengers traveling in these corridors spend the equivalent of over 100 years of travel time. The ability to improve bus speeds by only a few miles per hour will generate significant timesaving for transit patrons. Moreover, increased transit speeds will improve system operating efficiency by reducing the operating and capital requirements for the same level of service.

2.4 Potential Transitway Corridors

The MTA recently completed a transitway feasibility study in coordination with the LADOT. The study analyzed the feasibility of constructing and operating exclusive bus transitways in Los Angeles County. Generally, the study concluded that each of the corridors had suitable available right-of-way that could be converted into an exclusive busway. As part of the RTAA, the MTA directed that further studies be conducted in two of the corridors, the Exposition corridor and the San Fernando Valley Burbank/Chandler corridor. A description of each is as follows:

- *Exposition ROW* - A bus connection between Downtown Los Angeles and Santa Monica primarily via the abandoned, MTA-owned Exposition railroad right-of-way. The right-of-way segment is approximately 11.0 miles in length and the total route length from Union Station to Downtown Santa Monica would be 18.5 miles.
- *San Fernando Valley Burbank/Chandler ROW* - A busway extension of the Metro Red Line that starts at the North Hollywood Station (scheduled to open in May, 2000) with the West San Fernando Valley primarily via the abandoned, MTA-owned Southern Pacific Burbank/Chandler right-of-way. The right-of-way segment is 13.0 miles in length and the total route length from North Hollywood to Warner Center is 14.0 miles.

It is anticipated that the results of the Metro Rapid Bus Demonstration Program will be known at about the same time that the results of the Exposition ROW and San Fernando Valley Corridor Study analyses are completed. If a bus transitway option is selected for either the Exposition ROW or the San Fernando Valley corridor, the Metro Rapid Bus program could be expanded to incorporate the use of these exclusive busways to further speed bus transit operations.

2.5 Integrated Transit Land Use Planning

The City of Los Angeles General Plan, which is based on the Land Use/Transportation Policy, provides for the creation of transit corridors with higher density residential and commercial development to provide a supportive land use pattern for mass transit. The goal of this policy is to create pedestrian-oriented neighborhoods connected by a network of various transportation modes. The City's Transportation Element implements this goal through specific policies and programs, including designation of numerous transit priority streets, many of which are included in the Metro Rapid Bus network. Objectives of the Land Use/Transportation Policy which are consistent with the Metro Rapid Bus Program include the following:

- Focus future growth of the City around transit stations.
- Increase land use intensity in transit station areas, where appropriate.
- Create a pedestrian-oriented environment in context of an enhanced urban environment.
- Accommodate mixed commercial/residential use development.
- Reduce reliance on the automobile.

3.0 METRO RAPID BUS – PHASE ONE DEMONSTRATION

3.1 Metro Rapid Bus Attributes

The purpose of Metro Rapid Bus is to address the need for faster travel choices for bus riders, especially the transit-dependent, in consideration of the suspension of the Eastside and Mid-City rail segments of the Metro Red Line. As discussed earlier, MTA average bus speeds have declined nearly 13 percent since the early 1980s. Moreover, in a recent study by the LADOT, MTA buses were found to spend approximately 20 percent of their service hours stopped at intersections, 23 percent of the time boarding and alighting passengers (dwell time), 5 percent of the time in traffic congestion, and the remaining time moving while in service. As presented by the LADOT, traffic congestion (during the AM and PM peak periods) is clearly not as serious

a problem as is generally believed. Therefore, improvements in transit speed, reliability, and on-time performance must focus on the delay caused at bus stops and traffic signals.

A majority of delay at bus stops relates to the frequency of stops, the tendency of passengers to use the front door for both entering and exiting, and delays associated with fare payment. Mitigations such as fewer bus stops, multiple-door boarding, higher capacity/three-door buses, and prepaid fares would significantly reduce this delay. Traffic signal delays relate to the timing of signals and the amount of time allocated to the through movement of buses. Bus signal priority technologies, such as those currently being developed by the LADOT, will clearly benefit Metro Rapid Bus. Thus, faster overall operations will be achieved by reducing the time when buses are not moving, not by higher bus speeds.

Identification of Metro Rapid Bus attributes has been based both on fieldwork and analysis in Los Angeles County and on successful Bus Rapid Transit systems elsewhere. The Busway system in Curitiba, Brazil has received considerable attention regarding its success. Table 1 summarizes the essential attributes of Curitiba Busways and presents the planned attributes for Phase I and Phase II of the Los Angeles Metro Rapid Bus Program.

**Table 1
CURITIBA BUSWAYS
ATTRIBUTE COMPARISON**

Curitiba Busways Key Attribute	Metro Rapid Bus Phase I Demonstration	Metro Rapid Bus Phase II Expanded System
1. Exclusive Bus Lanes	No	Yes (at key points)
2. Infrequent Stops	Yes	Yes
3. Station Stops	Yes (6 pairs)	Yes
4. Signal Prioritization	Yes (limited area)	Yes
5. Fare Prepayment	No (simulated testing)	Yes
6. Level Boarding and Alighting	Yes	Yes
7. Frequent Headways (5 minutes or less)	Yes (limited)	Yes
8. High Capacity Buses	No (TBD)	Yes
9. Multiple-Door Boarding and Alighting	No	Yes
10. Simple Route Layout	Yes	Yes
11. Color-coded Buses and Stations	Yes	Yes
12. Feeder Network Modified to Support MRB	No	Yes
13. Coordinated with Land Use Planning	No	Yes (limited)

Application of these attributes to existing dense urban arterial corridors is largely untried. Recognizing that existing ridership on Los Angeles County corridors reaches levels typical of many urban rail systems, MTA/LADOT has applied as many of the attributes as feasible to Metro Rapid Bus. The following table presents the planned attributes for Metro Rapid Bus.

METRO RAPID BUS PLANNED SYSTEM COMPONENTS

FREQUENT SERVICE

Frequent service will be provided during both peak and most off-peak periods; service frequencies will be increased to accommodate demand during peak hours.

FEWER STOPS

Stops will be limited to major destinations and transfer points only. Local bus service to all stops will continue to operate in Metro Rapid Bus corridors.

SIGNAL PRIORITY FOR BUSES

To give Metro Rapid Bus faster and more reliable travel speeds and to reduce operating costs, automated transit priority measures will be implemented along various sections of the route. LADOT's automated traffic control system will extend the green time at intersections for buses as their approach is detected.

DEDICATED PEAK-HOUR BUS LANES

Where feasible and warranted, and only during peak travel periods, introduce priority bus-only lanes on various segments of lines to reduce customer travel times.

LOW-FLOOR BUSES

Low-floor buses will be utilized in order to permit level platform boarding and alighting for customers. This will also permit access to the disabled in a faster, more reliable fashion.

HIGH-CAPACITY BUSES

A low-floor, three-door articulated bus with 40 percent more capacity than the standard coach will be initially considered for Rapid Bus operation. Future consideration will be given to even larger vehicles.

MULTIPLE-DOOR BOARDING

Techniques to board at and alight from all vehicle doors will be tested.

STATION AND VEHICLE DIFFERENTIATION

In order to maximize use of Rapid Bus and avoid passenger confusion with other buses, both the Rapid Bus Stations and Vehicles will be identifiable by a common design theme.

SIMPLE ROUTE LAYOUT

The currently complex corridor route structures will be simplified with just a single trip pattern for Metro Rapid Bus.

FARE PREPAYMENT

Fare prepayment techniques will be identified for possible testing in later in the demonstration.

RAPID BUS STATIONS

Stations will include passenger queuing for reduced dwell times, real-time 'next-bus' displays, and information kiosks. Passenger amenities will include full-cover shelters, benches, and bike racks. Landscaping, adjacent sidewalk improvements and special clustered news racks and trash receptacles will improve the street environment for transit passengers and the adjacent community.

PEDESTRIAN CROSSWALKS

Specially paved pedestrian crosswalks will be installed to enhance linkages between transit stations and nearby destinations and heighten the pedestrian character of the area.

SIGNAGE

Signage will identify Metro Rapid Bus stops at important points throughout the community. Route maps, schedules, and fare information will be available at each stop and on each vehicle.

LATEST IN TECHNOLOGY

- Low-floor and high capacity buses
- Vehicle locator system to ensure reliability
- Real-time 'next bus' customer displays
- Fare-ticketing machines (future)
- Video surveillance of transit corridor operations and bus interiors

3.2 Demonstration Program Scope

Development of the Metro Rapid Bus Demonstration Program will build on work completed to date from the Regional Transit Alternatives Analysis. The Program will reflect the current cooperative efforts in the County, including the MTA and City of Los Angeles programs to implement bus signal priority systems on major arterial corridors. Principal tasks associated with *Milestone One* of the Demonstration Program include the following:

- Develop Goals and Objectives for the Implementation Plan
- Select Corridors for the Metro Rapid Bus Demonstration
- Develop Bus Operating Plans
- Develop Two-Phase Stop Program
- Develop Metro Rapid Bus Vehicle Program
- Confirm Bus Signal Priority Demonstration Program
- Identify Candidates for Expanded Metro Rapid Bus System
- Develop Metro Rapid Bus Implementation Plan

Milestone Two of the Metro Rapid Bus Demonstration Program will be initiated following approval of the Implementation Plan identified in Milestone One, and will coordinate the City of Los Angeles bus signal priority work on Wilshire Boulevard, West Sixth Street, and Whittier Boulevard with several other program elements, including fewer stops and low-floor buses. The current concept calls for service with low-floor buses in bus signal priority operation.

Milestone Three, implementation of Metro Rapid Bus in the San Fernando Valley and on a second East Side/Mid-City corridor, will be initiated following the Milestone Two Wilshire/Whittier demonstration. A Metro Rapid Bus Demonstration Program report will be prepared following Milestone Three. The report will describe the demonstration, issues, and performance of the program relative to the benchmarks established in Milestone One. The report will also advise MTA regarding whether to move ahead with full implementation of the Metro Rapid Bus Program, implement a modified program, or cease implementation.

3.3 Program Goals

The development of program goals and performance measures for Metro Rapid Bus has been based on both a review of industry experience and the recent Federal Transit Administration (FTA) guidelines for Bus Rapid Transit.

Industry Benchmarks – Many transit properties have implemented elements commonly associated with the Metro Rapid Bus concept as part of their transit system. Yet, few of these transit agencies have conducted before-and-after analyses to determine the effectiveness of these elements. In general, conclusions about Rapid Bus strategies are subjective in nature and have not received extensive (or any, in most cases) quantitative analysis. Decisions to include or exclude elements of the Rapid Bus concept fall into three categories:

1. Advantages/disadvantages of implementation are apparent without data analysis (e.g. public acceptance of low-floor buses);
2. Elements have been included as a part of the system for several years and are now a standard means of operation (e.g. Pre-payment of fares at bus stops); and,
3. Data collection and analysis highlight the costs and/or benefits to the system (e.g. signal priority).

The lack of research in the field of Rapid Bus strategies suggests that Los Angeles will likely emerge as a model for the nation and that the evaluation will necessarily involve a “research and development” element in identifying and calibrating tools for analysis. Data collection and analysis of Rapid Bus strategies (including before-and-after studies) will provide valuable information regarding the benefits and costs of the various Metro Rapid Bus elements.

Transit agencies included in the Regional Transit Alternatives Analysis were contacted regarding the various Rapid Bus strategies that have been implemented. The purpose in contacting these agencies was to receive comments about the advantages and disadvantages experienced as a result of implementation in addition to seeking before-and-after analyses of Rapid Bus elements. Although quantitative analysis was sparse; many transit officials conveyed general impressions about the implementation of various Rapid Bus strategies. These strategies include use of low-floor buses, electronic fare payment, prepayment of fares at stops, longer stop spacing, exclusive busways/bus lanes, and bus signal priority. A discussion of findings is as follows:

- Low-Floor Buses (Level-Boarding) – The inclusion of low-floor buses in transit fleets is increasing at a rapid pace. These buses are specially designed to simplify boardings for all passengers, but specifically for senior citizens and individuals with disabilities. Although this strategy is aimed at reducing boarding times, dwell times, and running times, transit agencies generally choose low-floor buses for customer service reasons and improved accessibility. The agencies that were consulted regarding the use of low-floor buses did not have any before-and-after studies documenting the benefits and costs of inclusion in transit fleets. Nevertheless, the general consensus, albeit subjective, was in strong favor of low-floor buses. Reasons for this support include fewer boarding accidents, positive public comments, ease of wheelchair boardings, and less intimidating for seniors and disabled users. Some transit officials reported improvements in dwell times; however, no formal studies have been conducted by any of the agencies contacted.

A recent TCRP study (Report 41, New Designs and Operating Experiences with Low-Floor Buses) evaluated operating experiences of low-floor buses. Average reported reduction in boarding times was 0.5 second per passenger for ambulatory riders and 19 seconds per passenger for passengers with disabilities. Alighting times experienced similar reductions. The study cautioned, however, that facilitation of reentry of the bus into the general traffic stream and a faster fare collection process are both needed to take advantage of the quicker boarding and alighting times. This study supported the qualitative findings from our survey of agencies regarding popularity of low-floor buses among riders, improved accessibility, decreased capacity, and minimal changes to maintenance facilities.

- Electronic Fare Payment – Electronic fare payment is also gaining widespread acceptance among transit agencies. However, discussions with transit officials suggest that the choice of electronic fare payment systems is critical in order to maintain the potential benefits derived from other Rapid Bus elements. Electronic fare payment systems that require the insertion of a “swipe card” slow boarding times and therefore may counterbalance the benefits derived from the use of low-floor buses and other Rapid Bus elements. Other contactless fare payment options may prove more beneficial under a Rapid Bus program, but contactless smart cards are still in the testing stage at most agencies. Unfortunately, no formal studies have been conducted concerning this element, and the assessment of this Rapid Bus option is subjective.

- Fare Prepayment – Pre-payment of fares at stops has not been implemented as widely as electronic fare payment. This fare option requires fare inspector staff to monitor boardings and ensure proper fare payment. Ottawa-Carleton Transpo (OC Transpo) has used fare pre-payment (referred to as “proof of payment”) since 1982. At OC Transpo, proof of payment has become a standard means of operation. Although no quantitative analyses have been conducted concerning this fare payment plan; transit officials report improvements in boarding times. This assessment is made based on a comparison of boarding delays experienced after 7:00 PM when fare pre-payment ends.
- Exclusive Busways, Bus Lanes, and Limited Stops – There is limited data in this field as well. No formal before-and-after studies have been conducted by the transit agencies surveyed. Generally, transit officials express satisfaction with exclusive busways and bus lanes, reporting improvements over mixed flow traffic based on informal, in-house assessments. Limiting the number of bus stops has also proved effective. Informal internal analysis by Denver Regional Transit District suggests a 15 percent timesavings over local routes after eliminating 60-70 percent of stops.
- Signal Priority – Signal priority functions on the basis that transit vehicles should have little or no wait time when approaching an intersection. With signal priority, signals are calibrated to interrupt the normal signal cycle and provide transit vehicles with the right-of-way. Consultation with transit officials regarding this Rapid Bus element showed that quantitative before-and-after analyses have been conducted. OC Transpo has implemented signal priority at isolated intersections in the region. Their before and after analyses show that based on a study of signal priority at three intersections with bus turning movements, time savings of 20 to 32 seconds (depending on the direction of travel) were registered. Aside from the benefits, signal priority for transit vehicles resulted in an increase in total vehicle delay at all three study intersections. Despite the increase in total vehicle delay, OC Transpo and the Traffic Operations Branch of the Region of Ottawa-Carleton are planning to implement signal priority at additional intersections and along corridor-specific routes. Their findings suggest that when implemented at multiple intersections, signal priority enhances the reliability of transit scheduling and contributes to a lower vehicle requirement. The Toronto Transit Commission and Metro Transportation, with funding provided by the Province of Ontario, also concluded in a signal priority demonstration study that transit priority capability has the potential to reduce running times and signal delay as well as capital and operating costs (transit signal delay was reduced initially by 30 to 40 percent with additional improvement expected). This study recommended the implementation of signal priority on a particular bus route to confirm the findings of the benefit/cost analysis.

Most transit agencies and traffic departments stated that the implementation of signal priority was part of a mutual agreement on both sides. In the case of Orlando LYNX, the traffic department insisted that signal priority be included as part of funding for an exclusive busway through downtown. An official with OC Transpo suggested that, while the transit agency first expressed a desire for signal priority, there was a large degree of cooperation from both sides. Despite potential increases in overall vehicle delay, reductions in running time are considered a strong incentive to attract new transit users. In corridors with extensive bus patronage, signal priority may increase vehicle delay but decrease person delay.

The general findings of the transit agency survey suggest that most decisions to include and maintain Rapid Bus elements are based on subjective assessments of their effectiveness. In many cases, transit officials stated that the benefits were visible without necessitating further analysis. The lack of research to quantify specific benefits and costs is an inherent drawback to the ability to predict outcomes of Rapid Bus implementation with a high degree of confidence. Data that are available regarding signal priority and dwell time suggest that there are overall quantifiable benefits for transit.

FTA Bus Rapid Transit – The FTA has developed goals for the Bus Rapid Transit demonstration program. The goals for Metro Rapid Bus are consistent with FTA's Strategic Planning goals such as improving mobility and accessibility and providing efficient transportation. It is anticipated that improvements in bus service efficiency and effectiveness and attendant ridership increases will result from Metro Rapid Bus. As well, effects on traffic congestion are also possible. An evaluation in conjunction with the demonstration will include an assessment of the degree of improvement in many of these variables, cumulatively and as a result of specific components of the Metro Rapid Bus program. Table 2 presents the proposed goals for the Metro Rapid Bus demonstration.

3.4 Performance Measures

Both qualitative and quantitative measures of performance will be used to assess the success of the Metro Rapid Bus demonstration and estimate the benefits. The measures permit a detailed examination of the relevant aspects of Metro Rapid Bus and the differences between the existing and demonstrated system. The measures will be performed such that the cumulative and individual effects of specific components will be identified. Table 3 presents the proposed performance measures.

3.5 City of Los Angeles Bus Signal Priority System

The LADOT is working in close partnership with the MTA to implement an advanced Transit Signal Priority (TSP) system for buses along major transit corridors. Advanced technologies will be deployed to provide preferential treatment for buses to travel through signalized intersections. The purpose of the system is to reduce bus delays, improve bus-operating speed, and enhance bus on-time performance. The project is a major component of the Metro Rapid Bus Demonstration Program.

LADOT and MTA have completed the preliminary test phase of three different technologies for vehicle detection and identification to permit transit priority treatments at traffic signals. The evaluation criteria for the preliminary test phase included detection performance, vehicular and field installations, and capital/maintenance costs. The technologies tested included a radio frequency (RF) antenna-transponder detection system, loop-transponder detector (LTD) system, and infrared/beacon system. Based on the preliminary field tests and data review, the LTD technology appears to be the most reliable, accurate, and cost effective to date. LADOT is currently implementing the LTD technology on the Metro Rapid Bus Ventura Boulevard corridor and will begin implementation on the Wilshire-Whittier corridor pending approval of this demonstration by the MTA Board of Directors. The project will be evaluated thoroughly in terms of effectiveness, reliability, maintenance and operation, costs, and benefits. During the evaluation period, other technologies that may be in concurrent design and marketing phase will continue to be evaluated. The Ventura Boulevard project is currently funded for 36 signalized intersections between Coldwater Canyon Boulevard and Balboa Boulevard; the remaining intersections along Ventura Boulevard are budgeted in this Rapid Bus demonstration. The implementation will occur in three distinct development stages:

Table 2
METRO RAPID BUS
DEMONSTRATION PROGRAM GOALS

- ***The degrees to which bus speeds and schedule adherence improve.*** Bus speeds are anticipated to improve by at least 10 percent over the current limited-stop services per assumptions in the RTAA. The ability to maintain frequency interval spacing is expected have major positive impacts for MTA including a) the ability to address overcrowding in a much more cost-efficient fashion; and b) the ability to maintain reliable service with all trips over the longer Metro Rapid Bus route distances. [MTA to monitor]
- ***The degree to which ridership increases due to Metro Rapid Bus improvements.*** These improvements are expected to influence three potential ridership groups: non-transit users converted to transit, existing transit riders riding more often and for varying travel needs, and existing riders contemplating conversion to non-transit modes. The collective improvement in service quality, reliability, competitiveness with alternative modes, the wait at the bus stop, comfort on the bus, and the increasing incidence of 'good' experiences raising the perceived 'value of transit' are expected to result in increased transit use. [MTA to monitor]
- ***The degree to which service efficiency and effectiveness increase due to Metro Rapid Bus improvements.*** The faster operating speeds are expected to allow for more efficient use of vehicle and operator resources in delivering bus service. This increased efficiency in conjunction with increased ridership is expected to significantly improve net service effectiveness. [MTA to monitor]
- ***The effect of the components of the Metro Rapid Bus program, individually and cumulatively, on the bus speeds, schedule adherence, and ridership.*** MTA would like to assess the relative contribution of each Metro Rapid Bus component on an improved bus service and operation. Of particular interest will be the benefits of bus treatment along major arteries. [MTA to monitor]
- ***The effect on other traffic.*** One of the principal challenges of introducing bus priority is the possible effect on other traffic, along the artery, on cross-streets, and making turns. [LADOT to monitor]
- ***The effect on surrounding community.*** MTA would like to assess the effect of Rapid Bus on the surrounding community, including changes in access to adjacent uses, in pedestrian movements, and in overall perceptions regarding transportation options. [MTA/LADOT to monitor]

- Stage One – Develop and implement hardware for detection of transit and emergency vehicles to provide signal priority along 36+ intersections on Ventura Boulevard without regard for bus progress relative to its schedule.
- Stage Two – Develop a “Transit Priority Manager” consisting of schedule-checking software, MTA bus schedule database and a two-way communication link between the MTA’s Operations Center and LADOT’s Automated Traffic Surveillance and Control (ATSAC) Center.
- Stage Three – Integrate Stage 1 and Stage 2 into LADOT’s Adaptive Traffic Control System (ATCS) currently under development for expanded application of the transit priority program in additional transit corridors.

Table 3
METRO RAPID BUS
DEMONSTRATION PERFORMANCE MEASURES

BUS SPEED MEASURES

- **Bus speed.** Average bus speeds along the demonstrated segments will be measured before and after. Of particular interest will be the change in average delay due to the various street-operating elements, such as traffic signals, congestion, pedestrians, and illegal parking.
- **Schedule adherence.** One or both of the average deviation from the schedule at timepoints and the average deviation from the scheduled interval will be measured. Customer surveys will seek to identify whether this improvement is perceptible to customers and at what thresholds.
- **Dwell times.** Average number of seconds that the bus dwells at the bus stop. These measurements will be factored by both average riders boarding and alighting and the incidence of wheelchair access/egress. Of keen interest will be the individual measurement of the effects of a) same-level boarding; b) expedited fare collection; c) directed boarding and alighting [board at the front, exit at the rear]; and improved customer information. Measurement of the effects on special populations like seniors, the disabled, and those traveling with small children or packages will be attempted.

TRAFFIC SPEED MEASURES

- **Signal priorities.** Average number of times per trip or mile of service that a bus exercises signal priority; average seconds per trip or mile of service of signal delay for the bus; and average number of minutes that intersecting traffic is delayed.
- **Queue jumpers.** Average seconds of signal delay per bus trip or mile of service.
- **Traffic speed.** Average speed of non-bus traffic of the arterial. This will be of interest especially where exclusive bus lanes or queue jumpers are present.

RIDERSHIP MEASURES

- **Passengers.** Total unlinked ridership and passenger-miles on the line. The number of additional passengers riding and the average distance that they travel will be measured.
- **Revenue.** Total fare revenue collected with a breakout by fare category.

OPERATING EFFICIENCY AND EFFECTIVENESS MEASURES

- **Operating costs.** Operating costs per service hour, service mile, passenger, and passenger-mile will be measured.
- **Productivity.** Unlinked passengers per service hour, service mile, and trip and average seat utilization will be measured.
- **Overall effectiveness.** Subsidy per passenger and passenger-mile and the mobility index will be measured.

CUSTOMER MEASURES

- **Customer profile.** The customer profiles will be measured by survey and include a variety of important demographic variables. Any changes in the mix of customers will be assessed.
- **Customer perceptions.** Changes in customer perceptions of bus service as defined by Metro Rapid Bus will be assessed in surveys. Key issues will include reliability, safety, convenience, vehicle comfort and cleanliness, use of use, ability of differentiate types of service on the street, new fare collection techniques, enhanced bus stops, same-level boarding, etc.

OPERATIONS MEASURES

- **Operator and Supervisor Perceptions.** Changes in operator perceptions of operating Metro Rapid Bus versus traditional local and/or limited service will be explored through both surveys and focused discussion groups. A variety of issues will be investigated including: reduction in stress, improved customer relations, improved on-time performance (amount of operator intervention required), reduction in running time perceptions, changes in operating procedures, and further suggestions.

COMMUNITY MEASURES

- **Resident and Destination Perceptions.** Changes in the perceptions of community residents and destinations (including employers, retailers, and schools) regarding the effect of Metro Rapid Bus on available transit choices, noise, safety, and access to community destinations are among the issues to be investigated through surveys.
- **Opinion Leader Perceptions.** Changes in the perceptions of community opinion leaders regarding effects of Metro Rapid Bus will be surveyed covering many of the same issues as noted in the previous measure

Target dates for completion of the first two Stages are June 1999 and September 1999, respectively. Stage Three is scheduled for implementation in December 1999.

To date, system architecture, design standards, and drawings have been completed. Communication protocol design and channel assignments are approximately 90 percent complete. Traffic signal design plans for 29 intersections were approved by the LADOT Design Division, with 7 additional intersections in the review process. Field crews have installed approximately 70 loop detectors along Ventura Boulevard. Traffic signal controllers (type 2070) have been purchased.

The next step is to procure loop detector transponders for installation on the planned 116 MTA buses and 20 LADOT DASH buses. ATSAC Center hardware specifications have been prepared and LADOT is working with MTA to complete MTA's center hardware specifications.

3.6 MTA Bus Signal Priority Pilot Project

The MTA's Bus Signal Priority Pilot project is a countywide turnkey demonstration to implement and test the effectiveness of various bus signal priority technologies. Both service and operating cost efficiencies associated with bus service delivery will be evaluated. Impacts on auto traffic will also be evaluated. The project encompasses all aspects of development, including corridor and technology selection, design, hardware, firmware and software development and integration, and evaluation of bus signal priority systems. The project objective is to deploy up to three different technologies in up to three corridors heavily served by transit throughout Los Angeles County.

Because the Pilot project will be developed concurrently with the Metro Rapid Bus program, coordination between both project implementation schedules will be essential. Decision point windows associated with the Metro Rapid Bus program have been scheduled which allow for the effective and timely implementation of signal priority systems other than LADOT's LTD technology on the third Metro Rapid Bus demonstration corridor. Since the Pilot project is to serve as the Countywide prototype, MTA is coordinating with LADOT, the municipal transit operators, and traffic/public works departments of various other jurisdictions to assure that the developed system will be compatible with the signal synchronization and transit scheduling systems in common use in the region. The MTA has convened an eighteen member Advisory Committee to ensure ongoing involvement in the development and deployment of this system by interested and impacted agencies. The advisory committee will be involved in all elements of the project including technology and route selection and implementation of potential on-street improvements. The system to be developed will avoid duplication of effort and the need for future interfaces by attempting to meet the needs of different jurisdictions and transit properties. Initial deployment will focus on MTA buses using the existing Blue Line light rail priority system as a basis to assure compatibility among different modes in implementing signal priority. The project is scheduled for completion in the spring 2002.

3.7 Other MTA Programs

MTA has recently endorsed several new programs which have the potential to make significant impacts on the Metro Rapid Bus Program. MTA's commitment to expedite procurement of low-floor buses will clearly benefit the demonstration program. Implementation of the Universal Fare System which will take longer to complete, will begin to make an impact during Phase II of the Rapid Bus program.

Procurement of Low-floor Buses – As of mid-1998, nearly 1,100 of the MTA's 2,600-bus fleet exceeded the FTA recommended 12-year/500,000-mile bus replacement guideline. Recognizing the benefits associated with a newer fleet, the MTA has made a concerted effort to expedite the purchase

of replacement vehicles through the Accelerated Bus Procurement Plan. In addition, the MTA has identified the benefits associated with low-floor buses and has adopted a policy to purchase only low-floor vehicles in the future. MTA's current low-floor bus procurement schedule is as follows (all buses are CNG-fueled):

- 215 NABI low-floor buses - delivered between December 1999 and May 2000.
- 223 New Flyer low-floor buses - delivered between August/December 2000.

Universal Fare System – The MTA is working with other operators in the region through an inter-agency task force to implement a Los Angeles County Universal Fare System for seamless interagency electronic payment of fares and transfers. A primary objective of the Universal Fare System (UFS) is to introduce off-vehicle fare payment, fare payment at all doors, and faster fare payment - all of which lead to reduced dwell times. The UFS is a set of requirements, functions, and specifications that integrate cash and electronic fare collection on MTA transit systems.

Within the next three years, MTA will replace all 2,400 of its obsolete and aging bus fareboxes with a new fare collection system. MTA's 212 rail system ticket vending machines (TVMs) are also being replaced or significantly upgraded. These bus and rail fare system upgrades will be compatible with the existing systems, UFS, and the MTA Smart Bus Advanced Transportation Management System. The first phase of UFS will replace all the current MTA bus fareboxes with bus fare collection systems that process cash and the Los Angeles regional Metrocard magnetic card/ transfer system currently being implemented on more than 500 standard buses in Los Angeles County. Phase One is scheduled for completion by winter 2001.

3.8 Proposed Metro Rapid Bus Operating Plan

The preliminary operating plan for the proposed Metro Rapid Bus demonstration includes several elements: service frequencies, hours of operation, schedule integration with local corridor service, number and type of vehicles, passenger and operating facility requirements, vehicle and stop differentiation, fare policy and fare collection methods, and operating and capital cost estimates.

Service Frequencies, Hours of Operation, and Schedule Integration – The demonstration phase of Metro Rapid Bus will involve changes in the basic schedule structure for the bus lines serving the corridors. In the Ventura Boulevard and Whittier/West 6th/Wilshire Boulevard corridors, Metro Rapid Bus will replace the existing limited stop services (Lines 425, 318, and 320). In the Pico/East 1st/Cesar Chavez corridor, Metro Rapid Bus will be the first limited-stop or express bus service along the corridor. Service frequencies as presented in Table 4 will be increased from the existing in nearly all cases for both Metro Rapid Bus and local bus services on all three corridors such that customers will have unconstrained choice between service types for the demonstration. To this end, balanced service frequencies are proposed for Metro Rapid Bus and local service. An operating contingency has been budgeted partly to assure an adequate capacity to meet both Consent Decree requirements and anticipated ridership growth during the demonstration.

Table 4
Corridor Service Frequencies

Corridor	Service Type		Proposed Service Frequencies (Minutes)				
			Wkdy Peak	Wkdy Off-Peak	Wkdy Eve	Saturday	Sunday
Whittier/Wilshire	Rapid	Existing Proposed	N/A 3.5-7	N/A 10	N/A 20	N/A 10	N/A 10
	Limited	Existing Proposed	4-10 N/A	10-14 N/A	20-30 N/A	N/A N/A	N/A N/A
	Local	Existing Proposed	4-10 3.5-7	10-14 10	20-30 20	5-6.5 10	7.5 10
	Combined	Existing Proposed	2-5 1.75-3.5	5-7 5	10-15 10	5-6.5 5	7.5 5
Ventura	Rapid	Existing Proposed	N/A 7-10	N/A 10	N/A 20	N/A 15	N/A 15
	Limited	Existing Proposed	7-18 N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
	Local	Existing Proposed	7-18 7-10	11 10	30 20	10 15	15 15
	Combined	Existing Proposed	3.5-9 3.5-5	11 5	30 10	10 7.5	15 7.5
Pico/East 1 st	Rapid	Existing Proposed	N/A 5-8	N/A 10	N/A 20	N/A 10	N/A 10
	Local	Existing Proposed	3-4.5 5-8	7.5 10	15 20	6 10	7.5 10
	Combined	Existing Proposed	3-4.5 2.5-4	7.5 5	15 10	6 5	7.5 5

The anticipated span of Metro Rapid Bus service is intended to provide service during the extended travel day. This will require hours of operation for Metro Rapid Bus from approximately 5:00 a.m. to 11:00 p.m. on weekdays, with weekend hours from approximately 6:00 a.m. to 10:00 p.m. Outside of these periods, local bus service will serve the entire corridor. Draft service schedules have been prepared for costing purposes and will be further refined in the continued implementation effort. The estimated vehicle service hours by corridor are presented in Table 5.

Table 5
Corridor Vehicle Service Hours

Corridor	Service Type		Weekday	Saturday	Sunday	Annual
Whittier/Wilshire	Rapid	Existing Proposed	N/A 657	N/A 439	N/A 439	N/A 218,000
	Local/Limited	Existing Proposed	1,201 897	775 697	623 697	385,800 308,800
	Combined	Existing Proposed	1,201 1,553	775 1,136	623 1,136	385,800 526,800
Ventura	Rapid	Existing Proposed	N/A 223	N/A 157	N/A 157	N/A 77,700
	Local/Limited	Existing Proposed	545 306	423 216	281 198	178,700 101,800
	Combined	Existing Proposed	545 540	423 373	281 358	178,700 179,500
Pico/East 1st	Rapid	Existing Proposed	N/A 257	N/A 189	N/A 189	N/A 87,200
	Local	Existing Proposed	431 336	300 249	241 249	140,700 114,200
	Combined	Existing Proposed	431 593	300 438	241 438	140,700 201,400
Total	Rapid	Existing Proposed	N/A 1,137	N/A 785	N/A 788	N/A 383,000
	Local/Limited	Existing Proposed	2,177 1,539	1,498 1,161	1,145 1,144	705,300 524,800
	Combined	Existing Proposed	2,177 2,686	1,498 1,947	1,145 1,931	705,300 907,800

Metro Rapid Bus Vehicles – It is proposed that the 116 buses for the Metro Rapid Bus demonstration as noted in Table 6 come from the 215 NABI low-floor buses currently on order. The Rapid Bus demonstration will require just 17 buses beyond MTA's existing fleet. Acquisition of the 17 buses is budgeted in the demonstration and can be ordered from either the NABI or New Flyer options in order to maintain the current expansion/retirement schedule for the fleet.

The demonstration plan calls for the 116 buses (97 peak plus 20 percent spares) to be dedicated to the Metro Rapid Bus fleet for the duration of the demonstration and not available for assignment on other duties. The current plan calls the buses to be painted in the proposed Rapid Bus Red color at the factory. Special MTA advertising is proposed for the buses: both the 'king' and 'queen' exterior advertisement spaces will have displays of the Rapid Bus routing and stations in a 'Rail line'-like stylized map. This theme will be repeated in the interior.

**Table 6
Corridor Peak Vehicle Requirements**

Corridor	Service Type		Wkdy Peak	Saturday	Sunday
Whittier/Wilshire	Rapid	Existing Proposed	N/A 57	N/A 27	N/A 27
	Local/Limited	Existing Proposed	101 72	46 42	46 42
	Combined	Existing Proposed	101 129	46 69	46 69
Ventura	Rapid	Existing Proposed	N/A 16	N/A 10	N/A 10
	Local/Limited	Existing Proposed	62 20	33 12	20 10
	Combined	Existing Proposed	62 36	33 22	20 20
Pico/East 1st	Rapid	Existing Proposed	N/A 24	N/A 9	N/A 9
	Local	Existing Proposed	41 29	23 11	18 11
	Combined	Existing Proposed	41 53	23 20	18 20
Total	Rapid	Existing Proposed	N/A 97	N/A 46	N/A 46
	Local	Existing Proposed	204 121	102 65	84 63
	Combined	Existing Proposed	204 218	102 111	84 107

The buses will be fully equipped with advanced Smart Bus technology to improve reliability, customer information, customer and operator security, passenger movements, and data collection. All Rapid Bus coaches will have automated vehicle location (AVL), video monitoring, and voice enunciators. MTA equipment operations has also indicated a willingness to test enhancements of the voice enunciation system to both provide ongoing information and help direct boarding and alighting passenger flows. Approximately 10 percent of the Rapid Bus fleet will be equipped with automated passenger counters (APC) to provide detailed data on field operations including door-open times and passenger boardings and alightings by stop.

As noted earlier, there is a desire to test high-capacity buses as part of the Rapid Bus demonstration. MTA Operations recently completed a successful test of the New Flyer 60-foot low-floor articulated bus. The bus had three doors and 58 seats with almost 50 percent more capacity than the new 40-foot low-floor buses currently on order. Operation of 43 articulated buses on Wilshire-Whittier would match capacity of the 57 standard buses currently proposed; 50 articulated buses would boost overall

capacity by almost 20 percent. Consequently, it is recommended that MTA consider an expedited order for low-floor, three-door articulated buses

Rapid Bus Station Program – One of the goals of the Rapid Bus program is to improve the overall experience of the bus rider, including the time spent at the bus stop, both for boarding and alighting. The program calls for the upgrading of bus stops to ‘Station Stops,’ with a correspondingly higher level of comfort, amenity, service, and security. These station stops are intended to both convey the high quality of transit service and achieve the expedited passenger boarding and alighting often associated with rail systems. The station stops are also intended to help establish the identity of the new Rapid Bus service, through their own visual language, and their integration with the appearance of the buses themselves. There are a variety of specific improvements called for in the program:

- Advanced passenger information : real-time and possibly multi-lingual displays
- Enhanced passenger amenities: improved shelters, benches, landscaping, and trash receptacles
- Improved security lighting and security surveillance
- Increased sidewalk width and streetscape improvements
- Enhanced pedestrian crosswalks
- Stronger, consistent visual identification common to station and vehicle
- Off-vehicle fare collection (tested in simulation in Phase I; deployed in Phase II)
- Level-platform boarding and alighting
- Separation of boarding and alighting
- Local stakeholder involvement

Fifty-five Metro Rapid Bus stops have been identified for the demonstration corridors based on maximizing ridership, minimizing stop dwell times, enhancing network connectivity and throughput, and assuring community access (Table 7). Stop spacing is appropriate compared with local and limited-stop MTA bus services and Metro Rail, as detailed in Table 8.

Table 7
METRO RAPID BUS STATIONS

CORRIDOR	NUMBER OF STATIONS
Whittier/Wilshire Corridor	24
Ventura Corridor	14
Pico/East 1st/Chavez Corridor	17
TOTAL	55

Implementation of the full Station program, however, is not feasible during the demonstration phase. As a result, the Station program will be undertaken in two stages with Stage One implemented during the demonstration phase and Stage Two implemented as part of the Phase II expansion.

Stage One – Of the 55 proposed Rapid Bus stop locations, the Station concept will be tested at six sites (one per major Metro Rapid Bus segment and one in downtown Los Angeles) with individual Station components tested independently where possible. In some cases where actual testing is not feasible, such as off-vehicle fare payment, simulations will be conducted to determine the possible benefit of these enhancements. Quantitative measurement, as well as

Table 8
Metro Rapid Bus- Demonstration Phase I
Average Station/Bus Stop Spacing

Ventura Rapid	
Rapid Stops/Stations	Distance
1 Universal City Red Line	
2 Ventura & Vineland	0.62
3 Ventura & Laurel Canyon	1.59
4 Ventura & Coldwater Canyon	1.11
5 Ventura & Woodman	1.02
6 Ventura & Van Nuys	1.15
7 Ventura & Sepulveda	1.02
8 Ventura & Balboa	2.04
9 Ventura & Reseda	2.12
10 Ventura & Tampa	1.05
11 Ventura & Winnetka	1.03
12 Ventura & De Soto	1.05
13 Ventura & Topanga Canyon	1.02
14 Warner Center Transit Center	1.12
Total Rapid Distance [mi]	15.94
Avg Rapid Station Spacing [mi] - Ventura Rapid	1.33
Avg Limited Stop Spacing [mi] - Limited Segments of Line 425	0.82
Avg Local Stop Spacing [mi] - Line 424	0.29

Wilshire/Whittier Rapid	
Rapid Stops/Stations	Distance
1 Ocean & Colorado	
2 Wilshire & 4th	0.76
3 Wilshire & Barrington	3.00
4 Wilshire & Westwood	1.17
5 Wilshire & Santa Monica	2.27
6 Wilshire & Beverly	0.61
7 Wilshire & La Cienega	1.34
8 Wilshire & Fairfax	0.87
9 Wilshire & La Brea	1.00
10 Wilshire & Rossmore/Crenshaw	1.14
11 Wilshire & Western	0.87
12 Wilshire & Normandie	0.50
13 Wilshire & Vermont	0.51
14 6th & Alvarado	1.16
15 6th & Witmer	0.59
16 5th/6th & Grand	0.78
17 5th/6th & Broadway	0.25
18 5th/6th & San Pedro	0.50
19 Whittier & Soto	1.94
20 Whittier & Lorena	0.96
21 Whittier & Herbert	1.05
22 Whittier & Arizona	0.97
23 Whittier & Atlantic	0.58
24 Whittier & Garfield	1.61
Total Rapid Distance [mi]	24.43
Avg Rapid Station Spacing [mi] - Wilshire/Whittier Rapid	1.11
Avg Limited Stop Spacing [mi] - Limited Segments of Lines 318 & 320	0.51
Avg Local Stop Spacing [mi] - Lines 18 & 20	0.17

Pico/E 1st Rapid	
Rapid Stops/Stations	Distance
1 Pico & Rimpau	
2 Pico & Crenshaw	0.60
3 Pico & Western	1.02
4 Pico & Vermont	1.00
5 Pico & Alvarado	0.50
6 Pico & Figueroa	0.98
7 Pico & Broadway	0.47
8 Broadway & 7th/8th	0.67
9 Broadway & 5th/6th	0.25
10 Broadway & 1st	0.55
11 1st & Alameda	0.54
12 1st & Boyle	1.05
13 1st & Soto	0.65
14 1st & Lorena	0.96
15 Cesar E Chavez & Rowan	0.60
16 Cesar E Chavez & Mednik	1.44
17 Cesar E Chavez & Collegian	1.16
Total Rapid Distance [mi]	12.44
Avg Rapid Station Spacing [mi] - Pico/East 1st Rapid	0.83
Avg Limited Stop Spacing [mi] - No MTA Limiteds in operation	N/A
Avg Local Stop Spacing [mi] - Line 31	0.17

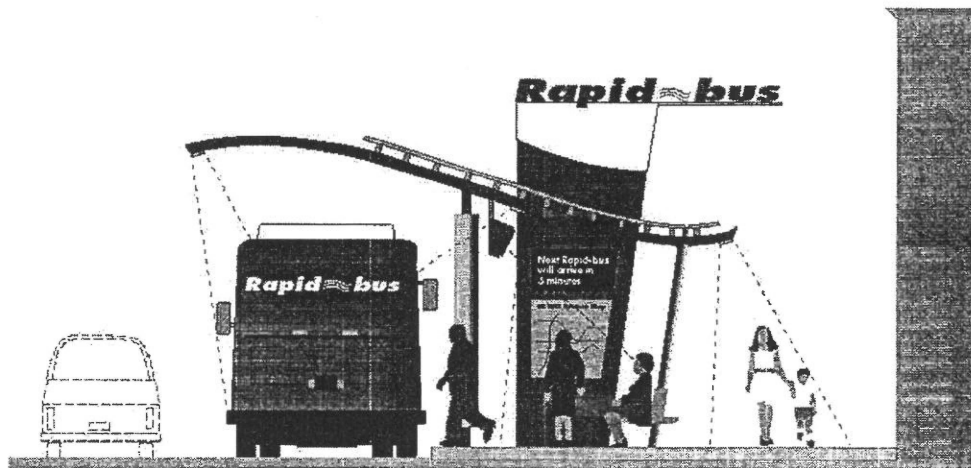
COMPARISON OF STOP/STATION SPACING (in miles):

Red Line:	1.21
- 16 stations (includes North Hollywood)	
Blue Line:	1.09
- 22 stations	
Green Line:	1.64
- 14 stations	

Average Rapid Station Spacing	1.08
- Pico/E 1st, Wilshire/Whittier & Ventura Rapid Bus Lines	
Average Limited Stop Spacing	0.65
- Limited-Stop Segments of Lines 318, 320 & 425	
Average Local Stop Spacing	0.21
- Lines 18, 20, 31 & 424	

qualitative customer, vehicle operator, and local stakeholder surveys and focus group discussions will be undertaken as part of the testing. The remaining 49 sites will also receive enhancements, including passenger information pylon, passenger amenities, and streetscape improvements, as well as a visual treatment to identify them as part of the Metro Rapid Bus system.

Stage Two - Full implementation of the Station concept will be implemented at the 49 remaining sites following a successful demonstration of the Metro Rapid Bus system. The specific Station components will be refined and finalized based on the findings of the testing at the six demonstration Stations.



Cross-Section Through Station Stop

SUTMAN
URBAN design
February 26, 1999

Table 9 describes the proposed Station design prototype.

Operating Facilities – Metro Rapid Bus demonstration services will be operated out of existing MTA operating divisions. The Equipment Maintenance Division of the Operations Department has approved the separation of the Rapid Bus fleet for the purposes of bus-to-line assignments and for minor maintenance enhancements (e.g., more detailed cleaning and expedited vandalism repair). Unless high capacity buses are used, no other changes are planned.

Service Field Management – One of the essential elements of Metro Rapid Bus is improved service reliability. To this end, a line management concept is proposed where a dedicated bus operations coordinator (BOC) will work in conjunction with transit operations supervisors (TOS) to manage the line on a day-to-day basis. During the demonstration period, two TOS per shift per line will work with the BOC during the 16-hour Rapid Bus service day. The role of this line management team has been expanded to assume responsibility for decision-making and performance attainment of the individual Rapid lines. Areas of responsibility will include such duties as individual and collective operator performance on the street, customer problem

Table 9
PROPOSED DESIGN PROTOTYPE FOR RAPID BUS STATION STOPS

Site Conditions – The station stops will generally be located along major boulevards within Los Angeles County; some may be located on separate rights-of-way in the future. The stops will generally be located at approximately one-mile intervals. The specific location will be on the far side of the intersection, along the public sidewalk, in almost all cases.

System Colors Palette – It is proposed that a strong red be used to identify the overall Rapid Bus system and its individual components. The goal of the particular selection of colors and materials is to convey a rapid, efficient, and modern bus system combined with passenger comfort and security, while maintaining clear visual differentiation with other bus services.

Sidewalk Width – A significant constraint on the design is the typically narrow width of sidewalks. While some boulevards may have sidewalks up to 20 feet wide, widths of 8 feet to 15 feet are more typical. The proposed design is intended primarily for sidewalks of a minimum of 12 to 15 feet with an ideal of 20 feet. "Bumpouts" or curb extensions may be used to extend an existing 12 feet sidewalk. Where no bumpout is possible, a 12-foot minimum sidewalk is recommended. In certain cases, acquisition of adjacent property, easement or setback may be necessary to accommodate the station stop. It is important to emphasize that the creation of an attractive and convenient bus station stop that can accommodate the existing and anticipated Station ridership cannot readily be achieved if the existing sidewalk is 10 feet or narrower, particularly if there are ground floor shops or other uses immediately adjacent.

Primary Design Features – The Station's primary features are a cantilevered multi-bay shelter, a tall pylon, and an optional staffed information booth.

Kit-of-Parts Design – The shelter is designed as a kit of parts, which are relatively simple, integrated, and few in number. This permits all the major elements to be fabricated off site, delivered to the site on trucks, and assembled on site. It also permits adaptation of the design to different conditions. For example, the station module can be extended to accommodate 60-foot buses rather than 40-foot buses; the information kiosk is optional as required; and the pylon can serve as a stand-alone marker.

Maps, Schedules and Area Information – The pylon will contain a range of useful information for transit users and passersby.

Paving – Special paving demarcates the station stop area.

Visibility and Transparency – The shelter and pylon are design to be visible both day and night from at least one block away in either direction, through the scale and color of the pylon and through the strategic illumination of the shelter and bus itself. At the same time, the shelter is designed to be as open and transparent as possible when seen close up, in order to minimize blocking of adjacent structures or activities, and to enhance security.

Sun and Rain Protection – Repetitive, pre-fabricated steel beams in the shape of an "s" support the shelter roof canopy. The steel beams support exposed wood joists that give the feeling of a garden trellis. The joists, in turn, support a semi-transparent or translucent acrylic roof covering that keeps out the rain and direct sunlight, while permitting filtered light to penetrate. This covering may project even further out over the bus doors; to give passengers protected passage between the shelter and the bus.

Lighting – The lighting fixtures are integrated into the s-curve beams, which hold up the shelter roof. Separate fixtures will illuminate four distinct zones: the sidewalk, the seating/leaning area, the doorway area, and the vehicle area. The vehicle lighting will only activate when the bus is in the station.

Seating – Two forms of seating will be available, depending on the requirements of the stop: durable wood benches, or stainless steel lean bars, or a combination of both.

Landscaping – Landscaping will vary from stop to stop. A shade tree is recommended beyond the pylon and kiosk.

Signage – The pylon will act as the principal sign for the station stop, supported by graphics on the information/vending kiosk if one is used. The buses themselves will function as moving signs, and at night, special illumination will emphasize the side of the bus.

Real-Time 'Next-Bus' Information – The station stops will be pre-wired to accommodate two monitors that will provide real-time information to waiting passengers on the arrival time of the next bus. The stops will also be pre-wired with a public address system that permits both one-time messages and regular recordings in one or more languages.

Fare Payment Options – The open design of the shelter can accommodate different payment and boarding methods. Honor-system pre-payment could be combined with multi-door boarding; pre-payment with turnstile could be accommodated with barriers. On-board payment and front-door-only-boarding can be accomplished with appropriate Station signage. The pylon will be pre-wired and designed to accommodate ticketing machines. The information kiosk, when used, can supplement or substitute for this function.

Advertising – It is strongly recommended that non-MTA advertising not be permitted at Stations during the initial deployment and expansion of Rapid Bus.

resolution, Station/stop monitoring, ridership development, vehicle quality, and information. It is not intended that the team will undertake all of these activities, but will have lead responsibility for monitoring and assurance of these activities.

An additional BOC workstation is budgeted to provide real-time vehicle location and radio communication with the Rapid Bus operation. LADOT has indicated a willingness to a) work with MTA to provide fiber optic connection from the MTA BOC center to the ATSAC system (video surveillance at intersections) in City Hall East, or b) allow MTA to station a Rapid Bus line supervisor at their ATSAC command center where they would have direct access to the system through LADOT staff. This offer reflects the growing partnership between LADOT and MTA and is a unique opportunity for transit bus operations to work cooperatively in real-time with the traffic control system staff. While no special budget items have been dedicated to this possibility, there is available funding proposed in the contingency to allow for MTA to pursue this opportunity.

Fare Policy and Fare Collection Methods – Several fare policy and fare collection methods are being considered for Metro Rapid Bus to speed customer boarding and alighting. Given the nature of the Metro Rapid Bus demonstration, it will not be feasible to test major changes in policy or collection method. It is, therefore, planned to simulate the impacts of new policies and collection methods on dwell times, customers, and Station design in order to identify potential benefits and costs. Of interest are off-vehicle fare collection strategies, multiple-door boarding and alighting, and reduced operator/customer fare interaction.

Management Responsibilities of the MTA and Participating Agencies

MTA - The Metro Rapid Bus management team will be lead by the MTA. MTA will be responsible for tasks associated with bus operations, number and type of vehicles to be operated, passenger and operating facility requirements, service schedules and public timetables, street supervision/line management requirements, fleet maintenance and cleaning requirements, vehicle and station stop differentiation, and marketing/public communications. MTA will also be responsible for monitoring of and reporting on non-traffic and bus signal priority-related activities during the demonstration.

LADOT - Working in partnership with the MTA, LADOT's responsibilities will include research, design, construction, and maintenance of the Wilshire-Whittier Boulevards and Ventura Boulevard loop-transponder detector (LTD) system, evaluation and performance monitoring of the LTD system, and evaluation of traffic impacts. LADOT will also be responsible for expansion of the LTD system to the third demonstration corridors, provided that the LTD system is identified as the preferred technology.

METRANS - Assisting in the program will be METRANS, a US Department of Transportation funded University Transportation Center, headquartered at the University of Southern California (USC) and partnered with California State University at Long Beach (CSULB). Preliminary discussions with METRANS suggest that appropriate support tasks could include (1) evaluation of bus line/corridor transit performance by identifying the source of line delays and quantifying their effects, (2) development of control strategies to improve schedule adherence, minimize passenger wait times at stops, and minimize on-board travel time, and (3) evaluation of the effects of stop spacing and the trade-off between passenger walking distance to stops versus on-board travel time.

3.9 Financial Plan

Estimated Project Operating Costs – Estimated project operating costs are based on the incremental increase in vehicle service hours, vehicle service miles, and peak vehicles. They were estimated by developing preliminary operating schedules for costing purposes. These schedules will be refined during the implementation period.

The incremental increase in operating requirements will translate into increased operating costs for the demonstration period. Staging of the three demonstration corridors is as follows:

- Whittier/West 6th/Wilshire: January to December 2000
- Ventura: May to December 2000 (coincides with Red Line opening)
- Pico/East 1st/Chavez: July to December 2000

Estimated net operating costs¹ are shown below. As noted above, several operating costs are included beyond basic service operation. Additional operations support includes special training and field support, enhanced vehicle maintenance, station/stop maintenance and repair, and technology maintenance. As well, customer service and marketing are also included. A contingency of 10 percent has been included based on the following:

- Research and development nature of a demonstration project
- Contingency for unforeseen capacity needs due to increased ridership
- Unforeseen operating costs (e.g., additional training or equipment)
- Testing flexibility with service frequencies

Table 10 presents both operating costs for the demonstration period (\$16.5 million) and on an annualized basis (\$17.95 million).

¹ Operating costs were estimated using MTA's marginal bus operating cost model: \$38.16 per VSH, \$1.26 per VSM, and \$13,099.94 per peak bus. Customer service was budgeted separately. No new revenue was considered, although an increase in ridership is anticipated.

Table 10
Metro Rapid Bus - Phase I Demonstration
Incremental Operating Costs

Description	Ongoing New Annual Cost	Demonstration Duration (months)	Demonstration Operating Cost
Service Operation			
Wilshire-Whittier Line	\$8,975,903	12	\$8,975,903
Ventura Line	(\$382,279)	8	(\$254,853)
Pico-East 1 st Line	\$3,510,425	6	\$1,755,212
Total Service Operation	\$12,104,049		\$10,476,263

Operations Support			
Special Operator Training	\$80,136		\$80,136
Bus Operations Controller	\$237,223		\$237,223
Enhanced Field Supervision	\$711,670		\$1,027,968
Enhanced Daily Bus Preparation	\$1,755,000		\$1,442,500
Support Vehicle Operations	\$36,000		\$30,000
Station/Stop Maintenance	\$522,000		\$522,000
Technology Maintenance	\$195,560		\$195,560
Total Operation Support	\$3,537,590		\$3,535,388

Customer Service and Marketing			
Customer Service Agents	\$630,053		\$515,039
Advertising/Media Events	\$50,000		\$400,000
Market Research	\$0		\$100,000
Total Customer Service and Marketing	\$680,053		\$1,015,039

Total Operating Cost	\$16,321,692		\$15,026,689
Operating Contingency (10%)	\$1,632,169		\$1,502,669
Grand Total Operating Cost	\$17,953,862		\$16,529,358

Estimated Project Capital Costs – An estimate of Metro Rapid Bus demonstration capital costs are presented in Table 11 below. The principal capital costs are associated with the acquisition of 17 additional buses, passenger Stations and enhanced stops, and technology support. A contingency of 10 percent has been budgeted. It should be noted that expenses associated with bus priority signalization, to a great extent, have already been funded through the MTA's Call for Projects process. The City of Los Angeles has also requested facility development funds for Rapid Bus in this year's Call for Projects. If the City is successful in securing these funds, then the proposed capital budget will be adjusted by a like amount.

Table 11
Metro Rapid Bus - Phase I Demonstration
Capital Costs

Description	Quantity	Unit Cost	Total Cost
Vehicles			
40-foot, low-floor Standard Bus	17	\$364,500	\$6,196,500
60-foot, 3-door, low-floor Articulated Bus			\$0
Field Support Vehicles	6	\$22,900	\$137,400
Total Vehicles			\$6,333,900
Passenger Facilities			
MRB Stations - Passenger Waiting Area	6	\$250,000-\$460,000	\$2,130,000
MRB Stations - Customer Service Booth	3	\$50,000	\$150,000
Standard Bus Stop - MRB Designation Signage	49	\$60,000	\$2,940,000
Total Passenger Facilities			\$5,220,000
Operating Facilities			
Upgrade for Articulated Bus Operation	N/A		N/A
Total Operating Facilities			N/A
Technology and Other Equipment			
Real-Time "Next-Bus" Displays	24	\$7,500	\$180,000
Bus Priority Loop Detectors (balance of Ventura)			\$500,000
Vehicle Transponders (full fleet)	116	\$100	\$11,600
Automated Vehicle Location (AVL) (full fleet)	116	\$5,000	\$580,000
Automated Passenger Counters (APC) (10% fleet)	12	\$9,000	\$108,000
On-Board Cameras	116	\$3,500	\$406,000
Bus Operations Control Workstation	1	\$170,000	\$170,000
Total Technology and Other Equipment			\$1,955,600
Total Capital Cost			\$13,509,500
Capital Contingency (10%)			\$1,350,950
Grand Total Capital Cost			\$14,860,450

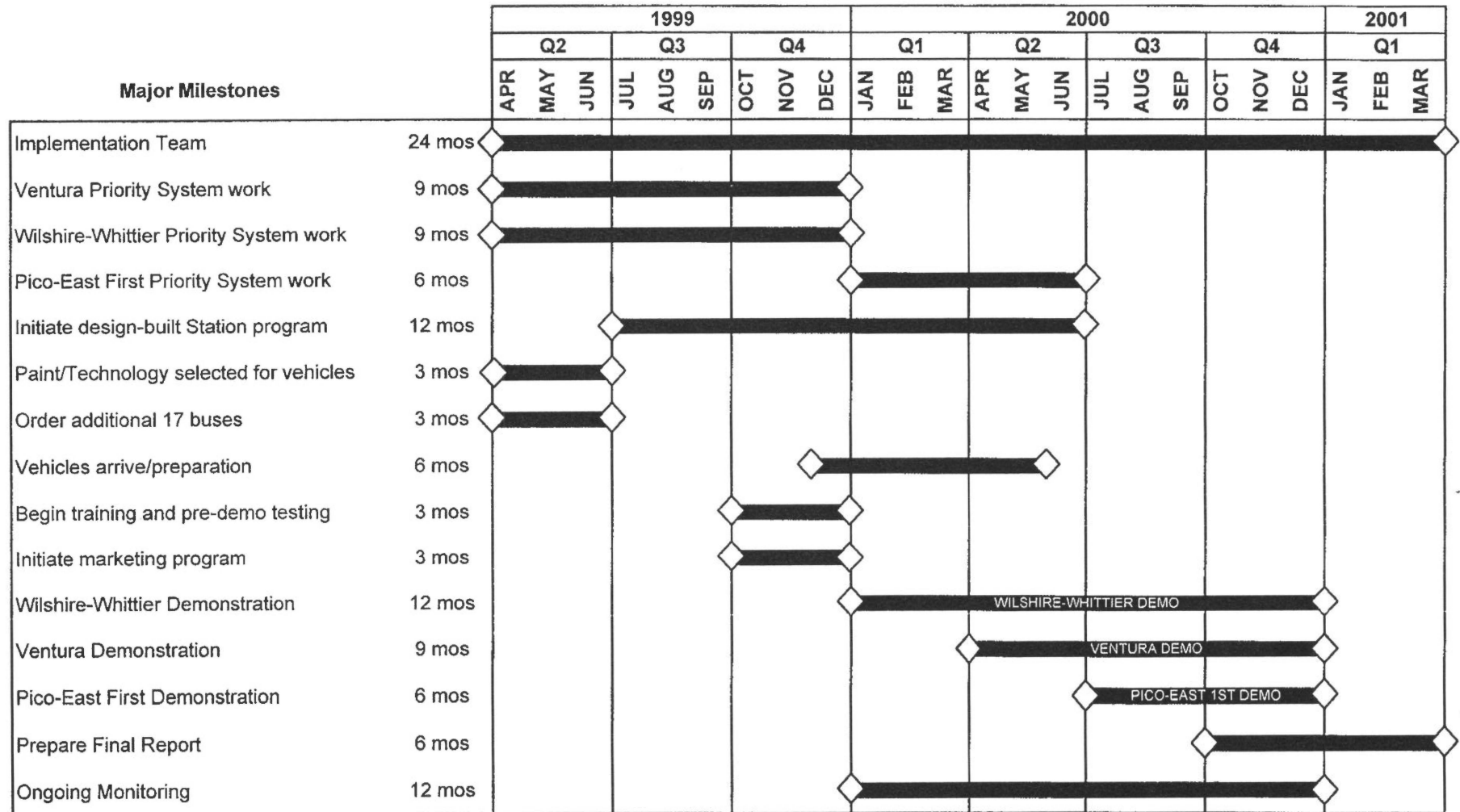
Estimated Ridership and Operating Revenue – Ridership estimates were originally undertaken for the RTAA Rapid Bus segments using MTA's forecasting model. The RTAA predicted increases in ridership of between 10 percent (Chavez/Venice) and 13 percent (Whittier/Wilshire), although it did not identify new riders from riders diverted from other lines. For the purposes of the Rapid Bus Demonstration implementation plan, 13 percent was used for the Whittier/Wilshire corridor and 10 percent for both Pico/East First/Chavez and Ventura corridors. This results in an estimated annual ridership of up to 4.2 million new passenger boardings and up to \$2.7 million in new operating revenue. A net operating subsidy per new rider of \$3.32 and a capital cost per new rider of \$3.57 is projected. These numbers reflect the demonstration nature of the Rapid Bus project, and can be expected to drop as the implementation matures.

3.10 Project Schedule

A work plan of the tasks associated with implementing the Metro Rapid Bus Demonstration Program is presented in Table 12. The work plan pivots from the planned corridor sequencing:

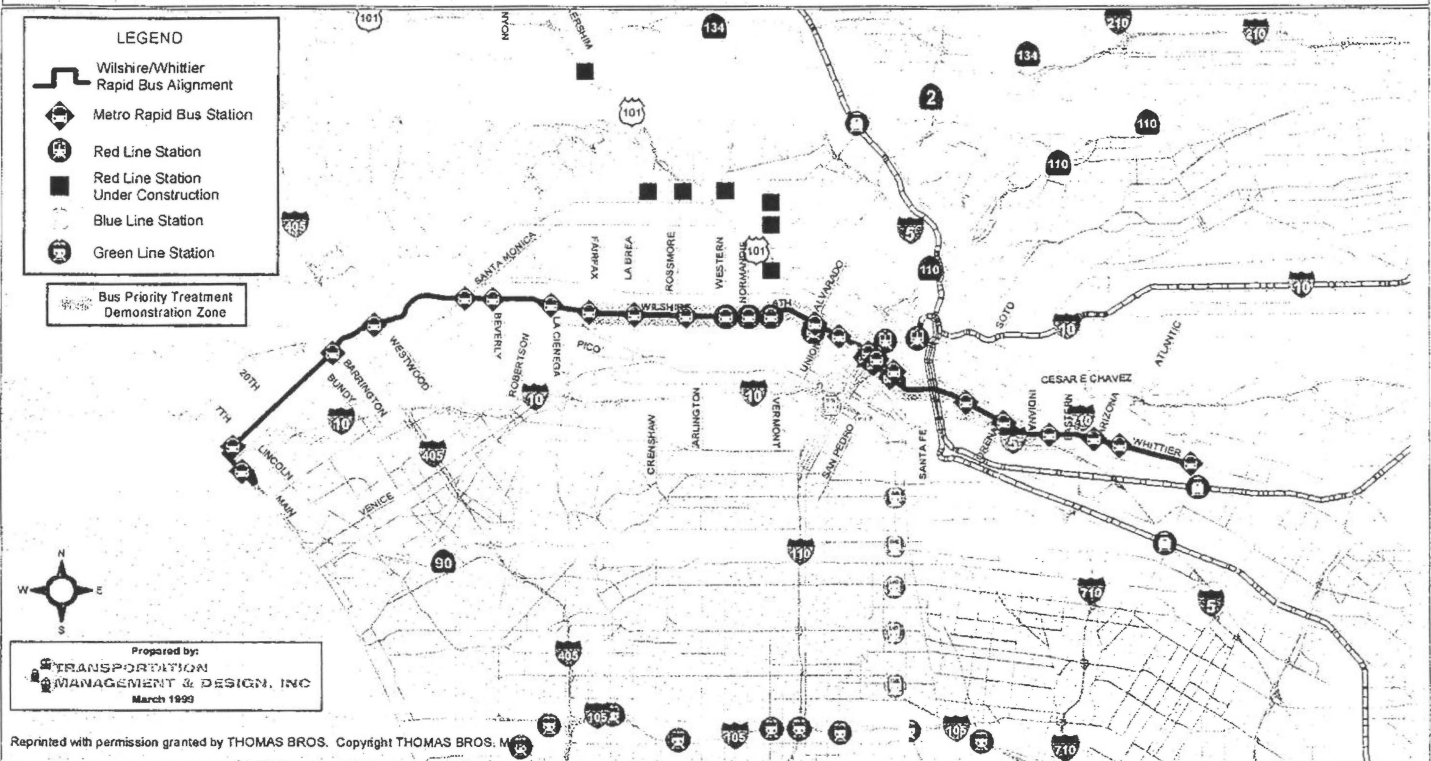
- Whittier/West 6th/Wilshire: January to December 2000
- Ventura: May to December 2000 (coincides with Red Line opening)
- Pico/East 1st/Chavez: July to December 2000

Table 12
Metro Rapid Bus - Demonstration Phase I
Project Schedule



APPENDIX

Wilshire/Whittier Rapid Bus



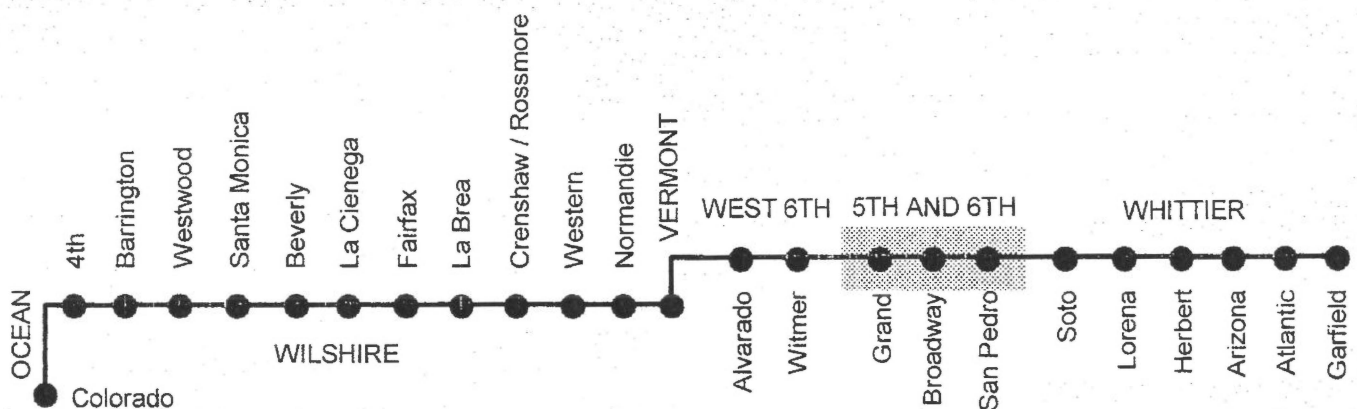
Route Characteristics

Route Length: 24.4 miles
Stations: 24
Buses: 57

Combined Corridor Frequencies for Rapid and Local (min)

	Wkdy Peak	Wkdy Mid	Sat	Sun
Existing:	2 - 4	5 - 7.5	5 - 6.5	7.5
Proposed:	1.75 - 3	5	5	5

Whittier/Wilshire Rapid Bus



 Downtown Los Angeles

Ventura Rapid Bus

The map illustrates the Ventura Rapid Bus alignment, which runs from the north (top) towards the south (bottom). The alignment is shown as a thick black line with circular markers indicating stations. The stations are labeled as follows: TOROJA CANYON, CANOJA, DE SOTO, WINNETKA, TUBA, RESEDA, BALBOA, VANIMES, WOODMAN, GOLDWATER CANYON, LAUREL CANYON, VANLAND, OXNARD, BURBANK, MAGNOLIA, CHANDLER, RIVERSIDE, MOORPARK, and VENTURA. The alignment is shown passing through the cities of Torrance, Inglewood, Watts, Compton, Carson, Long Beach, and Los Angeles. The map also shows major freeways: SR 101 (Ventura Freeway) running north-south, SR 10 (San Diego Freeway) running east-west, and SR 5 (Golden State Freeway) running north-south. A shaded area along the alignment indicates the 'Bus Priority Treatment Demonstration Zone'. A legend in the bottom left corner defines the symbols used: a thick black line for the Ventura Rapid Bus Alignment, a circle with a dot for a Metro Rapid Bus Station, a circle with a star for a Red Line Station, a square for a Red Line Station Under Construction, and a circle with a cross for a Blue Line Station. A north arrow is located in the bottom center. A text box in the top right corner states: 'Ventura Rapid Bus service to be introduced with the opening of the Metro Red Line to North Hollywood.' A text box in the bottom right corner indicates the map was prepared by 'TRANSPORTATION MANAGEMENT & DESIGN, INC.' in March 1998. A copyright notice at the bottom right states: 'Reprinted with permission granted by THOMAS BROS. Copyright: THOMAS BROS; Maps.'

Ventura Rapid Bus service to be introduced with the opening of the Metro Red Line to North Hollywood.

LEGEND

- Ventura Rapid Bus Alignment
- Metro Rapid Bus Station
- Red Line Station
- Red Line Station Under Construction
- Blue Line Station

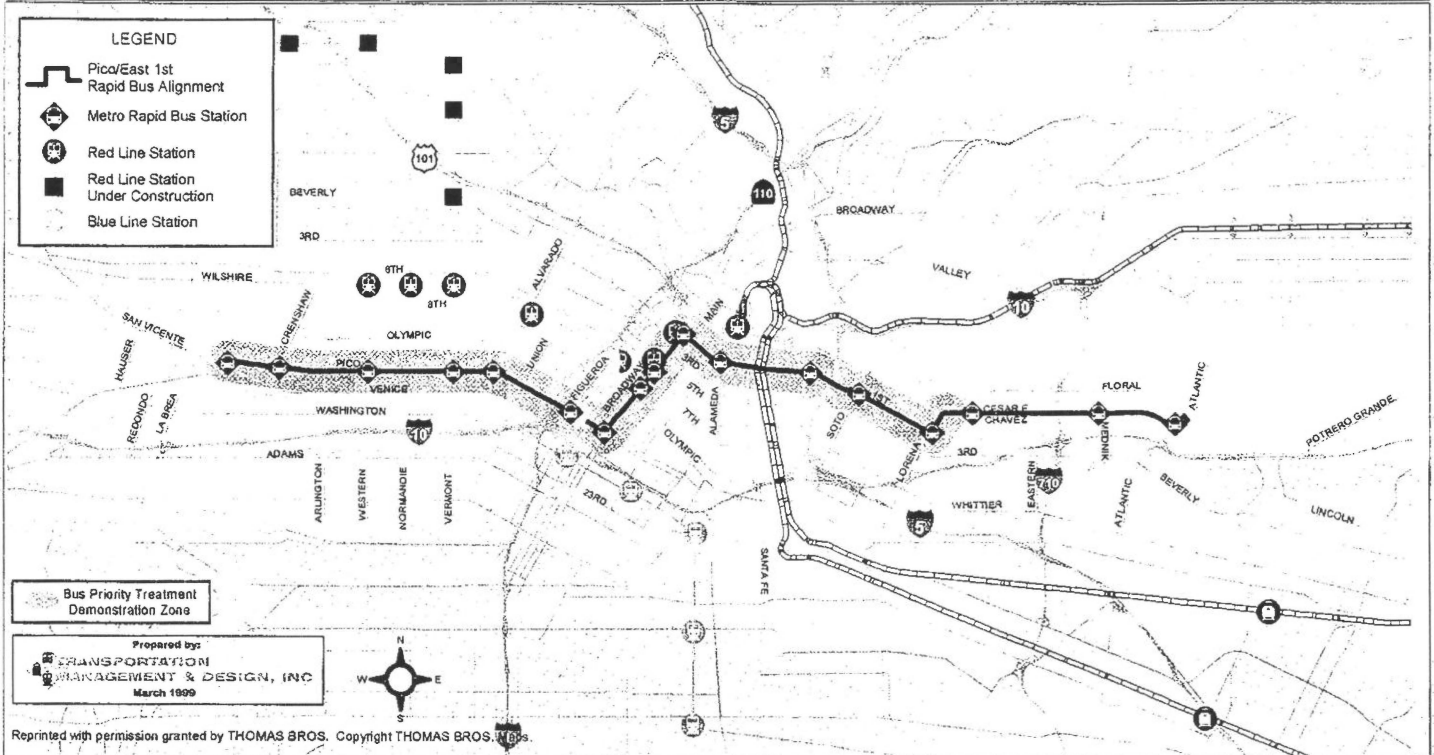
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March 1998

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	<u>Wkdy Peak</u>	<u>Wkdy Mid</u>	<u>Sat</u>	<u>Sun</u>
Existing:	3.5 - 9	11	10	15
Proposed:	3.5 - 5	5	7.5	7.5

Map of the Ventura Rapid Bus route. The route starts at Downtown Los Angeles (indicated by a shaded box), goes north to Topanga Canyon, then east to Oxnard, and continues east through Ventura to Lankershim. Stations marked along the route include De Soto, Winnetka, Tampa, Reseda, Balboa, Sepulveda, Van Nuys, Woodman, Coldwater Canyon, Laurel Canyon, and Vineland. The word "VENTURA" is written above the line between Sepulveda and Van Nuys.

Pico/East 1st Rapid Bus



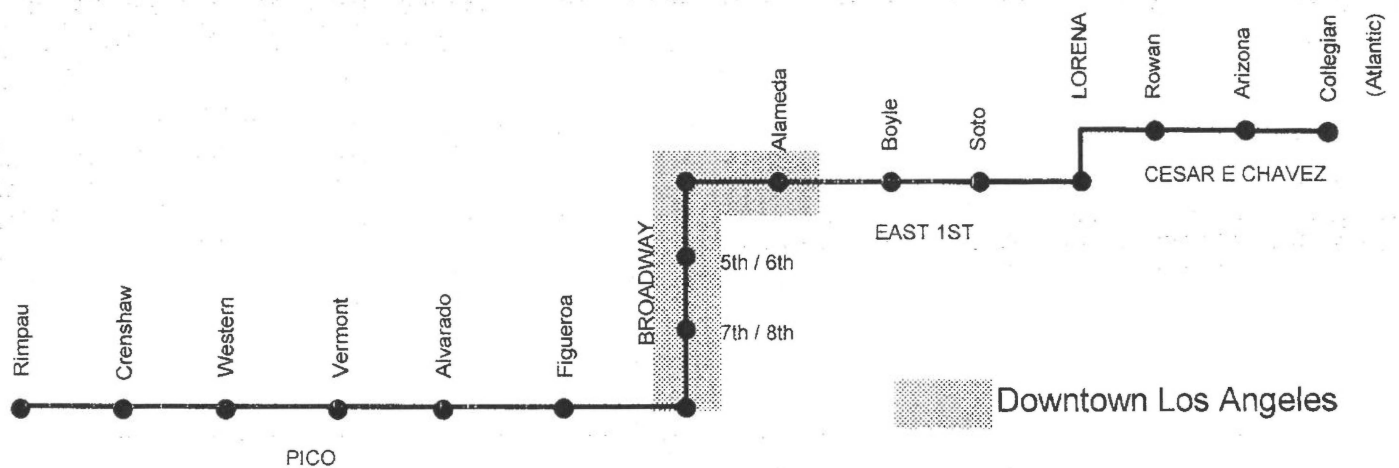
Route Characteristics

Route Length: 12.4 miles
Stations: 17
Buses: 24

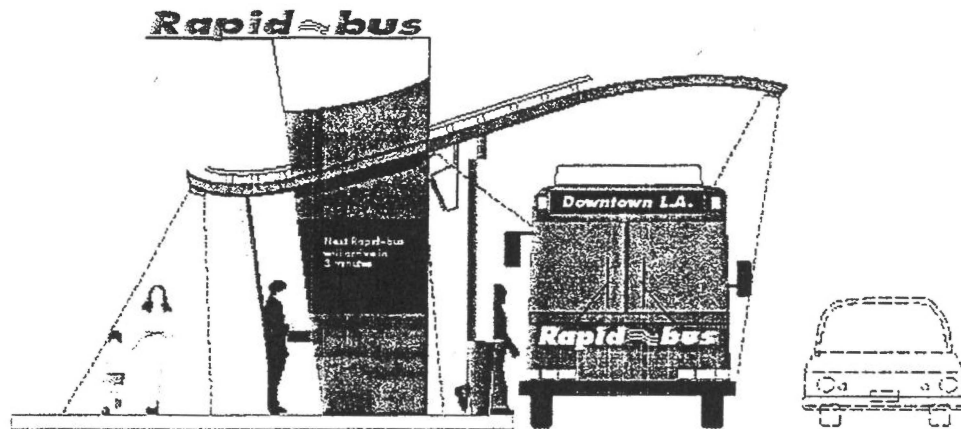
Combined Corridor Frequencies for Rapid and Local (min)

	Wkdy Peak	Wkdy Mid	Sat	Sun
Existing:	3 - 4.5	7.5	6	7.5
Proposed:	2.5 - 4	5	5	5

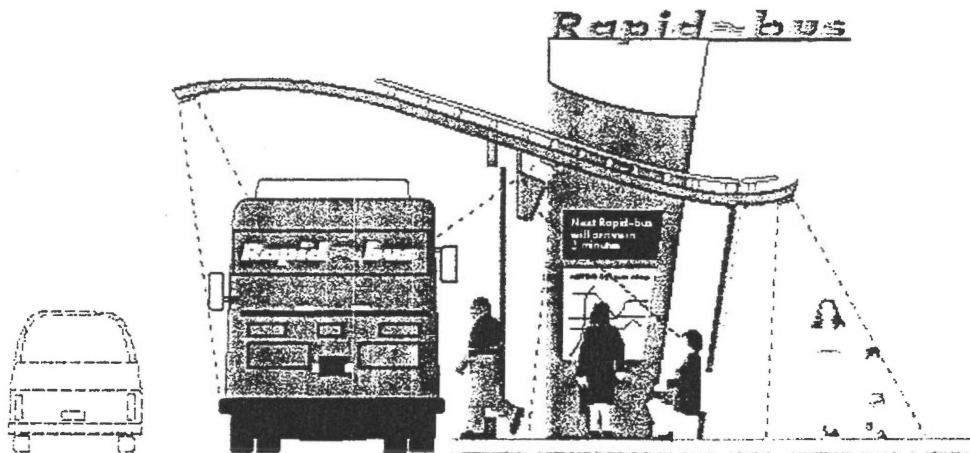
Pico/East 1st Rapid Bus



Metro Rapid Bus Station Concept



Front Elevation of Station Stop

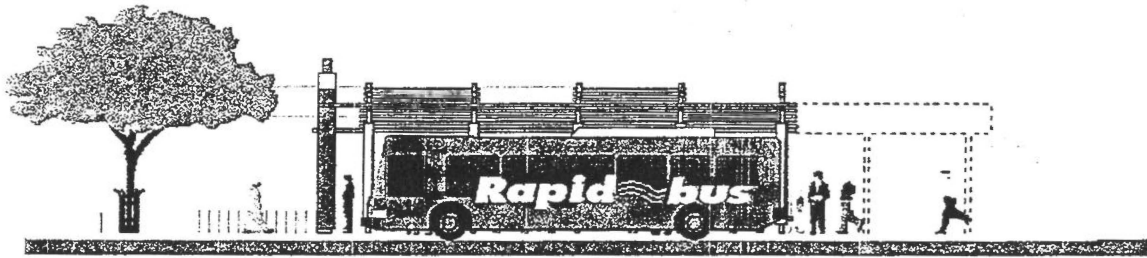


Cross-Section Through Station Stop

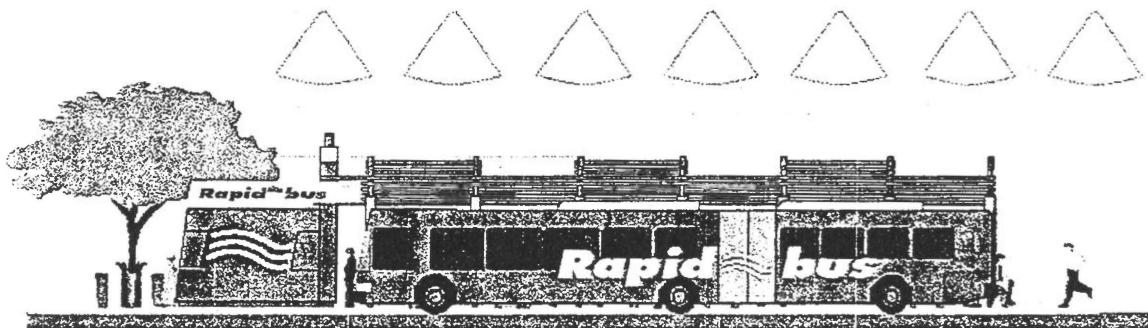
SUISMAN
urban design

March 1999

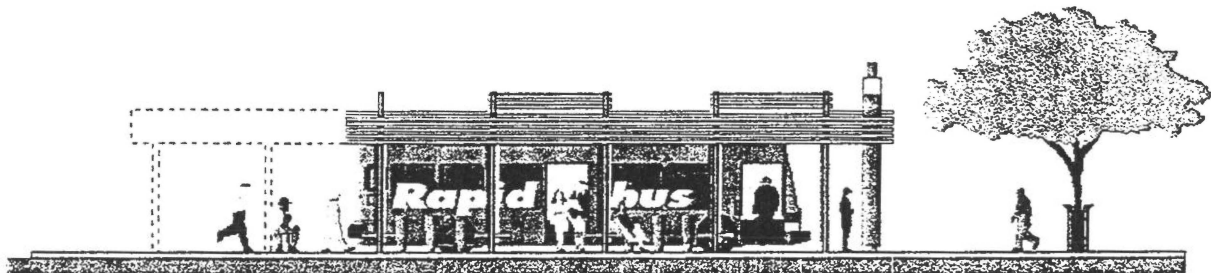
Metro Rapid Bus Station Concept



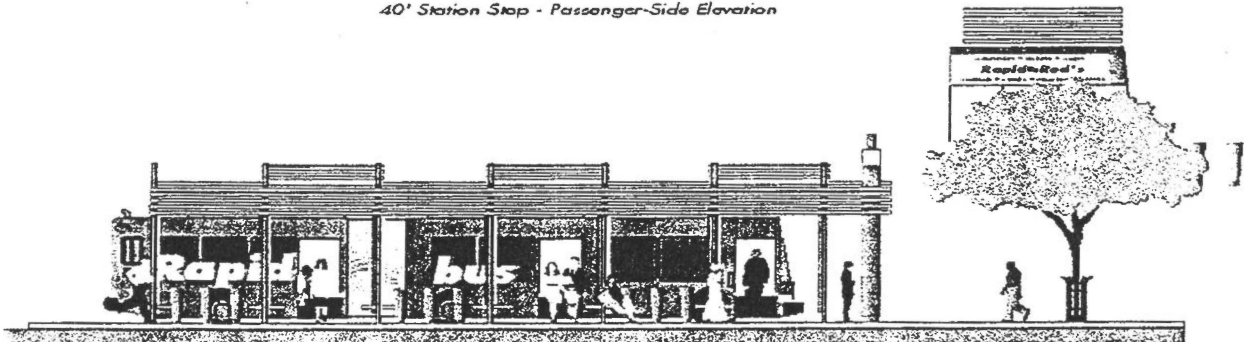
40' Station Stop - Driver's Side Elevation



60' Station Stop - Driver's Side Elevation
(shown with Information/Vending Booth)



40' Station Stop - Passenger-Side Elevation



60' Station Stop - Passenger-Side Elevation