South Placer County
Bus Rapid Transit Service Plan

Final Report

November 14, 2008

Prepared for

Placer County Transportation Planning Agency

by

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1.0 Introduction

1.1 Description of Task

This Final Report is a culmination of Placer County Transportation Planning Agency's (PCTPA) project to prepare a Bus Rapid Transit (BRT) Service Plan for South Placer County. The Service Plan is PCTPA's third phase in the development of a high-capacity, regional transit connection within and between the cities and unincorporated areas of South Placer County, which has been undergoing rapid growth in recent years. This report combines a series of technical memoranda prepared for PCTPA's BRT Service Plan, which included an examination of ridership estimates for BRT service; capital needs and technology opportunities for deployment of the system; an implementation phasing strategy; institutional models to manage the service; and a financial plan to establish capital and operating costs and to identify potential funding sources.

Placer County has an adopted Transit Master Plan that addresses various approaches to coordinated transit services. The BRT services outlined in this report were envisioned in that Master Plan, and would be one portion of the coordinated services in the county. This plan portrays a long-range vision for BRT services within Placer County and describes a potential phasing plan to incrementally implement and upgrade BRT services as development occurs in the southwestern portion of Placer County.

1.2 Definition of BRT

BRT is an integration of light-rail transit service ideals with the flexible operation of bus services. In the classic context, BRT services are usually defined by the attributes of the system. Systems with more attributes present are defined as BRT, and systems with fewer are often referred to as Rapid Bus. In the classic description, BRT services are defined as incorporating:

- Stylized BRT vehicles – often articulated vehicles;
- Exclusive or semi-exclusive rights-of-way for faster operation;
- Discrete stations spaced farther apart than traditional bus stops, with enhanced furnishings and amenities (lighting, shelters, seating, signage);
- Traffic signal prioritization (TSP);
- Real-time information systems;
- Proof-of-payment fare collection; and
- Branding and marketing.

For the Placer County BRT Service Plan, phased implementation of BRT will be described in Section 6.0, which will include the development of a "BRT-Light" concept.

2.0 Description of Proposed BRT System (at Full Build-Out)

2.1 Route Structure and Summary Characteristics

The route structure for the Placer County BRT System was developed based on planning work that was done between 2005 and 2007 for PCTPA and South Placer Regional Transportation Authority (SPRTA). The major elements of the basic route structure included in this report were first developed in the Bus Rapid Transit Implementation Study for South Placer County, completed in September 2006. The route structure from that report was assumed as the starting point for the work in this current project. In January 2008, the three basic BRT routes

from the 2006 study were reviewed with the members of the Transit Operators Working Group (TOWG). Through a series of workshops with the TOWG, primary and secondary routes were developed, and these are summarized in Table 1 and mapped in Figure 1. Figure 1 also includes working assumptions for major development projects that are currently undergoing development review and negotiations with Placer County and the City of Roseville, including California State University (CSU) Placer, West Roseville Town Center, and Placer Vineyards Center. Subsequent feasibility assessment and public comment at the time of plan implementation will determine viability of the primary routes. Modifications to the proposed primary and/or secondary routes will be developed at the time of implementation based on the results of actual project development and the more specific feasibility assessment.

Table 1: BRT Route Structure Attributes

Route	Route Variations	Route Structure Description
Route 1	**Route 1-A (primary)**	**CSU Placer – Hewlett–Packard Campus – Corporate Center – Galleria – Watt/I-80 Light Rail Station via Sunset Blvd, Foothills Blvd, Blue Oaks, CA–65, Roseville Parkway, I-80.** Future option: Extension to City of Lincoln
	Route 1-B-1 (secondary)	CSU Placer – Galleria – Watt/I-80 LRT Station via Sunset Blvd, Lone Tree, Fairway, Pleasant Grove Rd, Roseville Parkway, CA–65, I-80. Option: Extension to City of Lincoln
	Route 1-B-2 (secondary)	CSU Placer– Galleria – Watt/I-80 LRT Station via Sunset Blvd, Lone Tree, Fairway, Stanford Ranch, CA–65, I-80. Option: Extension to City of Lincoln
	Route 1-B-3 (secondary)	CSU Placer – Galleria – Watt/I-80 LRT Station via Sunset Blvd, Lone Tree, Fairway, Stanford Ranch, CA–65, I-80. Option: Extension to City of Lincoln
Route 2	**Route 2-A (primary)**	**CSU Placer – West Roseville Town Center – Placer Vineyards Center – Watt/I-80 LRT Station via Fiddyment Rd, Pleasant Grove Rd, Watt Ave.** Option: Extension to City of Lincoln
	Route 2-B-1 (secondary)	CSU Placer – Placer Vineyards Center – Watt/I-80 LRT Station via Fiddyment Rd, Placer Parkway and Watt Ave. Future option: Extension to City of Lincoln
	Route 2-B-2 (secondary)	CSU Placer – Placer Vineyards Center – Watt/I-80 LRT Station via Placer Parkway and Watt Ave. Future option: Extension to City of Lincoln
	Route 2-B-3 (secondary)	CSU Placer – Placer Vineyards Center – Watt/I-80 LRT Station via Westside, Blue Oaks, Placer Parkway, Watt Ave. Future option: Extension to City of Lincoln
	Route 2-C (secondary)	CSU Placer – Placer Vineyards Center – Watt/I-80 LRT Station via Westside, Pleasant Grove Rd, Watt Ave. Future option: Extension to City of Lincoln
Route 3	**Route 3-A (primary)**	**Galleria – Taylor – Hazel LRT Station – Sunrise LRT Station via Roseville Parkway, Sierra College Blvd, Hazel Ave, Folsom Blvd**
	Route 3-B (secondary)	Galleria – Taylor – Hazel LRT Station – Sunrise LRT Station – Butterfield LRT Station via Roseville Parkway, Sierra College Blvd, Hazel Ave, Folsom Blvd


LEGEND
BRT-1-A (primary)
BRT-1-B (secondary)
BRT-2-A (primary)
BRT-2-B, 2-C (secondary)
BRT-3-A (primary)
BRT-3-B (secondary)
BRT Bus Stop
Station
Transit Center
Existing Light Rail
Light Rail Station
County Boundary
SUNSET BLVD
2-B-1
CSU Placer
(proposed)
PLACER PKWY
WESTSIDE
1-A
SUNSET BLVD
H-P Campus
(proposed)
INDUSTRIAL AVE
BLUE OAKS
Corporate Center
(proposed)
ROSEVIL
FIDDYMENT RD
PLEASANT GROVE RD
Sierra Vista
(proposed)
VILLAGE GREEN
West Roseville
Town Center
(proposed)
PLEASANT GROVE RD
WOODCREEK OAKS
FOOTHILLS BLVD
RIEGO RD
BASELINE RD
VINEYARD RD
Placer
Vineyards Center
(proposed)
WATT AVE
PFE RD
2-B
ROSEVILLE RD
ELVERTA RD
ANTELOPE RD
ELKHORN BLVD
W ELKHORN BLVD
RIO LINDA BLVD
16TH ST
WALERGA RD
ROSEVILLE RD
GARFIELD AVE
MANZANITA AVE
WINDING
PASO RD
MAIN AVE
Watt/I-80 LRT Station
80
EDISON AVE
SAN JUAN RD
TRUXEL RD
NORTHGATE BLVD
NORWOOD AVE
MARYSVILLE BLVD
51
WALNUT AVE
FAIR OAKS BLVD
SACRAMENTO
CAMINO AVE
RICHARDS BLVD
FULTON AVE
ARDEN WAY
HOWE AVE
ASTERN AVE
Map Document: (U:\GIS\placer_co_BRT\Projects\placer_BRT_11x17.mxd) 5/19/2008 -- 9:16:51 AM MTorchia

While secondary routes are shown in Figure 1, the overall focus of this planning effort is on the three primary BRT routes, which are geared toward moving passengers to and from CSU Placer and the Galleria shopping center to points south and west. Subsequent service planning for secondary routes, including those to the cities of Rocklin and Lincoln, would be conducted at a later date, as funding becomes available and likely after full build-out of the three primary routes.

2.2 Date of Report Assumptions

The BRT system configuration assumed in this report represents the project's development as of August 29, 2008. The implementation details cited in this report may ultimately be affected by future project developments, especially when the proposed specific plans and development projects are finalized and approved by the County of Placer or the City of Roseville.

3.0 Estimated Ridership

This section provides a summary of near- and long-term ridership estimates from existing local and regional transportation planning documents for BRT service in South Placer County. These documents include the Transit Master Plan (TMP) for South Placer County (2007), the Conceptual BRT Plan for South Placer County (2005), BRT Implementation Study for South Placer County (2006), and the Placer County Regional Transportation Plan 2027 (2005). Ridership projections from these planning documents were developed to establish likely demand scenarios on a line-by-line basis for all hours of service.

3.1 PCTPA Transit Master Plan for South Placer County

In June 2007, PCTPA adopted the Transit Master Plan for South Placer County,[1] which presented a series of scenarios for possible future transit service levels, capital needs, financing and organization within the county. The document examined the issues inherent in coordinating transit service delivery for the five existing independent South Placer County transit operators: Auburn Transit, Lincoln Transit, Placer County Transit (PCT), Roseville Transit, and Consolidated Transportation Services Agency (CTSA). The Transit Master Plan also outlined recommendations in a variety of areas to assist Placer County in managing and planning transit services as the county grows. Recommendations were based on three long-range scenarios[2]:

- **Scenario 1 (Funding Constrained Service Level) –** Base line assumptions, but includes a 140% increase in transit vehicle miles and vehicle hours based on population growth, with funding coming from existing sources only;
- **Scenario 2 (Transition Service Level) –** Transition from rural to urban service, which includes a 190% increase in transit vehicle-miles and vehicle-hours, with higher service levels targeted in fast-developing areas; and
- **Scenario 3 (Urban Service Level) –** Transition to a full urban function for the transit services in the county, resulting in a 320% increase in transit vehicle miles and vehicle hours. Development assumptions in this scenario are consistent with urban density levels established under the Blueprint Preferred Alternative in the

[1] Placer County Transportation Planning Agency, Transit Master Plan for South Placer County, URS Corporation, June 2007.

[2] The scenario typology established in the Transit Master Plan (Scenarios 1, 2, and 3) were formerly referenced in prior reports as Funding Constrained, Long Range Scenario 1, and Long Range Scenario 2 respectively.

Sacramento Council of Government's (SACOG) Metropolitan Transportation Plan (MTP).

The TOWG has recommended that Scenario 2 be used for planning and policy purposes for development of future transit services in Placer County.

The Transit Master Plan also included information on projected transit boardings by transit operator for each of the three long-range scenarios. Ridership for the three proposed BRT routes were estimated separately from the existing transit operators, and the daily BRT boarding estimates for the three proposed scenarios are summarized in Table 2, along with the assumptions for which BRT routes would be operating in each of the scenarios. The Transit Master Plan only contained ridership information at the BRT system-level, not at the individual line level.

Table 2 - Estimated Total Daily BRT Boardings by Scenario

Scenario	BRT Routes Operated (1)	Estimated Total Daily Boardings for BRT (2)
Scenario 1	BRT 2	1,222
Scenario 2	BRT 2	2,749
Scenario 3	BRT 1, BRT 2, BRT 3	5,871

Sources:
(1) Table 3.2: Comparison of Transit Service By Scenario, Transit Master Plan for South Placer County, URS Corporation, June 2007.
(2) Table 3.4: Estimated Daily Boardings by Transit Operator, Transit Master Plan for South Placer County, URS Corporation, June 2007.

BRT ridership information on boarding totals for the individual BRT routes was developed for an interim working paper prepared during the TMP process, as part of an effort to estimate future ridership numbers for all transit services in the county. A summary of BRT ridership estimates on a line-by-line basis from the interim working paper version is provided in Table 3. The total ridership in the interim working paper was estimated at a higher level than in the final TMP. The line-by-line totals from the interim report were not reconciled with the lower overall total in the TMP, so there was no line-by-line ridership estimate available for the total ridership level shown in the final TMP. Other changes were made in the assumptions between the interim working papers and the final TMP. In the interim working paper, BRT Route 1 was assumed to begin operation in Scenarios 1 and 2, whereas in the Transit Master Plan Final Report, only BRT Route 2 was assumed to operate in Scenarios 1 and 2.

In order to estimate ridership on a line-by-line basis for the total ridership estimated in the final TMP, the line-by-line ridership percentages from the interim version of Scenario 3 was used to apportion the ridership in the final report to break down the totals in that report into line-by-line figures for Scenario 3. In Scenarios 1 and 2 in the final report, only one line was assumed to operate, so there is no need to scale the ridership for Scenarios 1 and 2 – all of the estimated ridership in Scenarios 1 and 2 is assumed to be on BRT Route 2, as the only BRT line operating

in these two scenarios. In Scenario 3, the ridership percentages on a line-by-line basis for the interim version were used to scale the Scenario 3 ridership shown in the final TMP.

Table 3- Estimated Daily Boardings by BRT Route
(Interim Report Version)

Line	Boardings by Scenario					
	Scenario 1: Funding Constrained	Percent of Total	Scenario 2: Transition Service Level	Percent of Total	Scenario 3: Urban Service Level	Percent of Total
BRT Route 1	1,724	100%	1,692	35%	4,024	49%
BRT Route 2	–		3,142	65%	3,143	38%
BRT Route 3	–		–		1,075	13%
Total	**1,724**	**100%**	**4,834**	**100%**	**8,242**	**100%**

Source: Table 3A: Estimated Boardings by Bus Route (working version), DKS Associates, PCLRTP Analysis of Transit Scenarios (5-11-07)

To establish the new estimated boardings by BRT route based on the new estimated total boardings developed in the Transit Master Plan, the total boarding estimates in Table 2 were broken-down on a line-by-line basis based on the percent share of the total ridership shown in Table 3, Scenario 3. A summary of the estimated line-by-line boarding estimates consistent with the final service levels in the Transit Master Plan are shown in Table 4.

Table 4 - Estimated Daily Boardings by BRT Route
(TMP version)

Line	Boardings by Scenario					
	Scenario 1: Funding Constrained	Percent of Total	Scenario 2: Transition Service Level	Percent of Total	Scenario 3: Urban Service Level	Percent of Total
BRT Route 1	–		–		2,866	49%
BRT Route 2	1,222	100%	2,749	100%	2,239	38%
BRT Route 3	–		–		766	13%
Total	**1,222**	**100%**	**2,749**	**100%**	**5,871**	**100%**

Note: TMP ridership totals for Scenario 3 apportioned based on percentages in DKS Associates, PCLRTP Analysis of Transit Scenarios (5-11-07).

To establish the projected ridership distributions during the peak and mid-day hours, the standardized daily boardings by BRT route in Table 4 were assigned to peak and mid-day periods. The peak and mid-day period percent distributions were based on the estimated total peak and mid-day walk and drive access distributions for all transit operators in the Transit Master Plan.[3] It was assumed the total peak and mid-day distributions for BRT boardings would mirror the total boarding distributions established for all transit operators in Placer County.

[3] Table 3.4: Estimated Daily Boardings by Transit Operator, Transit Master Plan for South Placer County, URS Corporation, June 2007.

The ridership demand shown in the Transit Master Plan for all lines (BRT plus local) in each scenario during the peak and mid-day periods are summarized in Table 5.

To calculate the estimated BRT boardings during the peak and mid-day periods, the percentage split between the peak and mid-day ridership from the Transit Master Plan[4] was applied to the line-by-line ridership totals in each of the scenarios. Table 6 shows the result of this calculation.

3.2 Conceptual BRT Plan for South Placer County

In April 2005, PCTPA accepted the Conceptual BRT Plan for South Placer County for the South Placer Regional Transportation Authority. No BRT ridership demand projections were included in this report.

Table 5- Estimated Boarding Distributions by Scenario (Peak and Mid-day)

Scenario 1

Period	Walk Access	Drive Access	Combined Boardings	Distribution (%)	Estimated Daily BRT Boardings	Distribution by Period
Peak	4,882	981	5,863	47%	1,222	574
Mid-day	5,835	781	6,616	53%		648
	Total Boardings		12,479	100%		

Scenario 2

Period	Walk Access	Drive Access	Combined Boardings	Distribution (%)	Estimated Daily BRT Boardings	Distribution by Period
Peak	5,647	1,019	6,666	47%	2,749	1,284
Mid-day	6,804	803	7,607	53%		1,465
	Total Boardings		14,273	100%		

Scenario 3

Period	Walk Access	Drive Access	Combined Boardings	Distribution (%)	Estimated Daily BRT Boardings	Distribution by Period
Peak	8,809	1,401	10,210	50%	5,871	2,931
Mid-day	9,423	818	10,241	50%		2,940
	Total Boardings		20,451	100%		

Source: Walk Access and Drive Access data from Table 3.4: Estimated Daily Boardings by Transit Operator, *Transit Master Plan for South Placer County*, URS Corporation with the assistance of DKS Associates, Inc., June 2007.

3.3 BRT Implementation Study for South Placer County

In September 2006, PCTPA accepted the BRT Implementation Study for South Placer County for the South Placer Regional Transportation Authority.[5] The study provided preliminary BRT ridership forecasts cited from the PCTPA Draft Conceptual Service Plan. The ridership

[4] Table 3.4: Estimated Daily Boardings by Transit Operator, Transit Master Plan for South Placer County, URS Corporation, June 2007.

[5] South Placer Regional Transportation Authority, Bus Rapid Transit (BRT) Implementation Study for South Placer County, Fehr & Peers, June 30, 2006.

estimates from the Draft Conceptual Service Plan were incorporated into Section 3.0 of the PCTPA Transit Master Plan. Due to rounding, the Implementation Study's ridership forecasts vary slightly from the total daily BRT boarding numbers cited in the Transit Master Plan.

Table 6 - Estimated Line-by-Line Boarding Distributions
by Scenario, BRT Route, and Time Period (Standardized; Peak and Mid-day)

Line	Scenario 1: Funding Constrained				
	Total Ridership	**Peak Percentage**	**Peak Riders**	**Mid-day Percentage**	**Mid-day Riders**
BRT 1	–	–	–	–	–
BRT 2	1,222	47%	574	53%	648
BRT 3	–	–	–	–	–
BRT Total	1,222		574		648
Line	**Scenario 2: Transition Service Level**				
	Total Ridership	**Peak Percentage**	**Peak Riders**	**Mid-day Percentage**	**Mid-day Riders**
BRT 1	–	–	–	–	–
BRT 2	2,749	47%	1,292	53%	1457
BRT 3	–	–	–	–	–
BRT Total	2,749		1,292		1,457
Line	**Scenario 3: Urban Service Level**				
	Total Ridership	**Peak Percentage**	**Peak Riders**	**Mid-day Percentage**	**Mid-day Riders**
BRT 1	2,866	50%	1,433	50%	1,433
BRT 2	2,239	50%	1,120	50%	1,120
BRT 3	766	50%	383	50%	383
BRT Total	5,871		2,936		2,936

3.4 Placer County Regional Transportation Plan 2027

In September 2005, the Placer County Transportation Planning Agency prepared the Placer County Regional Transportation Plan 2027. This regional transportation plan did not include BRT ridership demand information.

3.5 Analysis of Forecasts

There is limited available detailed information on the BRT ridership estimates. A survey of available local and regional transportation planning documents established that the majority of available BRT ridership data is based on the total daily boarding estimates established in the Transit Master Plan. The preceding discussion has correlated these totals with other figures developed during the interim stages of the Transit Master Plan to break down the totals into line-by-line figures that would be more useful to develop a Service Plan and which can be broken down into peak and mid-day periods.

4.0 Service Plan

The proposed service plan in this section describes the BRT system at full build-out and presents the three primary routes' service design criteria, operating scenarios, operating schedules, and preliminary operating cost estimates. The ridership estimates presented in Section 3.0 above was used as the basis for sizing the service design.

4.1 Service Design Criteria

4.1.1 Service Area

The BRT services would operate within southwestern Placer County and northeastern Sacramento County, as shown in Figure 1. The majority of services would occur in the City of Roseville and unincorporated areas of Placer County. The proposed services would also extend south into northern Sacramento County for approximately eight miles.

4.1.2 Days of Operation and Span of Service

As shown in Table 7, BRT service would operate seven days per week. The span of service would be from 6:00 AM to 6:00 PM on weekdays with peak operations to occur between 6:00 AM to 9:00 AM and between 3:00 PM to 6:00 PM. During weekends and holidays, BRT would operate from 7:00 AM to 7:00 PM, without peak periods.

Table 7 - Span of Service

		Peak Period	
Day	**Span**	**AM Peak**	**PM Peak**
Weekdays	6:00 AM – 6:00 PM	6:00 AM – 9:00 AM	3:00 PM – 6:00 PM
Weekends and Holidays	7:00 AM – 7:00 PM	N/A	N/A

4.1.3 Headways

Headways (i.e., service frequency) would be 15 minutes during peak periods and 30 minutes during off-peak hours on weekdays, and 30 minutes all day on weekends and holidays, as shown in Table 8. These headway assumptions were established in the BRT Implementation Study for South Placer County[6] (September 2006).

Table 8 - Headways

Day	Peak Headways	Non-Peak Headways
Weekdays	15 minutes	30 minutes
Weekends and Holidays	N/A	30 minutes

[6] South Placer Regional Transportation Authority, Bus Rapid Transit (BRT) Implementation Study for South Placer County, prepared by Fehr & Peers, September 2006, p. 36.

4.2 Operating Scenario

4.2.1 Stop Locations and Stop Spacing Standard

Transit centers and BRT stations were assumed to be located approximately as shown in PCTPA's BRT Implementation Plan (September 2006). Intermediate stops were subsequently placed using the standards described below.

The optimal distance between stops for BRT systems is generally 1/3 to 1/2 mile apart. Stop spacing for BRT systems in North America range from 1,200 feet (or about 0.2 mile) for the planned system in downtown Cleveland to about 7,000 feet (or about 1.3 miles) in Ottawa, which has extensive suburban coverage.[7]

Potential intermediate minor stop locations for the South Placer County BRT system were identified using a variety of other standards, while adhering to the optimal 1/3 to 1/2 mile spacing. (The latter was not always feasible, given existing land uses and street configurations.) These standards include:

- Where possible, stop locations in Placer County in currently developed areas were placed one-half mile apart.
- Where possible, stop locations in Sacramento County were placed one mile apart.
- For areas that are currently undeveloped (e.g., CSU Placer, West Roseville Specific Plan Area) and for which the street grid is not finalized, a stop was assumed every 1/2 mile.
- Where possible, stop locations were placed at signalized intersections.

These potential stop locations are listed in Appendix A and graphically depicted in Figure 1. This appendix provides detail on individual stops, including distance between stops, proposed type of stop (basic vs. enhanced); recommended near-side, far-side, or mid-block location; conceptual configuration; transfer opportunities; park-and-ride information; and queue jump recommendations.

4.2.2 Stop Types

It is assumed the South Placer County's BRT system would have two types of stops:

- Basic stop: This stop style would consist of a bench, covered shelter, and real-time passenger information (e.g., NextBus technology). Most BRT stops will be of this basic type.
- Enhanced stop: This type of stop would consist of a bench, covered shelter, bus schedule postings, real-time passenger information, transfer facilities, and ticket vending machines (TVMs). Enhanced stops would be located at the system's major points, e.g., CSU Placer, Galleria, the light-rail stations, etc. Examples of this type of stop can be found at transit centers in the Cities of San Rafael and Santa Rosa.

This stop classification system and palate of amenities differ from that presented in PCTPA's BRT Implementation Plan (September 2006), which included more complex features. However,

[7] Characteristics of Bus Rapid Transit for Decision-Making, Transportation Research Board, August 2004, p. 3-6.

simpler, less costly stops were deemed more appropriate for this system's relative simplicity and lower intensity,

4.2.3 Stop Placement

Stops were generally placed at the far side of signalized intersections. It was assumed that signal priority for BRT would apply at these intersections. At intersections where a near-side stop is required due to the position of traffic generators, it was assumed that a queue jump lane with preferential signal phasing would be installed.

4.2.4 Operating Speeds

The system's average operating speed on local streets was derived using guidance provided in the Transit Cooperative Research Program (TCRP) publication Bus Rapid Transit, Volume 2: Implementation Guidelines.[8]

- For vehicles operating in mixed traffic and on dedicated bus lanes in Placer County, a preliminary figure of 2.6 minutes per mile was obtained using calculations from the TCRP report that factors in type of roadway, stop spacing, and average dwell time per stop. Potential losses in time also needed to be considered, given varying operating conditions (e.g., service delivery in a central business district or outlying areas; travel in a dedicated bus lane or mixed traffic flow, etc.).

  This savings in time resulted in a base bus running time of 3.8 minutes per mile (or 15.8 mph) for buses operating in mixed traffic and 3.3 minutes per mile (or 18.2 mph) for vehicles operating in dedicated bus lanes in Placer County. These calculations are documented in Appendices B-1 and B-2.
- Separate calculations were made for operations in Sacramento County, as stops were placed further apart in this area than in Placer County.

  Using this standard, a preliminary operating speed of 1.3 minutes per mile was calculated. Adding a factor of 1.2 minutes per mile potential loss due to the operating environment resulted in a base bus running time of 2.5 minutes per mile (or 24.0 mph) for BRT buses traveling on arterials in mixed traffic in Sacramento County. These calculations are documented in Appendix C.
- For operations on a freeway HOV lane without stops, TCRP recommends using study data for HOV lane flows and speeds. Forecast speed figures were obtained for future HOV lanes on I-80 for 2026 from a Caltrans traffic study.[9]

These operating speeds are comparable to existing BRT systems' average speeds, including Cleveland (12 mph), Miami (14 mph), and Vancouver (14 mph).[10]

Table 9 summarizes the average operating speed assumed for each applicable operating environment. These operating speeds are averaged over the length of the line and include dwell

[8] Transit Cooperative Research Program (TCRP), Bus Rapid Transit, Volume 2: Implementation Guidelines, TCRP Report 90, 2003, p. 8-8.
[9] Traffic Study for Interstate 80 from Sacramento/Placer County Line to ½ Mile East of SR 65, EA 367800, Caltrans District 3, April 2003.
[10] Transit Cooperative Research Program (TCRP), Bus Rapid Transit, Volume 2: Implementation Guidelines, TCRP Report 90, 2003.

time spent at stations and stops. Appendix C provides a description of segments along each BRT route using these operating speeds to obtain basic travel times and estimated travel times for each segment.

Table 9 - Average Operating Speed for BRT Routes

Operating environment	Base bus running time
Mixed traffic in Placer County	3.8 minutes per mile (or 15.8 mph)
Mixed traffic in Sacramento County	2.5 minutes per mile (or 24.0 mph)
Dedicated bus lanes in Placer County	3.3 minutes per mile (or 18.2 mph)
HOV lane on I-80 freeway	1.3 minutes per mile (or 45.0 mph)

4.2.5 Running Times

Estimated one-way run times for the BRT routes range from 43 to 45 minutes at full build-out with transit priority in place. Adding an assumed 15 percent for recovery time to the round trip (or about seven minutes on either end) produces cycle times of 99 to 104 minutes, as shown in Table 10. Recovery time, or the time that buses lay over at their terminal points, is generally calculated at 15 percent of a route's run time.

Table 10 - Estimated Running Times

	One-way travel time	Total travel time	Recovery time (15%)	Minimum cycle time (round-trip)
BRT Route 1	43 minutes	86 minutes	13 minutes	99 minutes
BRT Route 2	44 minutes	88 minutes	14 minutes	102 minutes
BRT Route 3	45 minutes	90 minutes	14 minutes	104 minutes

4.2.6 Running Ways

Appendix C also describes the type of running way assumed for each line segment: HOV lane, median dedicated bus lane, or mixed traffic. The type of running way was used to determine average speed, as discussed in Section 4.2.4 above.

4.2.7 Vehicle Requirements

Cycle times and headways are the variables used to determine a system's vehicle demands. Once cycle times are known, headways for peak periods are used to calculate vehicle requirements, using the shorter headways (i.e., greater service frequency) and higher vehicle demand during peak hours. The peak vehicle demand is obtained by dividing the cycle time by the peak headway, rounded up to the nearest whole number.

Vehicle requirements also include spare buses so that routine maintenance and unscheduled repairs and cleaning can occur on vehicles that are not in service – thereby not adversely affecting service delivery. Federal Transit Administration (FTA) guidance for spare ratios for diesel buses is that the spare ratios should normally not exceed 20%. [11]

[11] Federal Transit Administration, Circular C9030.1C (10-01-98), Chapter V.

Table 11 shows the peak vehicle demand, spares needed, and total fleet demands for each BRT route at full build-out with all transit priority in place. The proposed service plan for this BRT system includes peak headways of 15 minutes, which would require 22 buses to meet peak vehicle demand. Five spare buses would be needed to meet the 20 percent spare ratio. Thus, to operate South Placer County's three-route BRT system with the desired service frequency would require 27 vehicles.

Table 11 - Vehicle Requirements during Peak Hours

		Round-trip cycle time (minutes)	Peak Headways (minutes)	Peak Vehicles Needed
BRT Route 1	6:00 AM – 9:00 AM	99	15	7
	3:00 PM – 6:00 PM	99	15	7
BRT Route 2	6:00 AM – 9:00 AM	102	15	8
	3:00 PM – 6:00 PM	102	15	8
BRT Route 3	6:00 AM – 9:00 AM	104	15	7
	3:00 PM – 6:00 PM	104	15	7

Sub-total peak vehicles required (8+8+8)	22
20% spares	5
Total vehicles required for peak operations	**27**

Reducing service frequency would reduce the bus vehicle requirements. For instance, if peak headways were increased (i.e., service frequency reduced) to 20 minutes, then 21 vehicles would be required to operate the service – 17 vehicles for peak period service and four vehicles for spares.

4.2.8 Fare Collection

Fare collection methods can affect overall vehicle travel times by speeding or slowing boarding times at stops. Many BRT systems plan for proof-of-payment (POP) fare collection to speed boarding processes. POP requires passengers to carry a valid fare receipt or pass upon entering the vehicle. The ticket or pass is presented to fare inspectors upon request to indicate that the passenger has paid the fare. Violators are ticketed and must pay a premium fare penalty. POP systems usually require enforcement through a staff of fare inspectors.

Given the relatively low density of the service area and frequency of the service, POP may not be a good option for the initial South Placer County BRT system. Implementing POP with the initial system may add significant costs to the BRT system, as fare inspection officers would need to be deployed and TVMs would need to be installed at all BRT stops. This becomes an ongoing maintenance and stocking requirement. An alternate method that could be implemented for lower cost than full POP would be to retain standard fare collection on the vehicles, but at major stops with high boardings such as at Transit Centers, install TVMs to speed the boarding process through fare pre-payment.

4.2.9 Relation to Other Transit Providers

Table 12 summarizes locations on the three BRT routes that offer transfer opportunities to services operated by other transit operators in the county. These operators include PCT, Roseville Transit, and Sacramento Regional Transit District (SacRT). The major transfer points identified are at proposed BRT stops co-located with existing transit stops (e.g., Galleria) or are located less than one block from an existing transit stop.

Table 12 - Major Transfer Point Opportunities

Major transfer points	Intersection	Transit Operators
BRT Route 1		
Roseville Parkway	Gibson and Castaic Drives	Roseville Transit
Galleria	–	PCT, Roseville Transit
Watt /I-80 LRT Station	–	PCT, SacRT
BRT Route 2		
Fiddyment	Del Webb Blvd	Roseville Transit
Fiddyment	Pleasant Grove Blvd	Roseville Transit
Watt Avenue	Elverta Road	SacRT
Watt Avenue	Antelope Road (U Street)	SacRT
Watt Avenue	Roseville Road	SacRT
Watt/I-80 LRT Station	Watt and I-80	PCT, SacRT
BRT Route 3		
Galleria	–	PCT, Roseville Transit
Taylor P&R	–	Roseville Transit
East Roseville Pkwy	North Sunrise	Roseville Transit
Douglas Blvd	East Roseville Pkwy	Roseville Transit
Douglas Blvd	Sierra College Blvd	Roseville Transit
Sierra College Blvd	Eureka Road	Roseville Transit
Hazel Avenue	Oak Avenue	SacRT
Hazel Avenue	Greenback Lane	SacRT
Hazel Avenue	Winding Way	SacRT
Sunrise LRT station	–	SacRT

Table 13 - Estimated Annual Revenue Vehicle Hours (RVH)

BRT Route	Time Period	Number of vehicles	Number of hours	RVH	Annualization Factor (1)	Annual RVH
Weekdays						
1	6:00 AM – 9:00 AM	7	3	21	–	–
	9:00 AM – 3:00 PM	4	6	24	–	–
	3:00 PM – 6:00 PM	7	3	21	–	–
			Sub-total	*72*	*251*	*16,566*
2	6:00 AM – 9:00 AM	8	3	24	–	–
	9:00 AM – 3:00 PM	4	6	24	–	–
	3:00 PM – 6:00 PM	8	3	24	–	–
			Sub-total	*72*	*251*	*18,072*
3	6:00 AM – 9:00 AM	7	3	21	–	–
	9:00 AM – 3:00 PM	4	6	24	–	–
	3:00 PM – 6:00 PM	7	3	21	–	–
			Sub-total	*66*	*251*	*16,566*
Weekends and Holidays						
1	6:00 AM – 9:00 AM	4	3	12	–	–
	9:00 AM – 3:00 PM	4	6	24	–	–
	3:00 PM – 6:00 PM	4	3	12	–	–
			Sub-total	*48*	*114*	*5,472*
2	6:00 AM – 9:00 AM	4	3	12	–	–
	9:00 AM – 3:00 PM	4	6	24	–	–
	3:00 PM – 6:00 PM	4	3	12	–	–
			Sub-total	*48*	*114*	*5,472*
3	6:00 AM – 9:00 AM	4	3	12	–	–
	9:00 AM – 3:00 PM	4	6	24	–	–
	3:00 PM – 6:00 PM	4	3	12	–	–
			Sub-total	*48*	*114*	*5,472*
				Estimated annual revenue hours		**67,620**

(1) The annualization factors were determined by using the following assumptions and calculations:
For weekends, it was assumed that there would be 10 holidays during the year that would require weekend operation, instead of weekday operation:
- 52 Saturdays in one calendar year + 52 Sundays in one calendar year + 10 assumed holidays = 114 days of weekend operation.
- 365 days in a calendar year – 114 days of weekend operation = 251 days of weekday operation

4.3 Preliminary Operating Schedule

A draft Operating Timetable is presented in Appendix D for each of the three primary BRT routes. This timetable was created assuming operational components presented in previous studies conducted for the South Placer County BRT system, the route alignments shown in Figure 1, and the running times shown in Table 10, above.

4.4 Preliminary Operating Costs

Preliminary operating costs were estimated using revenue vehicle hours (RVH) and fully allocated hourly operating costs for the operating agencies in the area. RVH were calculated using the service criteria outlined above (e.g., headways), which totals to approximately 67,620

hours per year for the BRT system at full build-out. These RVH calculations do not include deadhead hours or hours for testing and maintenance, which are not revenue-producing hours. The total estimated RVH for the BRT system at full build-out are shown in Table 13.

The estimated RVH was multiplied by hourly operating costs to get an estimated figure for the BRT's annual operating expenses. Fully allocated hourly costs were obtained from the FTA's National Transit Database (NTD) for Roseville Transit and PCT. Fully allocated costs were used to determine annual operating costs as the size of the additional BRT service as a percentage of the system's current size is large, and thus it is likely that expansion of the systems would entail adding all functions covered in the fully allocated NTD rate.

The most current NTD figures available were for 2006 and were subsequently escalated to 2008 dollars using a 3.5 percent annual escalation factor. The reported hourly costs for Roseville Transit and PCT vary significantly – $57.00 and $102.90, respectively. Both hourly costs were used to calculate operating costs for the new BRT system to show a range of potential costs. As shown in Table 14, it is estimated that the BRT system's annual operating costs would range from $4.1 million to $7.5 million, when fully built out.

Table 14 - Estimated Annual Operating Costs

	Revenue Vehicle Hours	Hourly Cost (low end) (1)	Hourly Cost (high end) (2)	Estimated Annual Operating Costs
BRT Route 1	22,038	$61.06	$110.23	$ 1,345,640 – 2,429,249
BRT Route 2	23,544			$ 1,437,593 – 2,595,233
BRT Route 3	22,038			$ 1,345,640 – 2,429,249
Estimated total annual operating costs				$ 4,128,877 – 7,453,753

(1) Roseville Transit's fully allocated operating costs reported in the 2006 NTD was $57.00; escalated to 2008 (3.5% annually) = $61.06
(2) PCT's fully allocated operating costs reported in the 2006 NTD was $102.90; escalated to 2008 (3.5% annually) = $110.23

5.0 Capital Needs (at Full Build-Out)

While similar to conventional bus transit service, the capital needs and technology used for BRT systems vary slightly. A survey for this Service Plan was conducted to determine the types of vehicles, fixed facilities, and amenities available in the market that may fulfill the goals for Placer County's BRT service.

Additionally, information from the ridership estimates (Section 3.0) was used to make preliminary estimates of capital items needed to operate and maintain the desired level of service (i.e., initial fleet size and subsequent, phased fleet increases). Estimated capital costs for the major elements of acquisition, start-up, operation and maintenance system are also presented. Of particular importance will be the definition of maintenance and storage facility requirements, as these may be among the determinants of a preferred management strategy, which is discussed in Section 7.0.

5.1 Technology Options Appropriate for BRT

BRT system components can be grouped into the following general categories:

- BRT running ways;
- Traffic signal priority (TSP);
- BRT stations;
- Vehicles; and
- Fare collection.

Each of these components are discussed and illustrated by reference to a series of exhibits presented below. The exhibits are taken from the TCRP Report 118 entitled Bus Rapid Transit Practitioner's Guide (2007),[12] which provides a comprehensive review of all BRT system elements available.

5.1.1 BRT Running Ways

BRT systems operate in a variety of running ways, ranging from shared lanes with mixed traffic to exclusive lanes to grade-separated busways. Most BRT systems incorporate several different types of running ways in different portions of the system, depending on the site circumstances. Five classes of BRT running way facility types are presented in Figure 2, which shows the degree/type of access control associated with each class. Full access control is noted for Class I running ways like bus tunnels and grade-separated busways. At the other end of the extreme is Class V characterized by mixed traffic operations. Many BRT systems are either planning or are constructing an arterial median busway in physically separated lanes within the street rights-of-way (ROW), which are designated as Class III.

The state of the industry contains examples of every type of running way listed in the TCRP report. Class I running way is typified by portions of Boston's Silver Line, the Los Angeles County Metropolitan Transportation Authority (LAMTA) freeway busways, and the PAT busways in Pittsburgh. These are the most expensive types of bus running ways to construct. Class II running ways are typified by the LAMTA Orange Line in the San Fernando Valley and the new system in Eugene, Oregon. Class III arterial median busways are the "classic" BRT running way, representing the system in Curitiba, Brazil, and systems in the United States such as the Euclid Corridor in Cleveland, now under construction. Class IV running ways are common in some larger cities, such as the arterial bus lanes and contraflow lanes in San Francisco and New York. Class IV running way is common on systems that are incrementally updating, such as the AC Transit Rapid Bus system in the San Francisco Bay Area and the LAMTA Rapid Bus network in Los Angeles.

Construction of BRT running ways within existing street rights-of-way can be difficult to accomplish, especially if it requires removing existing lanes or parking.

[12] Transit Cooperative Research Program (TCRP), Bus Rapid Transit Practitioner's Guide, TCRP Report 118, 2007.

Figure 2 - BRT Running Ways

Class	Access Control	Facility Type
I	Uninterrupted flow - full control of access	Bus tunnel Grade-separated busway Reserved freeway lanes
II	Partial control of access	At-grade busway
III	Physically separated lanes within street right-of-way	Arterial median busway Bus streets
IV	Exclusive/semi-exclusive lanes	Concurrent and contraflow bus lanes
V	Mixed traffic operations	

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-10, Transportation Research Board, 2007.

Figure 3 furnishes estimates of BRT running way construction cost, excluding ROW acquisition cost. The most expensive are tunnel busways, running $60 million or more per lane-mile. Aerial busways on structure would be costly as well – on the order of $12 to $30 million per lane-mile. At-grade busways will run $0.5 million to over $10 million per lane-mile, depending on specific type. Mixed flow operations with queue jumps at signalized intersections are much cheaper, on the order of $0.1 to $0.3 million per lane-mile. Figure 3 also provides cost estimates for optical guidance, both per vehicle and per mile of running way. Optical guidance can add very significantly to bus cost when optical guidance equipment, hardware and integration are factored in. It has had very limited application to date, chiefly in Europe. An initial US application of this technology has occurred in Las Vegas, with mixed success in the harsh desert environment.[13]

Figure 3 - Typical BRT Running Way Costs (2004)
(excluding right-of-way costs)

Component	Cost (Millions)
Running Way Type	
Grade-separated busway	
Below grade (tunnel)	$60 to $105 per lane-mile
Aerial	$12 to $30 per lane-mile
At-grade busway	
Separate ROW or median	$0.5 to $10.2 per lane-mile
Arterial lanes (reconstructed)	$2.5 to $2.9 per lane-mile
Mixed flow lanes - queue jump	$0.1 to $0.29 per lane-mile
Guidance Type	
Optical	$11,000 to $134,000 per vehicle
Electromagnetic sensors	$20,000 per mile
Hardware and integration	$50,000 to $95,000 per vehicle

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-12, Transportation Research Board, 2007.

[13] Federal Transit Administration, Las Vegas Metropolitan Area Express Bus Rapid Transit Demonstration Project Evaluation, August 2005.

BRT running way features and components can make for substantial savings in bus travel time, as evidenced by Figure 4. Exclusive running ways can save up to 50 percent in travel time, as applied in exclusive busways in Adelaide, Australia and Miami. The greater stop spacing characteristic of BRT operations can also save significantly in time, on the order of 25 to 67 percent. Traffic signal priority treatments for buses in BRT mode also can save significant amounts of time.

Figure 4 - Sources of BRT Travel Time Savings

BRT System	Exclusive Running Way	Increased Stop Spacing	Exclusive Lanes/Queue Bypass	TSP
Adelaide (Australia)	55%	40%	3%	2%
Los Angeles: Wilshire-Whittier	—	67%	—	33%
Los Angeles: Ventura	—	67%	—	33%
South Miami-Dade Busway	50%	25%	—	25%

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-13, Transportation Research Board, 2007.

5.1.2 Traffic Signal Priority (TSP)

TSP is a very common application for bus systems in the United States and an excellent example of where Intelligent Transportation Systems (ITS) is a particularly appropriate application for bus transit. TSP is frequently applied with BRT systems to reduce delay at signal-controlled intersections and to enhance overall running time.

Characteristics and cost associated with different approaches to TSP hardware, which vary widely, are presented in Figure 5. "Smart loops" that work with existing loop detectors are relatively inexpensive. Wayside readers that use radio frequency technology are more expensive to install at the intersections, on the order of $20,000 per intersection. Optical systems are expensive as well, costing about $15,000 per intersection and $2,000 per bus; however, these are the most common systems for implementing TSP. Optical TSP systems can often be implemented in conjunction with signal pre-emption for emergency vehicles using the same technology, and the cost can be shared with the emergency response agencies. Varying levels of pre-emption or priority can be provided, with emergency vehicles receiving a higher level than transit vehicles. In some circumstances, video vehicle detection can also be used for TSP.

Substantial time savings can be achieved from implementation of TSP, as evidenced by Figure 6. Running time savings of up to 15 to 18 percent have been reported, which is notable for an ITS application to bus transit.

Figure 5 - Characteristics of TSP Detection Systems

System	Technology	Cost/ Intersection	Cost/Bus	O&M Costs
Optical	Optical emitters	Moderate ($15,000)	Moderate ($2,000)	Emitter replacement ($1,500)
Wayside Reader	Radio frequency (RF) technology. Uses bus-mounted tags and wayside antenna, which must be located within 35 feet of bus. Radio transmits and decoder reads rebound message.	High ($20,000)	Low ($250)	Tag replacement ($50)
"Smart" Loops	Loop amplifier detects transmitter powered by vehicle's electrical system.	Low ($2,500 per amplifier; use existing loop detector)	Low ($500)	Same as loop detector

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-38, Transportation Research Board, 2007.

Figure 6 - Reported Initial Estimates of Benefits to Buses from Traffic Signal Priority

Location	% Running Time Saved	% Increase in Speeds	% Reduced Intersection Delay	Source
Anne Arundel County, MD	13-18	—	—	*9, 12*
Bremerton, WA	10	—	—	*2, 9, 12*
Chicago: Cermak Road	15-18	—	—	*12*
Hamburg, Germany	—	25-40	—	*2*
Los Angeles: Wilshire-Whittier Metro Rapid	8-10	—	—	*2, 12*
Pierce County, WA	6	—	—	*2*
Portland, OR	5-12	—	—	*9*
Seattle: Rainier Avenue	8	—	13	*2, 12*
Toronto	2-4	—	—	*2*

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-39, Transportation Research Board, 2007.

5.1.3 BRT Stations

Figure 7 documents various types of BRT stations/stops and features commonly applied by transit properties. Station/stop types vary depending on the curbside running way, median arterial busway, and access-controlled busway. The X's in Figure 7 indicate when the particular feature is typically provided. Public address/automated passenger information systems that include "Next Bus" technology is an ITS application that indicates wait time until the next vehicle.

Stop or station features can be upgraded incrementally as service is upgraded. AC Transit's Rapid Bus System was implemented with only a modified shelter and new signage at the station. As AC Transit upgrades from Rapid Bus to full BRT, station amenities will be enhanced with real-time information, off-vehicle ticketing, and new shelters and seating. Also, as AC Transit converts from Rapid Bus to BRT, operation will move from right-lane operation in mixed traffic to center median exclusive lane operation, which will give the opportunity to make the stations distinctive in the urban streetscape.

Figure 7 - BRT Station Types and Features

Feature	Curbside Bus Stop		Median Arterial Busway		Busway		
	Typ-ical	Major	Typ-ical	Major	Typ-ical	Major	Inter-modal Center
Conventional shelter[1]	X						
Unique BRT shelter	X	X	X	X	X	X	X
Illumination	X	X	X	X	X	X	X
Telephones/security phone		X	X	X	X	X	X
Temperature control			X	X[2]	X[2]	X	X
Passenger Amenities							
Seating		X	X	X	X	X	X
Trash containers		X	X	X	X	X	X
Restrooms							X
Public address/automated passenger information systems		X	X	X	X	X	X
Passenger Services							
Vending machines, newsstands		X	X	X	X	X	X
Shops						X	X
Special services (e.g., dry cleaners)						X	X

[1] Conventional shelter is a minimum treatment that generally should not be used for a BRT service.

[2] In some environments

NOTE: Major stations should be provided at interchanging transit lines, large park-and-ride lots, and important passenger generators.

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-64, Transportation Research Board, 2007.

Costs for BRT stations vary with the amenities provided, as evidenced by Figure 8. Simple stops may cost only $16,000 per stop, whereas enhanced stops could cost in the range of $25,000 to $35,000. Designated BRT *stations* could run as high as $2.5 million, though $150,000 may be sufficient depending on amenities offered. Full intermodal transit centers could cost $5 to $20 million, depending on size, amenities, etc. Cost estimates for roadway features including bus pullouts and passing lanes at stations are also given in Figure 8.

Figure 8 - Reported BRT Station Costs by Type of Station and Roadway Features

Item	Cost
Type of Stop/Station	
Simple stop	$16,000 to $26,000 per shelter
Enhanced stop	$25,000 to $35,000 per shelter
Designated station	$150,000 to $2.5 million
Intermodal transit center	$5 to $20 million
Roadway Feature	
Bus pullout	$0.05 to $0.06 million per station platform
Passing lanes at station	$2.5 to $2.9 million per mile per lane

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-66, Transportation Research Board, 2007.

5.1.4 BRT Vehicles

Selection of BRT vehicle types is an important consideration in BRT service implementation planning. Figure 9 compares size and passenger capacity data for typical bus types with applicability for BRT operation. A 40-foot standard transit vehicle has a maximum capacity of 50 to 60 seated plus standing passengers. An 80-foot double-articulated bus could accommodate 110 to 130 seated riders plus standing passengers. Sixty-foot vehicles are a common type selected for BRT system operation, and they have a capacity of 80 to 90 seated riders plus standing passengers.

Figure 9 - Typical Bus Sizes and Capacity

Length	Width	Floor Height	Number of Door Channels	Number of Seats (including seats in wheelchair tie-down areas)	Maximum Passenger Capacity (seated plus standing)
40 ft (12.2 m)	96-102 in	13-36 in	2-5	35-44	50-60
45 ft (13.8 m)	96-102 in	13-36 in	2-5	35-52	60-70
60 ft (18 m)	96-102 in	13-36 in	4-7	31-65	80-90
80 ft (24 m)	96-102 in	13-36 in	7-9	40-70	110-130

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-74, Transportation Research Board, 2007.

Figure 10 - Inventory of BRT Vehicles

Standard-Length Buses				
Make/ Model	**Description**	**Length**	**Width**	**Height**
NABI 40 - LFW	▪ Seats - 40 ▪ Standees - 30 ▪ Front- or rear-door wheelchair ramp ▪ Two wheelchair positions ▪ Low-floor entry/exit at all doors	40 ft	102 in.	116 in.
Orion VII	▪ Seats - 43 (37 seated passengers with 2 wheelchair positions filled) ▪ Standees - 34 ▪ Front- or rear-door wheelchair ramp ▪ Low-floor entry/exit at all doors	41 ft	101.8 in.	132 in., 135 in. Hybrid, CNG
Stylized Standard-Length Buses				
Make/ Model	**Description**	**Length**	**Width**	**Height**
New Flyer - Model Invero D40i	▪ Seats - 44 (90% forward facing with perimeter seating available) ▪ Standees - 46 ▪ Patented two-stage wheelchair ramp ▪ Low floor at all doors, step rear ▪ Plug slide front and rear doors	41 ft	102 in.	126 in. with rear-mount HVAC
New Flyer - Model D40LF	▪ Seats - 39 (70% forward facing with perimeter seating available) ▪ Standees - 43 ▪ Flip-out wheelchair ramp ▪ Low floor at all doors, step rear ▪ Slide glide front and rear doors	40 ft	102 in.	111 in. with rear-mount HVAC
Van Hool - Model A330	▪ Seats - 33 forward-facing ▪ Standees - 49 ▪ Flip-out wheelchair ramp ▪ Low floor at all doors ▪ Three doors (first and third pivot in, center wide door opens out)	40 ft, 6.6 in.	102 in.	122 in.
NOVA LFS	▪ Seats - 47 various configurations ▪ Standees - 32 ▪ Two ultra-wide doors ▪ Wheelchair ramps ▪ Low-floor entry/exit at all doors ▪ Full low-floor, ADA compliant	40 ft	102 in.	123 in.
NABI CompoBus 45C - LFW	▪ Seats - 46 transit and suburban configurations available ▪ Standees - 23 ▪ Front- or rear-door wheelchair ramp ▪ Two wheelchair positions ▪ Low-floor entry/exit at all doors	45 ft	102 in.	126 in.
Conventional Articulated Buses				
Make/ Model	**Description**	**Length**	**Width**	**Height**
NABI 60 - LFW	▪ Seats - 62 ▪ Standees – 31 ▪ Two doors, third door optional ▪ Choice of door width and type ▪ Front- or rear-door wheelchair ramp ▪ Two wheelchair positions ▪ Low-floor entry/exit at all doors	60 ft	102 in.	116 in.

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-77, Transportation Research Board, 2007.

Figure 10 (Continued from previous page)

Neoplan AN 460LF	▪ Seats - 68, customer selectable ▪ Standees - 29 ▪ Front- or rear-door wheelchair ramp ▪ Two wheelchair positions ▪ Full low-floor for easy entry/exit ▪ Two or three doors, extra-wide plug	60 ft	102 in.	135 in.
New Flyer - Model DE60LF	▪ Seats - 62 forward-facing, perimeter seating available ▪ Standees - 53 ▪ Flip-out wheelchair ramp ▪ Low floor at all doors, rear riser ▪ Up to three slide and glide doors	61 ft	102 in.	131 in. with roof-mount battery pack
Stylized Articulated Buses				
Make/ Model	**Description**	**Length**	**Width**	**Height**
NABI 60 - BRT	▪ Seats - 60, transit and suburban configurations available ▪ Standees - 30 ▪ Front- or rear-door wheelchair ramp ▪ Two wheelchair positions ▪ Low-floor entry/exit at all doors (15") ▪ Two doors, third door optional ▪ Up to two left-side doors	60 ft	102 in.	135 in.
New Flyer - Model DE60-BRT	▪ Seats - 47 to 53 (75% forward facing with perimeter seating available) ▪ Standees - 53 ▪ Flip-out wheelchair ramp ▪ Low floor at all doors, rear riser ▪ Three to five slide and glide doors	61 ft	102 in.	131 in. with roof-mount battery pack
Van Hool - Model A300	▪ Seats - 43 forward-facing ▪ Standees - 57 ▪ Flip-out wheelchair ramp ▪ Full low floor and at all doors ▪ Four doors - first, third, and fourth pivot in, second (center wide door) opens out	60 ft, 6.6 in.	102 in.	134 in.
Specialized BRT Vehicles				
Make/ Model	**Description**	**Length**	**Width**	**Height**
APTS - Phileas 60	▪ Seats - 37 forward-facing ▪ Standees - 67 (1 passenger/2.7 ft^2) ▪ Full low-floor (100%) ▪ Three doors, on one or on both sides	60.5 ft	100 in.	123 in.
Irisbus CIVIS	▪ Seats - 27 forward and perimeter ▪ Standees - 90 (1 passenger/2.7 ft^2) ▪ Flip-out wheelchair ramp ▪ Full low-floor ▪ Four wide doors, on one side	60 ft	100 in.	134 in.

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-77, Transportation Research Board, 2007.

In selecting vehicle type, some of the most important criteria will be the peak-hour passenger load factors that will be expected to be carried as well as length of the trip. Some longer distance suburban trips may be too long for passengers to be willing to stand for the entire trip, especially on a service considered as premium service. Another important criterion is whether or not the vehicle is expected to be used for other services besides the BRT service. Figure 10 provides details on various buses ranging from standard-length buses to articulated buses to specialized BRT vehicles.

Figure 11 shows the typical price ranges by type of bus, from conventional standard buses through articulated buses through specialized BRT vehicles. Costs range from $300,000 to over $1.5 million for specialized BRT vehicles.

Figure 11 - Costs of BRT Vehicles by Size

Bus Type	Bus Length	Typical Price Range
Conventional Standard	40-45 ft	$300,000 to $350,000
Stylized Standard	40-45 ft	$300,000 to $400,000
Conventional Articulated	60 ft	$500,000 to $600,000
Stylized Articulated	60 ft	$600,000 to $950,000
Specialized BRT	60-80 ft	$950,000 to $1,600,000

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-82, Transportation Research Board, 2007.

Vehicles are one area where the state of the practice is extremely variable. The largest BRT systems in Latin America have pioneered the use of double-articulated vehicles, though most use standard 60-foot articulated vehicles. BRT and Rapid Bus systems often begin operation with more conventional vehicles, and then transition to specialized vehicles as the system grows. AC Transit and LAMTA's Rapid Bus lines began operation with 40-ft low-floor vehicles, and LAMTA has transitioned some lines to stylized 60-foot vehicles (Figure 12) as ridership has grown. In US and European practice, many systems are trending toward stylized 60-foot vehicles, such as the LAMTA's Orange Line, Las Vegas' MAX, and the Lane Transit (Eugene) system. Boston's Silver Line, in contrast, operates with standard 60-foot articulated vehicles.

Figure 12 - Typical stylized 60-foot articulated BRT vehicle

5.1.5 Fare Collection Equipment

Fare collection is an area where ITS can be applied to system design to enhance system throughput and provide options to the rider and the operator. For BRT operations, reducing station dwell time is typically a primary objective for the system. This can be accomplished through wayside pre-payment of fares and POP fare inspection on the vehicles. In a POP system, riders can board through any door and do not need to pay the driver or display fare media to the driver when boarding. Instead, POP systems have fare inspection staff who conduct random inspections on the system to ensure compliance. Fare inspection staffing can be a large cost component, which needs to be considered in determining which fare collection strategy to pursue.

In a POP system, tickets are generally sold through wayside TVMs or riders have monthly or weekly passes. Smart card fare systems also allow POP systems to encourage riders to pre-pay fares through online or regular debit card deduction, and have the fare value automatically loaded on the smart card. Examples of smart card systems are TransLink in the San Francisco Bay Area, and the Smart Card Fare Study currently being done by SACOG for the Sacramento area. Figure 13 provides capital and maintenance cost ranges for bus-related fare collection fixed capital costs, payment media costs, and operating & maintenance costs. There are significant trade-offs to be considered in system design between the time needed to process on-board payment by passengers and the capital and ongoing operating costs of various POP fare collection strategies.

In U.S. practice, POP fare collection on buses or BRT systems is still fairly rare. LAMTA's Orange Line uses POP fare collection, as does Lane Transit's EMX and portions of the Silver Line in Boston. The need to conduct onboard fare inspections is often more difficult on a bus than on rail systems, where there is more experience in the U.S. with POP.

As noted previously in Section 4, given the relatively low density of the service area and frequency of the service, POP may not be a good option for the initial South Placer County BRT system. Implementing POP with the initial system may add significant costs to the BRT system, as fare inspection officers would need to be deployed and TVMs would need to be installed at all BRT stops. This becomes an ongoing daily maintenance and stocking requirement. An alternate method that could be implemented for lower cost than full POP would be to retain standard fare collection on the vehicles, but at major stops with high boardings such as at Transit Centers, install TVMs to speed the boarding process through fare pre-payment.

5.1.6 System Packaging and Comparative Assessment

Bus rapid transit in South Placer County is to represent an affordable, appropriately sized, practical package of BRT elements, perhaps as an incremental approach beginning with "BRT-Light." BRT is not a single, "only one way to do it" approach to rapid bus services; rather, it should represent a package assembled from various potential component parts depending on the needs of the individual operation. This will become fairly evident in Section 6.0, which presents an implementation strategy consisting of incremental steps to deploy various components of the service in a phased implementation. Figure 14 summarizes a variety of unit costs for alternative approaches to running way, transit preferential treatments, stations, vehicles, fare collection, passenger information, "branding," and ITS applications.

Figure 13 - Fare Collection Equipment Capital and Maintenance Costs

Capital Cost Elements (Bus-Related Fixed Costs per Unit)	Low	High
Mechanical farebox	$2,000	$3,000
Electronic registering farebox	$4,000	$5,000
Electronic registering farebox (with smart card reader)	$5,000	$8,000
Validating farebox (with magnetic card processing unit)	$10,000	$12,000
Validating farebox (with smart card reader)	$12,000	$14,000
Validating farebox (with magnetic & smart card reader)	$13,000	$17,500
Stand-alone smart card processing unit	$1,000	$7,000
Magnetic fare card processing unit (upgrade)	$4,000	$6,000
On-board probe equipment**	$500	$1,500
Garage probe equipment**	$2,500	$3,500
Application software (smart card units)	$0	$100,000
Garage hardware/software	$10,000	$20,000
Central hardware/software	$25,000	$75,000
Payment Media Costs	**Low**	**High**
Magnetic or capacitive cards	$0.01	$0.30
Contactless cards (plastic)	$2.00	$5.00
Contactless cards (paper)	$0.30	$1.00
Contact cards	$1.50	$4.00
Operation and Maintenance Costs	**Low**	**High**
Spare parts (% of equipment cost)	10%	15%
Support services include training, documentation, revenue testing, and warranties (% of equipment cost)	10%	15%
Installation (% of equipment cost)	3%	10%
Nonrecurring engineering & software costs (% of equipment cost)	0%	30%
Contingency (% of equipment/operating cost)	10%	15%
Equipment maintenance costs (% of equipment cost)	5%	7%
Software licenses/system support (% of systems/software cost)	15%	20%
Revenue handling costs (% of annual cash revenue)	5%	10%
Clearinghouse (e.g., card distribution, revenue allocation) *** (% of annual automatic fare collection revenue)	3%	6%

* Actual cost depends on functionality/specifications, quantity purchased, and specific manufacturer.

** In an integrated regional system, there is no additional cost for probe equipment.

*** This cost depends on the nature of the regional fare program, if any.

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 4-127,Transportation Research Board, 2007.

Figure 14 - Representative BRT Component Development Costs

Component	Unit	Cost/Unit
Running Way		
Off-street busway		
At-grade	Per route-mile	$5 million
Grade-separated	Per route-mile	$13 million
Elevated	Per route-mile	$50 million
Tunnel	Per route-mile	$200 million
On-street		
Median arterial busway	Per route-mile	$4 million
Bus lane - new construction	Per route-mile	$25 million
Bus lane - striping lane	Per route-mile	$100,000
Transit Preferential Treatments		
Queue bypass		
Parking removal	Per approach	Negligible
Use of right-turn lane	Per approach	Negligible
Added lane	Per approach	$300,000
Curb extension	Per extension	$60,000
TSP	Per intersection	$30,000
Special transit phase	Per intersection	$10,000
Stations		
Typical		
Basic	Per station	$21,000*
Enhanced	Per station	$30,000*
Major		
At-grade	Per station	$150,000
Grade-separated	Per station	$2.5 million
Intermodal center	Per station	$12.5 million
Passing lane	Per lane-mile	$2.7 million
Vehicles		
Conventional standard	Per vehicle	$325,000
Stylized standard	Per vehicle	$350,000
Conventional articulated	Per vehicle	$570,000
Stylized articulated	Per vehicle	$780,000
Specialized BRT	Per vehicle	$1.3 million
Fare Collection		
On-board		
Magnetic card media	Per vehicle	$15,000
Smart media	Per vehicle	$20,000
Off-board		
Magnetic card media	Per machine	$60,000
Smart media	Per machine	$65,000
Passenger Information		
At-station information	Per sign	$6,000
On-board information	Per vehicle	$4,000
Branding		
Branding	Per system	Negligible
ITS Applications		
On-board security	Per vehicle	$10,000
On-board vehicle guidance		
Optical/magnetic sensors	Per mile	$20,000
Hardware integration	Per vehicle	$50,000
On-board precision docking		
Optical/magnetic sensors	Per station	$4,000
Hardware integration	Per vehicle	$50,000
On-board performance monitoring	Per vehicle	$2,000
AVL	Per vehicle	$8,000

* One direction

NOTE: Values are in 2004 U.S. dollars.

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 5-4, Transportation Research Board, 2007.

Figures 15 and 16 illustrate typical benefits of implementing BRT with various running way components and BRT station spacing and dwell times. Figure 15 summarizes the effect that running-way treatments can potentially produce, saving up to several minutes per operating mile. Signalized intersection treatments can save several seconds of bus delay per intersection, as well. Station (stop) spacing can also have an effect on running times, and changing stop spacing can produce time savings as well, as evidenced by Figure 16.

Figure 15 - Typical Effects of BRT Running Way Components

Component		Estimated Effects	Savings Compared to Base*	Comments
Off-street	Elevated	40 mph, 1.5 min/mi	4.5 min/mi	Assumed speed
	Some grade separation	35 mph, 1.7 min/mi	4.3 min/mi	Reflects wide station spacing
	At-grade	25 mph, 2.4 min/mi	3.6 min/mi	
On-street	Median arterial busway	13.3 mph, 4.5 min/mi	1.5 min/mi	Assumes no change in station spacing
	Bus lane (new construction or striping)	12.2 mph, 4.9 min/mi	1.1 min/mi	From TCRP A-23A April-June 2005 Quarterly Progress Report (*7*)
Traffic treatments	Queue bypass	—	6 sec/int	Estimated
	Curb extension	—	4 sec/int	From TC&QSM (*8*), Exhibit 4-5, 400 vehicles per hour
	TSP	—	5 sec/int	From Los Angeles, Oakland
	Special signal phase	—	—	Has important safety benefits

* Benefits are keyed to a base running speed of 10 mph (6 minutes/mile and 6 stations/mile).

NOTE: int = intersection

SOURCE: Derived from project profiles

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 5-5, Transportation Research Board, 2007.

Figure 16 - Typical Effects of BRT Station Spacing and Dwell Times

Condition		Before (6 stops per mile)	After (2 stops per mile)	Change
Same boarding times	Dwell/stop	15 seconds	15 seconds	0 seconds
	Minutes/mile	4.8	2.6	+2.2
Slower boarding times	Dwell/stop	15 seconds	20 seconds	-5 seconds
	Minutes/mile	4.8	2.7	+2.1
Faster boarding times	Dwell/stop	15 seconds	10 seconds	5 seconds
	Minutes/mile	4.8	2.4	+2.4

NOTE: Excludes traffic delays

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 5-6, Transportation Research Board, 2007.

Figure 17 - Typical Effects of Door Channels and Fare Collection Methods on Passenger Service Times

Situation	Single-Door Boarding Time (seconds/passenger)[1]
Swipe or dip card	4.5
Exact change	4.0
Smart card	3.5
Single ticket or token	3.5
Pre-payment[2]	2.5
Situation	**Single-Door Alighting Time (seconds/passenger)[1]**
Front door	3.3
Rear door	2.1
Situation	**Proportion of Basic Dwell Time[3]**
1 door channel	1.00
2 door channels	0.60
3 door channels	0.44
4 door channels	0.36
5 door channels	0.24

[1] Add 0.5 second/passenger for standees. Subtract 0.5 second/passenger for low-floor buses.

[2] Pre-payment includes no fare, bus pass, free transfer, and pay-on-exit.

[3] The dwell times in the upper two-thirds of the table are reduced to these percentages as door channels are added. For example, adding a single-channel rear door to a bus that currently has one boarding channel can reduce dwell time to 60% of the current dwell time. These percentages assume fares are prepaid and can be applied to boarding or alighting.

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 5-7, Transportation Research Board, 2007.

Figure 17 illustrates the interactions between several elements of BRT system design on ultimate passenger-handling ability. Decisions about vehicle configuration and fare collection methods need to be considered together to produce optimal operational configuration.

Figures 18 and 19 illustrate some cost-effectiveness trade-offs for BRT system design. Figure 18 summarizes cost per mile, time savings per mile, and cost per time saved for various BRT running way options. Figure 19 summarizes costs per installation, cost per mile, and time savings anticipated for various transit preferential treatments. These elements in conjunction can provide significant time and cost savings for the BRT operation.

Figure 18 - Cost and Travel Time savings of Various BRT Running Way Options

Running Way Option	Cost per Mile (millions)	Time Savings per Mile (minutes)	Cost per Minute Saved (millions)
Partially grade-separated busway	$13.00	4.30	$3.00
At-grade busway	$5.00	3.60	1.40
Median arterial busway	$4.00	1.50	2.70
Bus lane (rebuilt)	$2.50	1.10*	2.30
Bus lane (re-striped)	$0.10	1.10*	0.09
Queue bypass (add lane)	$0.30*	0.10	3.00
Curb extension	$0.24	0.27	0.90
TSP	$0.12	0.33	0.40

* May be 0.5 to 0.7 minutes/mile for higher bus operating speeds

NOTE: The base condition is a running speed of 10 mph (6 minutes/mile and 6 stations/mile).

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 5-8, Transportation Research Board, 2007.

Figure 19 - Costs and Travel Time Savings of Preferential Treatments

Treatment	Approaches per Mile	Cost/ Installation (millions)	Cost/Mile (millions)	Time Savings/ Unit (seconds)	Time Savings/ Mile (seconds)
Queue bypass (with construction)	1	$0.30	$0.30	6	6
Curb extension	4	$0.06	$0.40	4	16
TSP	4	$0.03	$0.12	3	20

Source: TCRP Report 118 Bus Rapid Transit Practitioner's Guide, Exhibit 5-9, Transportation Research Board, 2007.

BRT system planning is often considered to be a "menu" from which the operating agency chooses elements that suit the particular application being considered. This can also take the form of choosing elements for an initial starter system (Rapid Bus or BRT Light; the latter is reviewed in Section 6.2), then incrementally improving the system over time with upgrades to the running ways, vehicles, or transit priority treatments as ridership builds or as traffic congestion worsens. This is further discussed in Section 6.0.

5.2 Unit Requirements and Cost Range for Selected Technology

Capital requirements for full implementation of the service plan presented in Section 5.0 above are identified below and include vehicles, running-way and construction, signal priority, station furnishings, and a maintenance facility. The discussion on the costs for these capital items includes associated order-of-magnitude costs, with the numbers of units and costs rolled up to yield system totals at full build-out.

These costs are preliminary estimates, with actual costs being dependent on the design developed for system implementation. A proposed approach for phased implementation of the BRT system is presented in Section 6.0.

Table 15 displays preliminary capital requirements in terms of number of units and an associated cost range for the system's full build-out. The unit requirements quoted in this table were drawn from the proposed Service Plan (Section 4.0), with the unit costs based on the figures in Section 5.0. Numbers of units and unit costs (low and high estimates) are presented in Table 15 for six component categories. The table displays capital costs for both low and high estimates, and provides an overall mid-point value. Appendix E includes the basis for the quantities of the capital items related to bus stops itemized in Table 15.

5.2.1 Vehicle Requirements

The Service Plan in Section 4.0 established a need for 27 buses for full system build-out, which includes an allowance for spares. The likely breakdown for BRT operations will be 17 40-foot conventional standard buses and ten 60-foot conventional articulated buses. This will allow one of the BRT routes to be operated entirely with 60' articulated vehicles. Per vehicle cost estimates range between $350,000 and $400,000 for the former and between $550,000 and $700,000 for the latter. As indicated in Table 15, the vehicle cost sub-total for full build-out of all three BRT routes is estimated in the range of $11 million to $13 million.

Vehicle costs recur on a 12-year cycle, as FTA requirements are for buses purchased with federal funds to have a 12-year service life before they are eligible for replacement.[14] This is a consideration in planning for the capital needs of a system.

[14] Federal Transit Administration, Circular C9300.1A.

Table 15- Capital Cost Summary for Scenario 3 (Full Build-Out) [1]

Items	No. of Units	Unit Cost (000)		Total Cost (000)	
		Low	High	Low	High
Vehicles					
40-foot conventional standard	17	$350	$400	$5,950	$6,800
60-foot conventional articulated	10	$550	$700	$5,500	$7,000
60-foot stylized articulated	0	$700	$1,100	$0	$0
Subtotal Vehicles				*$11,150*	*$13,100*
Running Way Construction					
BRT median right-of-way construction – per mile	12	$5,000	$10,000	$60,000	$120,000
Queue jump lane construction	5	$350	$400	$1,750	$2,000
Freeway HOV on/off-ramps, including reconstruction of existing freeway overcrossing[2]	2	$25,000	$40,000	$50,000	$80,000
Subtotal Running Way Construction				*$111,750*	*$202,000*
Station Construction					
Platform stop in median ROW	36	$60	$100	$2,160	$3,600
Sidewalk bulb-out at bus stop	46	$65	$80	$2,990	$3,680
Pull-out at bus stop	19	$55	$70	$1,045	$1,330
Surface park-and-ride lot – cost per parking stall[3]	950	$1.5	$2	$1,425	$1,900
Structured parking (Galleria) – cost per parking stall[3]	100	$12	$15	$1,200	$1,500
Transit Center	7	$250	$2,000	$1,750	$14,000
Subtotal Station Construction				*$10,570*	*$26,010*
Signal Priority					
Install signal priority at signalized intersection – cost per intersection	73	$30	$40	$2,190	$2,920
Queue jump lane signal components	5	$10	$15	$50	$75
Signal priority - vehicle components – cost per vehicle	29	$1	$3	$29	$87
Subtotal Signal Priority				*$2,269*	*$3,082*
BRT Station Furnishings					
Simple shelters and furnishings	80	$20	$30	$1,600	$2,400
Expanded shelters and furnishings	10	$30	$40	$300	$400
Real-time passenger information system (e.g. NextBus)	50	$175	$300	$8,750	$15,000
Ticket vending machine (TVM)	10	$70	$80	$700	$800
Subtotal BRT Station Furnishings				*$11,350*	*$18,600*
Bus Maintenance Facility					
Bus maintenance facility – large (100 vehicles)	0	$25,000	$30,000	$0	$0
Bus maintenance facility – small (40 vehicles)	1	$15,000	$20,000	$15,000	$20,000
Subtotal Bus Maintenance Facility				*$15,000*	*$20,000*
Total Cost (low estimate vs. high estimate)				$162,400	$283,500
Total Cost (mid-point of cost range)				$222,950	

[1] Source for cost estimates excluding parking and the freeway ramps: South Placer County Bus Rapid Transit Service Plan, Technical Memorandum No. 2, "Technology Opportunities", prepared by URS Corporation for PCTPA, February 2008. (Figures were escalated to US$2008.)

[2] City of Roseville, California, Press Release from February 17th, 2004: Detailed Description of the Douglas/I-80 Project "A Brighter Sunrise For Douglas" coming with $35 million Interstate 80 Improvement Project

[3] Source for parking construction costs: Parking Today (2000), "Determining the Cost of an Above-Grade Parking Structure", Parking Today, May 2000, pp. 27-28. (Figures were escalated to US$2008.)

5.2.2 Running-Way Construction

As shown in Table 15, running way construction for the BRT system encompasses selected BRT median ROW construction, queue jump lane construction at several intersections, and the addition of I-80 High Occupancy Vehicle (HOV) on/off ramps, including reconstruction of the existing freeway grade separations at Roseville Parkway.

Cost estimates were obtained for two ramps, i.e., an on-ramp for the eastbound direction and an off-ramp for the westbound direction. The freeway work at I-80 is estimated to cost $25 million to $40 million per location. Per-mile BRT median transit guideway construction is estimated to cost in the range of $5 million to $10 million. Queue jump lanes would cost considerably less. Twelve miles of BRT median construction and five queue jump lanes are anticipated. Preliminary cost estimates running-way construction stands at $112 million to $202 million.

5.2.3 Station Construction

Preliminary service plan requirements for BRT stations are given by route in Appendix E. Station construction, depending on location, may comprise about 36 platform stops in median ROW, 46 sidewalk bulb-outs at bus stops, 19 pull-outs at bus stops, the addition of surface parking lots with 950 parking stalls, a 100-stall parking structure at the Galleria, and seven off-street transit centers. Assuming these quantities and the applicable cost ranges shown in Table 15, build-out costs for station construction stands at $11 million to $26 million.

5.2.4 Signal Priority

Signal priority treatments at signalized intersections are also part of the service plan. Detailed by route in Appendix C, this would encompass installation of signal priority at an estimated 73 locations, installation of queue jump traffic signal components at five locations, and on-board signal priority components for each of the 29 buses in the BRT fleet. Assuming the estimated cost ranges given in Table 15, signal priority treatments would cost in the range of $2 million to $3 million. Once signal priority is installed, it could also be used for local buses.

5.2.5 BRT Station Furnishings

Order of magnitude quantity requirements for basic stops and enhanced stops (see Section 4.2.2) are presented in Table 15, along with applicable cost ranges. The subtotal for furnishings at the BRT stops is estimated in the range of $11 million to $19 million.

5.2.6 Bus Maintenance Facility

Not specific to any given route, a bus maintenance facility will be required to house, clean, service, and repair the buses in BRT service. Depending on the institutional arrangements selected to manage and deliver the system, this may be a small maintenance facility that could accommodate the 29 BRT buses plus additional capacity for nominal growth. Alternatively, the facility could be larger (e.g., 100-bus capacity), if the BRT system is consolidated with other operations/vehicles.

A small bus maintenance facility dedicated to BRT is assumed to be needed for the purposes of costing the system. Such a stand-alone facility is estimated at between $15 and $20 million. This cost would be inclusive of administrative offices for operations and maintenance personnel, dispatch facilities and drivers' rooms.

6.0 Implementation Phasing Plan

6.1 Recommended Phasing Strategy

Like other major transit projects, it would be difficult to implement the full BRT service described in this document all at one time. BRT services are often rolled out in phases, as funding availability, right-of-way availability and other factors allow. The recommended phasing plan in this report uses the full build-out scenario in the service plan as an end point and presents a scenario for implementation in incremental phases that would culminate in the full build out. For example, a scaled-down version of the build-out scenario is first proposed as an initial starter system to get the service running, which is then expanded over time.

For the purposes of this planning effort, none of the secondary routes are included in the phasing plan. Subsequent service planning for secondary routes, including those to the cities of Rocklin and Lincoln, would be conducted at a later date, as funding becomes available and likely after full build out of the three primary routes. For example, a BRT segment to the City of Lincoln could be added to either a full-featured BRT Route 1 or 2. As part of the phasing process, any one of these secondary routes could be chosen as the route that would be implemented. This would be part of a decision made by PCTPA in consultation with the TOWG.

6.2 "BRT Light" Concept

A full BRT system would include the entire spectrum of BRT features, as defined in Section 1.0. As full implementation may not be possible immediately, due to available funding, length of construction, engineering timelines, and other factors, it can be desirable to execute a BRT program in incremental steps, incorporating only selected features at first, as allowed by available funding. This concept would be to implement a "BRT-Light" version of BRT, and this concept is integral to the phasing plan presented in this report.

Incremental implementation of BRT is one of the features that make BRT systems attractive to cities and transit operators. BRT systems can be operated initially with new vehicles but with little infrastructure investment, then incrementally upgraded as ridership builds and as funding is identified for ROW and station improvements. The first step is to get the buses operating on the streets while other BRT amenities are being developed or built. Other properties have successfully implemented BRT systems this way, such as AC Transit's Rapid Bus service, Boston MBTA's Silver Line, and Los Angeles MTA's Metro Rapid Lines.

BRT Light can consist of a variety of elements. For the purposes of the South Placer County system, BRT Light would be comprised of the following elements:

- Stylized BRT vehicles
- Mixed-flow operations
- Simple bus stops (i.e., shelter, furnishings)
- Limited traffic signal prioritization (TSP)
- Branding

Other BRT components, such as reserved running ways, median transit lanes, queue jump lanes, real-time information, and so forth, could be installed in later stages and be in place at the full build-out stage of each route.

6.3 Phasing Elements

6.3.1 Rights-of-way and Roadways

PCTPA's BRT Implementation Study for South Placer County (2006) provided a broad overview of running ways conducive to BRT operations. Roadway elements applicable to a BRT system in South Placer County at this stage of planning include median transit lanes, queue-jump lanes, and freeway on- and off-ramps.

- **Median transit lanes** are proposed for segments of BRT Routes 1 and 2 that operate in Placer County. These types of running ways are physically separated lanes within street ROWs, usually providing for more reliable travel times and speeds as buses can travel unimpeded by other modes. When using median transit lanes, buses must stop at center islands.
- **Queue-jump lanes** allow for transit vehicles to move through an intersection before other non-transit vehicles to reduce the delay caused by the signal. It is assumed that a queue jump lane with preferential signal phasing would be installed at intersections where a near-side stop is required due to the position of traffic generators.
- **Freeway on- and off-ramps** would be reconstructed to add high-occupancy vehicle (HOV) on- and off-ramps at the Stanford Ranch entrance to I-80. These HOV on- and off-ramps ramps would be used by BRT buses as well. The existing freeway grade separations at Roseville Parkway would also be reconstructed.

The BRT-Light stage of this Implementation Phasing Plan assumes that most initial BRT operations in the BRT-Light stage would be in mixed traffic. In this situation, lanes are shared between buses and automobiles, and buses stop at the curb. There is no separate running way for BRT buses. As mentioned in the Implementation Study (2006), most rubber-tired transit services operate in mixed traffic. This makes implementation less costly, but when buses share streets with other vehicles, they often face delays in congested situations. A critical step to reduce bus travel times, thereby shortening passengers' trips, would be to convert the BRT system to reserved ROW operation as soon as it is possible to fund and build the reserved ROW.

Establishing exclusive transit rights-of-way within existing roadways with extensive existing infrastructure may be difficult, as it may require retrofitting existing structures such as bridges, overpasses, freeway on and off ramps, and traffic control devices. Management of the reserved right-of-way needs to be carefully considered. In some jurisdictions, there may be interest in giving other high-occupancy vehicles (HOVs) access to the transit lanes, though this could reduce reliability for the BRT services. When planning BRT rights-of-way, consideration should also be given to possible future conversion of the right-of-way to light rail transit (LRT) service. This could influence curve radii, station platforms locations and design, or other aspects of design of the system.

6.3.2 Transit Priority

Transit signal priority (TSP) systems program traffic signal controls to give priority or advantage to approaching transit vehicles through an intersection with less delay than would have otherwise occurred. It allows transit riders to travel through congestion faster and increases the

bus' average route speed, enabling travel time savings of 3 to 15 percent.[15] Faster travel times would also help reduce operational costs and increase the productivity of the vehicles and operating staff. TSP controls would be installed at signalized intersections with BRT stops at the far side of the intersection. In situations where implementation of exclusive ROWs is not possible, TSP can offer travel time savings with a lower level of investment and can be implemented in phases.

6.3.3 Stops and Stations

The BRT-Light scenarios would include simple features at each stop location (e.g., shelter, bench, lighting, and trash can, whether it is a basic stop or an enhanced stop. Some of the enhanced stop locations, such as those proposed at the West Roseville Town Center and Placer Vineyards on BRT Route 2, are in areas currently going through the development approval process. Their build-out dates are not known at this time. The precise location, configuration, and funding sources for the BRT stops in these locations will continue to evolve. Thus, the development of these stops is planned for the implementation plan's last phase.

6.3.4 Marketing/Branding

One of the central features of a BRT system is a coordinated marketing and branding plan to convey a specific image or identity that is carried through all of the system's components. The branding can include a distinct logo or graphics with a specific color theme that should be visibly integrated into all system elements, including vehicle design, station design, running ways, signage, maps and schedules, public information materials, and other parts of the BRT system. A BRT system's branding and styling invite people to use the service. But it is the operational features, such as frequency, reliability, and timeliness that would retain users.

A BRT system's identity and branding scheme should be part of its service from inception. Accordingly, the proposed implementation plan for South Placer County BRT assumes that BRT services are initiated and operated as a differentiated service from the start, with early branding and marketing of the BRT services. Local services within the BRT service area will still be offered by Roseville Transit and PCT, with the BRT service operating as a distinct and identifiable service offering a different type of service for different markets.

Over time, it may be possible to subsume portions of the PCT network into the BRT network as additional local services are developed, allowing some of the limited-stop and express portions of the PCT service to transition to BRT operation and BRT branding. An example of this is the Auburn-to-Light Rail route, which offers a level of service similar to the service envisioned for the BRT service in terms of stop-spacing.

6.3.5 Vehicles

As BRT gains increasing popularity among transit operators, the number of bus sizes, types, and propulsion systems on the market has increased as well.[16] Two types of vehicles are proposed for the South Placer County BRT system: the 40-foot stylized standard vehicle, which has a capacity for 55 seated and standing passengers; and the 60-foot stylized articulated vehicle, which has a capacity for 83 seated and standing passengers.

[15] TCRP Report 100: Transit Capacity and Quality of Service Manual, 2nd Edition, 2003. From Exhibit 4-39 on p. 4-39.
[16] TCRP Report 118: Bus Rapid Transit Practitioner's Guide, 2007, p. 4-60.

All BRT vehicles would need to be identified with the BRT system's logo and graphics. The system's marketing and identity campaign would need to occur from the very beginning of system planning. This includes ensuring that when the BRT buses are ready to go into operation, they include the appropriate logo and graphics.

6.3.6 Park-and-Ride Lots

The planning and construction of the proposed park-and-ride lot at CSU is assumed to occur in the last phase (i.e., Phase 4) of the BRT implementation plan, due to its anticipated high costs. This phasing plan assumes that existing park-and-ride lots would be available for use by BRT passengers in Phases 1 through 3. Joint-use arrangements or agreements with the Galleria and SacRT may need to be explored and implemented so that BRT passengers can use these existing park-and-ride lots.

If park-and-ride facilities are desired during Phases 1 through 3, interim parking facilities could be arranged with adjacent owners of current parking lots in advance of constructing the dedicated BRT park-and-ride lots. In such a situation, preliminary agreements or memoranda of understanding would need to be developed with the current owners.

Park-and-ride facilities could be provided as a "management option", which would allow park-and-ride lots to be constructed as part of adjacent joint-use development, or as part of rezonings through conditional approval of modifications to existing developments. Adjoining businesses could also be permitted to sell parking permits in existing lots. All of these options could reduce the right-of-way and capital costs of BRT.

This phasing plan was developed with the assumption that Placer County may want to begin the initial phases of BRT before access to extensive funding for large infrastructure projects is available. Thus, BRT-light services could be phased-in in advance of park-and-ride facility construction. Many BRT systems are constructed without park-and-ride facilities, though for systems in suburban locations, park-and-ride facilities do extend the catchment area.

Table 16 - Park-and-Ride Lots for BRT System

Route	Stop Location	Park-and-Ride Description
Route 1	CSU Placer	Proposed; 300 spaces
	Galleria	Existing; 100 spaces
	Watt/I-80 LRT station	Existing; 240 spaces
Route 2	CSU Placer	Proposed; 300 spaces
	Galleria	Existing; 100 spaces
Route 3	Galleria	Existing; 100 spaces
	Hazel LRT station	Existing; 430 spaces
	Sunrise LRT station	Existing; 490 spaces

6.4 Phasing Scenarios

This section outlines the proposed phasing plan for the entire BRT system network for South Placer County, which is summarized in Table 17. The implementation plan consists of four phases, with the fourth phase representing the full build out of Scenario 3 of the BRT system from the Transit Master Plan (2007). The three proposed primary routes would be implemented in various forms as the implementation phases progress, with subsequent enhancements over time as funding becomes available, as development occurs in the area, and/or as passenger demand increases.

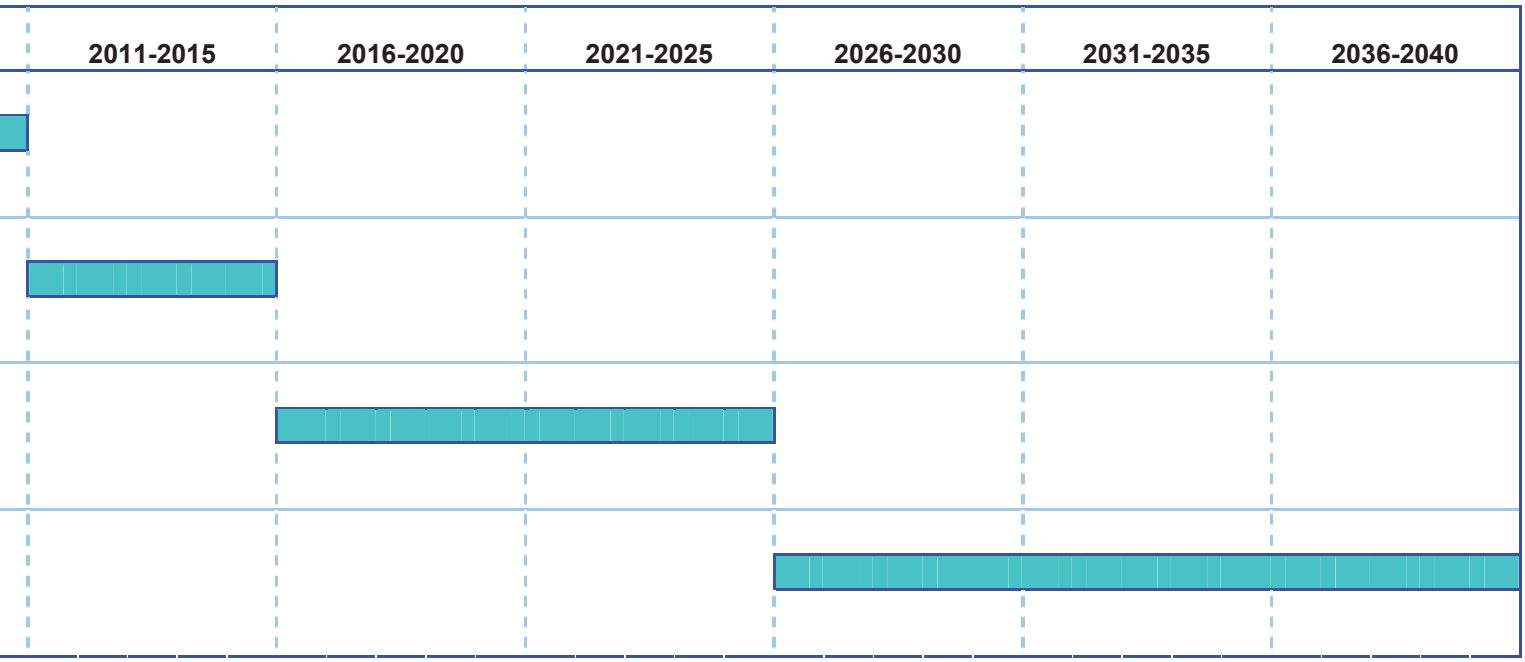
The phasing in this report differs from that found in the Transit Master Plan (TMP). The TMP is a long-range plan for the five transit providers operating in South Placer County that is used as a policy guideline for transit service in this area. It presents three scenarios that are primarily driven by projected population and employment growth assumptions for 2040. Additionally, the analyses and recommendations in the Transit Master Plan are explicitly not intended for transit service planning and operations. The phasing strategy presented in this current report was developed based on the Transit Master Plan's scenarios, but was primarily focused on the logical sequencing of BRT services in light of operational factors; existing and planned development; funding availability; and other factors. A preliminary timeline for the phasing scenario is shown in Figure 18.

Table 17 - Proposed Phasing Plan for BRT System

	Routes	Cost Drivers	Configuration
Phase 1	BRT 1 Light (short): CSU – Galleria BRT 3 Light: Galleria – Sunrise LRT	Weekday headways 30 minutes during peak 60 minutes during off-peak Weekend and holiday headways 60 minutes	BRT vehicles Mixed-flow running operations Simple bus stops
Phase 2	BRT 1 Light: CSU – Watt/I-80 LRT BRT 3 Light: Galleria – Sunrise LRT	Weekday headways 30 minutes during peak 60 minutes during off-peak Weekend and holiday headways 60 minutes	BRT vehicles Mixed-flow running operations Simple bus stops Limited TSP
Phase 3	BRT 1 Light: CSU – Watt/I-80 LRT BRT 2 Light: CSU – Watt/I-80 LRT BRT 3 Light: Galleria – Sunrise LRT	Weekday headways 30 minutes during peak 60 minutes during off-peak Weekend and holiday headways 60 minutes	BRT vehicles Mixed-flow running operations Simple bus stops Limited TSP
ario 3	BRT 1 (full build out): CSU – Watt/I-80 LRT BRT 2 (full build out): CSU – Watt/I-80 LRT BRT 3 (full build out): Galleria – Sunrise LRT	Weekday headways 15 minutes during peak 30 minutes during off-peak Weekend and holiday headways 30 minutes	BRT vehicles All transit priority, reserved ROW lanes, transit centers, etc. in place

(2007)

Table 18 - Conceptual Timeline for BRT Implementation Phasing Plan



6.4.1 BRT System Phase 1

This first phase of BRT would include a reduced (or "BRT-Light") versions of BRT Routes 1 and 3. It would consist of travel between CSU and the Galleria on BRT-1 (Light) and between the Galleria and Sunrise LRT for BRT-3 (Light). No segment of BRT Route 2 would be operational during this phase. BRT-1 (Light) riders would transfer at Galleria to PCT service to reach Watt/I-80 LRT.

Weekday headways would be 30 minutes during peak hours and 60 minutes during off-peak hours. Headways during the weekends and holidays would be 60 minutes. Buses would travel in shared streets with other vehicles (i.e., mixed-flow operations), and simple stops consisting of a shelter, bench, lighting, and trash can would be provided. TSP treatments would not be implemented on either route at this time.

The round-trip cycle times during this initial phase would be about 69 minutes for BRT-1 (Light) and approximately 111 minutes for BRT-3 (Light), as shown in Table 19.

Table 19 - Cycle Times for BRT System Phase 1

Phase 1 Routes	One-way travel time (minutes)	Total travel time (minutes)	Recovery time (15%)	Cycle time (minutes)
BRT 1 Light (short): CSU – Galleria	30	60	9	69
BRT 3 Light: Galleria – Sunrise LRT	48	96	15	111

Nine vehicles would be needed to operate both of these routes in Phase 1, as shown in Table 20. This number includes a 20% spare ratio for two spare vehicles.

Table 20 - Vehicle Requirements for BRT System Phase 1

BRT 1 Light (short): CSU – Galleria	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	69	30	3
9:00 AM – 3:00 PM (Off-peak)	69	60	2
3:00 PM – 6:00 PM (Peak)	69	30	3

BRT 3 Light: Galleria – Sunrise LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	111	30	4
9:00 AM – 3:00 PM (Off-peak)	111	60	2
3:00 PM – 6:00 PM (Peak)	111	30	4

Sub-total vehicles required during peak hours	7
20% spare	2
Total vehicles required	9

It is anticipated that this phase could occur from 2009 – 2010, depending on funding availability and the progress of development in this area.

6.4.2 BRT System Phase 2

The second phase of the implementation plan would be identical to the Phase 1, with some key upgrades:

- Operating BRT-1 (Light) to run from CSU to the Watt/I-80 LRT station. (This represents the route's full line at build out.) BRT-1 (Light) would assume operation of the Galleria-Watt/I-80 LRT portion of the current PCT Auburn-Light Rail route.
- TSP would be installed at selected stop locations in Placer County for both BRT-1 (Light) and BRT-3 (Light).

No segment of BRT Route 2 would be operational during this phase.

The upgrades during Phase 2 would change the round-trip cycle times and vehicle requirements. The round-trip cycle time would be 113 minutes for BRT-1 (Light). Installation of some TSP treatments would reduce BRT-3 (Light)'s round-trip cycle time from 111 minutes in Phase 1 to 109 minutes during Phase 2. These numbers are shown in Table 21.

Table 21 - Cycle Times for BRT System Phase 2

Phase 2 Routes	One-way travel time (minutes)	Total travel time (minutes)	Recovery time (15%)	Cycle time (minutes)
BRT 1 Light: CSU – Watt/I-580 LRT	49	98	15	113
BRT 3 Light: Galleria – Sunrise LRT	47	94	15	109

Ten vehicles would be needed to operate BRT-1 (Light) and BRT-3 (Light) in Phase 2, as shown in Table 22. This number includes two spare vehicles.

It is anticipated that Phase 2 could occur from 2011 – 2015, depending on funding availability and the progress of development in this area.

Table 22 - Vehicle Requirements for BRT System Phase 2

BRT 1 Light: CSU – Watt/I-580 LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	113	30	4
9:00 AM – 3:00 PM (Off-peak)	113	60	2
3:00 PM – 6:00 PM (Peak)	113	30	4

BRT 3 Light: Galleria – Sunrise LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	109	30	4
9:00 AM – 3:00 PM (Off-peak)	109	60	2
3:00 PM – 6:00 PM (Peak)	109	30	4

Sub-total vehicles required during peak hours	8
20% spare	2
Total vehicles required	10

6.4.3 BRT System Phase 3

Phase 3 would build on the previous phases by adding operation of BRT-2 (Light) from CSU Placer to the Watt/I-80 LRT station and including TSP treatments on this route's intersections in Placer County and simple stop locations. Operations for BRT-1 (Light) and BRT-3 (Light) in this phase would be the same as in Phase 2, and all routes would operate in mixed traffic.

Weekday headways for all three routes in Phase 3 would be 30 minutes during peak hours and 60 minutes during off-peak hours. Headways during the weekends and holidays would be 60 minutes.

Cycle times for all three routes in Phase 3 are shown in Table 23. BRT Routes 1 and 2 would each have a round-trip cycle time of 113 minutes. BRT-3 (Light)'s round-trip cycle time would be 109 minutes.

Table 23 - Cycle Times for BRT System Phase 3

Phase 3 Routes	One-way travel time (minutes)	Total travel time (minutes)	Recovery time (15%)	Cycle time (minutes)
BRT 1 Light: CSU – Watt/I-580 LRT	49	98	15	113
BRT 2 Light: CSU – Watt/I-580 LRT	49	98	15	113
BRT 3 Light: Galleria – Sunrise LRT	47	94	15	109

Table 24 - Vehicle Requirements for BRT System Phase 3

BRT 1 Light: CSU – Watt/I-580 LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	113	30	4
9:00 AM – 3:00 PM (Off-peak)	113	60	2
3:00 PM – 6:00 PM (Peak)	113	30	4

BRT 2: CSU – Watt/I-580 LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	113	30	4
9:00 AM – 3:00 PM (Off-peak)	113	60	2
3:00 PM – 6:00 PM (Peak)	113	30	4

BRT 3 Light: Galleria – Sunrise LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	109	30	4
9:00 AM – 3:00 PM (Off-peak)	109	60	2
3:00 PM – 6:00 PM (Peak)	109	30	4

Sub-total vehicles required during peak hours	12
20% spare	3
Total vehicles required	15

A total of 15 vehicles would be needed to operate the BRT system in Phase 3, as shown in Table 24. This number includes three spare vehicles.

It is anticipated that Phase 3 could occur from 2016 – 2025, depending on funding availability and the progress of development in this area.

6.4.4 BRT System Phase 4 (Full build out)

Phase 4 represents a full build out of all three primary BRT routes. Full build out would include all BRT attributes, including reserved ROWs in Placer County; TSP and queue jump lanes installed at designated locations; and station furnishings for basic and enhanced stop locations.

In this phase, headways for all three routes would be 15 minutes during peak periods and 30 minutes during off-peak hours on weekdays, and 30 minutes all day on weekends and holidays. These headway assumptions were established in the BRT Implementation Study for South Placer County (2006). The round-trip cycle time would be 99 minutes for BRT-1; 102 minutes for BRT-2; and 104 minutes for BRT-3, as shown in Table 25.

Table 25 - Cycle Times for BRT System Phase 4
(Full Build Out of All Routes)

Phase 4 Routes	One-way travel time (minutes)	Total travel time (minutes)	Recovery time (15%)	Cycle time (minutes)
BRT 1: CSU – Watt/I-580 LRT	43	86	13	99
BRT 2: CSU – Watt/I-580 LRT	44	88	14	102
BRT 3: Galleria – Sunrise LRT	45	90	14	104

Full build out of the three BRT routes would entail 27 vehicles, as summarized in Table 26. This number includes five vehicles that would be used for standby.

Table 26 - Vehicle Requirements for BRT System Phase 4
(Full Build Out of All Routes)

BRT 1 (Full build out): CSU – Watt/I-580 LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	99	15	7
9:00 AM – 3:00 PM (Off-peak)	99	30	4
3:00 PM – 6:00 PM (Peak)	99	15	7

BRT 2 (Full build out): CSU – Watt/I-580 LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	102	15	8
9:00 AM – 3:00 PM (Off-peak)	102	30	4
3:00 PM – 6:00 PM (Peak)	102	15	8

BRT 3 (Full build out): Galleria – Sunrise LRT	Cycle time (minutes)	Headways	Vehicles Needed
6:00 AM – 9:00 AM (Peak)	104	15	7
9:00 AM – 3:00 PM (Off-peak)	104	30	4
3:00 PM – 6:00 PM (Peak)	104	15	7

Sub-total vehicles required during peak hours	22
20% spare	5
Total vehicles required	27

It is anticipated that Phase 4 could occur from 2026 – 2040, depending on funding availability and the progress of development in this area.

6.5 Issues to be Considered During Phasing Implementation

6.5.1 Coordination with Operators

Roseville Transit, PCT, and SacRT currently provide transit services within the BRT system's proposed service area. While it is PCTPA's intent that the BRT network function as an overlay on the existing local transit network to complement current routes, some consolidation may be desirable to increase efficiencies.

For example, RT's Route 109 provides weekday service on Hazel Avenue (Sacramento County), with two one-way trips during the morning commute hours and two one-way trips during the afternoon commute. Roseville Transit plans to introduce a commute route along Sierra Blvd. (Placer County) in fall 2008 with two peak hour trips in each direction that could be consolidated with RT's Route 109. Such a consolidation would need to be negotiated between RT and Roseville Transit. When BRT Route 3 becomes operational, it could potentially replace both operators' lines in this corridor.

The other major integration opportunity is to integrate portions of PCT's current routes into the BRT system, provided that sufficient local service coverage remains. PCT's Auburn-Light Rail route currently operates between Galleria and Watt/I-80 Light Rail with only one stop, at the Orlando Transit Center. Potentially, this portion of the route could be attached to the portion of BRT 1 Light between CSU Placer and Galleria. This could provide some cost efficiencies in starting up BRT service, especially if PCT is the agency designated as the BRT operator.

Similarly, BRT operations, stops, and right-of-way configuration on Watt Avenue needs to be coordinated with Sacramento RT. RT operates multiple bus lines on Watt Avenue, and services may overlap in areas.

6.5.2 Coordination with Sacramento County

As all the proposed BRT routes will travel in streets in northern Sacramento County, it would be necessary to hold discussions related to planning and implementation with County staff. Relevant topics would include attainment of bus running ways, installation of TSP devices, amongst other things.

6.5.3 Coordination with Land Development Projects in Placer County and City of Roseville

Many segments of the BRT network are planned for portions of the street network that are currently being developed. The ultimate land uses and street configurations in these areas are key factors in determining how the BRT system would operate in these locations. This is especially true of the developments for CSU Placer and West Roseville Town Center, as major stop locations are proposed within these properties, and the BRT system's circulation patterns would be determined by these developments' street layouts.

City of Roseville and Placer County staff have designated BRT ROW within the new streets identified in the 2006 BRT Implementation Plan and have informed developers of PCTPA's plans for BRT in these areas. As the developers' plans proceed through the entitlement process, PCTPA and the BRT operating agency will need to work with the developers to ensure that the proposed BRT system and the development plans complement one another. This is

especially important for elements of the developments such as pedestrian access to bus stops and locations of bus stops.

6.5.4 Availability of Funding Sources

Phases 1 through 3 represent incremental system phases that could be implemented in advance of funding becoming available for construction of BRT guideways. The “BRT-Light” concepts envisioned for these phases would require capital funds for vehicles and simple stop improvements and operating funds, but not for major capital construction. As funding becomes available for more extensive capital improvements, ROW improvements can be undertaken. These can also be done incrementally on a route-by-route basis, or even at selected locations within each route based on where delays and reliability problems occur. The funding aspects of the phasing of BRT implementation are explored in detail in the financial plan presented in Section 8.0 below.

6.5.5 Right-of-way Width and Configuration on Ramps to SR-65 and Bridges over SR-65

BRT Route 1 includes travel on SR-65. The ramps to this highway currently consist of one-lane on- and off-ramps. The current configuration would not be sufficient to provide BRT stations as envisioned at Corporate Center. In order to construct this station, widening of the roadway or the bridge structure may be needed, or additional ROW may need to be acquired if this station is to be built on Blue Oaks. The existing freeway grade separations for Blue Oaks, Pleasant Grove and Stanford Ranch may also need to be reconstructed if the reserved median ROW is carried across the bridge structures. Costs for rebuilding these structures have not been included to date in the capital needs analysis.

6.5.6 Other Infrastructure

BRT Route 1 also includes travel on Blue Oaks Avenue over Industrial and the Union Pacific Railroad. This bridge would need to be widened to accommodate adding a BRT right-of-way to this portion of Blue Oaks Avenue.

6.6 Trade-Offs

While BRT treatments such as TSP can improve transit service performance, trade-offs are likely when such features are implemented. These trade-offs can include but are not limited to the following:

- Reserving rights-of-way for BRT service dedicates that space to transit use, and ensures that the transit operation can be operated reliably even when parallel traffic is congested. It does mean, however, that that space cannot also be used for expanded numbers of lanes or parking uses.
- TSPs may subtly disrupt signal progression by lengthening or shortening the green aspect for a few minutes each hour. Most drivers may never notice the change, however there will be a few drivers every hour who experience a few seconds of additional delay because of this. The window of disruption will extend for several minutes past when the priority is given, as it takes a few signal cycles for the program to return to the standard operation. With 15, 30 or 60-minute headways, this effect should not be very noticeable. The trade-off is that the transit system riders

experience faster travel times, more closely resembling auto travel times, and the transit agency receives better utilization of its vehicles and operators.

Buses have traditionally not received as much priority as rail projects, however a national focus on BRT is demonstrating that buses can provide a similar level of service to light rail, given the application of priority treatments where warranted. Given projected increases in population and congestion in Placer County as well as growing concerns about climate change, it is reasonable to advocate for projects, such as BRT, that seek to curb congestion and automobile emissions. If implemented strategically and meaningfully, BRT's benefits may make trade-offs such as those listed above worthwhile in the long-term.

7.0 Management Model

This proposed BRT system would be regional in scope, serve multiple communities, and complement development throughout the County. If public transit is used to foster and complement desired development patterns on that scale, it is logical that BRT implementation and management should be under the auspices of a multi-jurisdictional agency. Four alternative structures that meet these criteria have been proposed to PCTPA to administer the start-up and operation of BRT services: PCT, Roseville Transit, or a new multi-jurisdictional entity managed by an existing transit operator, such as Roseville Transit. In addition, an existing JPA, such as SPRTA, could be modified to become the operator of the system.

When an institutional model for the BRT system has been chosen, PCTPA and other stakeholders would need to analyze the integration of service to include elements, such as storage, maintenance, schedules, routes, dispatching, information center, fares, transfers, amongst other things.

7.1 Storage and Maintenance Issues

The Transit Master Plan for South Placer County (June 2007) was completed recently for the Placer County Transportation Planning Agency (PCTPA). This Transit Master Plan for South Placer County dealt with the five existing independent but cooperating provider agencies: Auburn Transit; Lincoln Transit System; PCT; Roseville Transit; and CTSA.

The Transit Master Plan concluded that forecast demand, operations and fleet requirements for future transit in Placer County (including BRT) would exceed the capacities of existing storage and maintenance facilities. The forecast service requirements would necessitate provision of greater maintenance capacity and operational capabilities. In this context, the Transit Master Plan identified three consistent needs for public transit in South Placer County:

- Consolidation of maintenance for multiple operators;
- Upgrade of capabilities to accommodate modern new technologies; and
- Rationalization of operations to better utilize maintenance and storage facilities based on service density and/or vehicle types.

The need for more maintenance capacity would be particularly pronounced for PCT and Roseville Transit, the two largest properties, and those best positioned (organizationally and geographically) to administer BRT services.

The following sections discuss alternative institutional arrangements on the basis of the potential efficiencies they offer in managing forecast increases in services and fleets, and how BRT services may be administered in each context.

7.2 Background to Institutional Arrangements

The Transit Master Plan for South Placer County addresses such considerations as maintenance facility capacity, fleet size and composition, institutional structures and agency integration, relative to all transit services in South Placer County. The Transit Master Plan presents "integration" as a range of institutional strategies that could potentially yield efficiencies in bus transit operation and maintenance. The plan puts forward a number of institutional arrangements, principally:

- Establishment of a new umbrella transit agency (requiring State enabling legislation);
- Consolidation of existing properties/operators under a single operating entity;
- Establishment of a Joint Powers Authority with representation from all involved entities; and
- Provision of contract services through concessionaire under the auspices of PCT.

A number of opportunities for greater efficiency and economy were cited as rationales for institutional integration, including:

- Efficient allocation of operating and maintenance resources;
- Integration of schedules and routes;
- Centralized dispatching;
- Improved regional connectivity and passenger convenience;
- Integration of policies and procedures; and
- Centralized information management.

This report uses the fleet requirements of South Placer County's transit operators as a surrogate for forecast growth of services, administrative needs, and facility requirements.

7.2.1 Inventory of Transit Vehicles: Current

The Transit Master Plan for South Placer County (2006) inventories then existing vehicle fleets for the five aforementioned service providers. It also estimates vehicle requirements by categories of service for a horizon year build-out scenario. Table 27 below (adapted from the Transit Master Plan) furnishes an inventory of transit vehicles by type by operator. The inventory figures are updated from that given in the most recent (2005) Short Range Transit Plans (SRTPs). Although PCT and Roseville Transit both operate commuter services, no BRT service is currently offered.

Table 27 - South Placer County Transit Operators – Current Vehicle Inventory

Operator	Fixed Route (Diesel)	Fixed Route (CNG)	Commuter	Dial-a-Ride	TOTAL
Auburn Transit	2*	3	–-	–-	5
Lincoln Transit	4	–-	–-	–-	4
Placer County Transit	9**	10**	2***	–-	21
Roseville Transit	7	8	7	12	34
CTSA	–-	–-	–-	33	33
TOTAL	**22**	**21**	**9**	**45**	**97**

* Gasoline-powered
** Current figures are 3 and 13, respectively
*** Contractor-provided

Source: PCTPA Transit Master Plan for South Placer County, June 2007

7.2.2 Inventory of Transit Vehicles: Future

The Transit Master Plan also projects vehicle requirements by category of service for three horizon year build-out scenarios, shown below in Table 28 (adapted from the Transit Master Plan). Figures on current vehicles are updated from that given in the most recent (2005) SRTPs. Operation of all three BRT routes is estimated in the Transit Master Plan to require 12 buses in Scenario 3, though this current BRT service plan yields a different fleet requirement – 27 BRT vehicles instead of the 12 envisioned in the 2007 report. The far right column in Table 28 adds the fleet requirements from the current Service Plan to the TMP totals in the column titled “Modified Scenario 3”.

The next round of SRTPs to be prepared by the Placer County transit service providers will address BRT implementation. Should the County and local transit operators agree on this course of action, BRT implementation and phasing, possibly including operation of a demonstration service, should be addressed in the SRTP of the designated individual agency. As PCT or Roseville Transit are two examples of appropriate existing agencies to assume this responsibility, BRT implementation should be addressed in the next SRTP completed by PCT or Roseville Transit .

Table 28 - Horizon Fleet Year Sizes by Service Type, Operator and Scenario

Category of Service	Current	TMP Scenario 1	TMP Scenario 2	TMP Scenario 3	Modified Scenario 3
Local Fixed Route	**43**	**125**	**156**	**236**	**236**
Auburn Transit	5	6	6	6	6
Lincoln Transit	4	18	23	25	25
Placer County Transit	19	81	107	175	175
Roseville Transit	15	20	20	30	30
Commuter	**9**	**17**	**17**	**30**	**30**
Placer County Transit	2	2	2	5	5
Roseville Transit	7	15	15	25	25
Dial-A-Ride	**45**	**100**	**100**	**100**	**100**
Roseville Transit	12	21	21	21	21
CTSA	33	79	79	79	79
BRT	**0**	**2**	**4**	**12**	**27**
TOTAL	**97**	**244**	**277**	**378**	**393**

A comparison of Table 27 and Table 28 indicates an estimated *four-fold* increase in overall bus fleet requirements from 2006 through build-out of Scenario 3. Local fixed route would account for 62 percent of the Scenario 3 total vehicle requirement; dial-a-ride for 26 percent; and commuter for 8 percent of the total. BRT vehicles would only account for a small (3 percent) proportion of the total future fleet requirement, although they would be an important component of overall transit service to the region. The PCTPA Board adopted Scenario 2 as the recommended scenario, which requires the acquisition of four BRT vehicles. This Service Plan considers a fleet total of 27 BRT vehicles at full build-out.

7.2.3 Assessment of Current Maintenance Facilities

In considering institutional arrangements for administering BRT services in Placer County, a primary concern is providing for storage and maintenance of the vehicles. PCT and Roseville Transit are each well located to administer BRT services, given (a) their proximity to the three planned BRT routes, and (b) that these two agencies are the largest transit providers in the County. The Transit Master Plan for South Placer County assesses their respective abilities to store and service additional vehicles at their existing yards. Each facility is essentially already at capacity, unable to accommodate the needed increases in vehicles pursuant to Table 28 without significant facility expansion and improvement. The 12 vehicles estimated for build-out of Scenario 3 could not be accommodated at any of the present facilities. The 27 vehicles estimated for full build-out of the phased implementation of BRT could similarly not be accommodated.

In addressing institutional questions, the Transit Master Plan identified “management efficiency” and “capacity of garages” as two particularly critical issues. The need for some degree of integration was noted to yield greater efficiency and standardization of vehicle types, procurement, fleet maintenance, dispatch and new technology programs. The most recent SRTPs for Placer County transit operators indicate that PCT and Roseville Transit bus facilities currently lack the capacity to accommodate the number of additional vehicles that would be required for considerably enhanced or new services, including BRT. It is further noted that provision of new capacity under current institutional models may not yield the most efficient location or specification (size etc.) for a new facility.

Short of creating a new organization to exclusively administer BRT in South Placer County, such as a concession-based approach under the auspices of the PCTPA, decisions on housing and maintaining BRT vehicles must be considered in light of the forecast growth in other transit service types.

7.3 Options for Institutional Arrangements

In considering forecast growth of transit services in South Placer County, the Transit Master Plan presents a range of institutional models that could be applied to the consolidation of transit services. The five alternative models that were compared are described in Table 29. The alternative approaches in Table 29 are meant primarily to address the overall consolidation of transit services issue, not just BRT. However, short of creating a new organization or establishing a subsidiary agency to exclusively administer BRT services, a decision on institutional framework for BRT should not be divorced from decisions on institutional arrangements for overall transit services, especially over the longer term.

Depending on the timing for expansion of all transit services, BRT could be the first major element of transit expansion in South Placer County that requires a new institutional arrangement. The initial three-line BRT system envisioned in this planning process could be a starter BRT system for the County and thus should not be viewed as the ultimate system. Therefore, even though this initial system would serve only a portion of the county, a consideration of institutional arrangements needs to acknowledge that the system may eventually grow beyond the initial jurisdictions.

Table 29 - Comparison of Institutional Models for Transit Service Consolidation

Alternative and Examples	Advantages	Disadvantages
1. Establish a new umbrella transit agency via State legislation.	▪ Responsibilities, powers, terms, structures, etc. can be specifically defined according to needs and objectives. ▪ Ability to grant new powers to the Agency. ▪ Legislation legitimizes project and agency at state government level. ▪ Certain critical terms and provisions can be locked into statutory language. ▪ Independent entity, not beholden to interests of representative agencies.	▪ Significant time to legislate and establish. ▪ Uncertainty of legislative process. ▪ Changes require legislation.
2. Consolidate the existing powers and authorities of several operators under one of the existing agencies.	▪ Builds on capabilities and credibility of existing entity. ▪ Legislation legitimizes project and agency at state government level. ▪ Ability to consolidate staffs in certain operations areas (i.e. accounting, human resources) thus reducing expenditures. ▪ Costs associated with administration of services by individual jurisdictions could be reduced by elimination of duplicated efforts.	▪ Time to legislate and establish. ▪ Added responsibility may create or imply conflict with basic charter of agency. ▪ Existing transit agencies may not agree with approach and potential difficulties in coming to an agreement among all jurisdictions involved. ▪ Potential need for additional specialized staff such as road supervisors for the additional expanded service.
3. Establish a new joint powers agency (JPA) comprising representation from all operating entities.	▪ Does not require legislation, sponsorship, electoral approval. ▪ JPA can adopt all the powers of its constituent agencies ▪ Management may be delegated or contracted. ▪ Dedicated policy and management body geared solely to program objectives. ▪ Conflicts can be resolved expeditiously depending on the nature of the implementing agreements. ▪ Costs associated with administration of services by individual jurisdictions could be reduced by elimination of	▪ Decisions can require consensus agreement. ▪ Goals of JPA may be frustrated by one or more of the constituent agencies. ▪ Creation can be time and resource consuming. ▪ Detailed legal and administrative nature of a JPA can sometimes lead to greater administrative costs and delays. ▪ Existing transit agencies may not agree with approach and potential difficulties in coming to an agreement among all jurisdictions involved.

Alternative and Examples	Advantages	Disadvantages
	duplicated efforts.	
4. Execute a memorandum of understanding (MOU) among operating entities.	▪ Simplicity – does not require legislation or new structure. ▪ Flexibility – structure defined by whatever agencies can legally agree to. ▪ Ability to acquire services and development of a coordinated and centralized administration without legal, political and administrative complexity. ▪ Relatively low-cost method of improving transit services in the region.	▪ Institutions may be vulnerable to disagreements. ▪ Inability to independently implement transit improvements. ▪ Added responsibility may create or imply conflict with basic charter of agency. ▪ Interest of service usually subordinate to those of MOU signatories. ▪ Decisions can require consensus agreement. ▪ No identifiable entity visible to the public.
5. Establish a subsidiary to the PCTPA to jointly operate and manage County transit services.	▪ Builds on capabilities and credibility of existing entity. ▪ Separate subordinate need not detract from parent agency's functions. ▪ Parent agency defines structure, roles, and responsibilities. ▪ Costs associated with administration of services by individual jurisdictions could be reduced by elimination of duplicated efforts.	▪ Parent agency not protected from liability or risk of subordinate. ▪ Does not consolidate transit services, thus increasing costs. ▪ Can lead to duplicate transit services. ▪ Existing transit agencies may not agree with approach and potential difficulties in coming to an agreement among all jurisdictions involved.

7.4 Applicability of Institutional Arrangements

Many different models exist within California for how transit services are organized and managed institutionally, and no one model provides all of the answers for a successful operation. From the passenger's perspective, integration of BRT from the outset with other service types – including integration of scheduling and operations, fares, passenger information, transfer stations and transit marketing is essential to the success of the service. Equally important, but perhaps invisible to the rider, is the work of managing the system, which is a function of the institutional arrangements.

One logical institutional model for managing the BRT service would be for one of the existing transit operators in Placer County, such as PCT or Roseville Transit, to operate the BRT services as an integrated operation with BRT and local bus in the same organization. This type of arrangement would ensure that the bus drivers on the local runs are familiar with BRT services and vice versa, better enabling the drivers to inform patrons about both types of services and allowing good opportunities for coordination of system planning.

If BRT is to be phased in over time as demand increases, it makes sense for operations to reside with an existing operator, such as PCT or Roseville Transit, which are agencies positioned, staffed, funded and equipped to introduce incremental changes over time. An

analogous case is that of the "Rapid" service in Alameda County, where AC Transit has already introduced "BRT Light" (i.e. "Rapid") services and is intending to implement *full* BRT as the more capital-intensive BRT projects are developed through the environmental process, then permitted and funded. Having the initial "BRT Light" services operated by the same operator as the future BRT services ensures that incremental service improvements can take place under the umbrella of a single agency, and thus be well integrated in terms of fares, schedules, and passenger information.

A second institutional model to consider would be the formation of a Joint Powers Authority (JPA) or execution of a Memorandum of Understanding (MOU), which would enable the communities served and affected by BRT operations to plan and oversee those services. Given that BRT operations are planned to serve multiple communities in a particular section of Placer County, it is appropriate to consider institutional structures that will enable those communities to participate in BRT service planning and management. In either case, it is common in the transit industry for one of the participating agencies in the JPA or the MOU to assume responsibility for day-to-day management of the service. In the case of the Caltrain service operated by the Peninsula Commute Joint Powers Board (JPB), San Mateo County provides administrative resources and facilities for managing the service that is owned by a three-county. Either Roseville Transit or PCT could assume this role in administering BRT operations in South Placer County if a JPA or MOU were formed to operate the BRT service.

A third model would be a contract model for BRT service provision, in which an existing agency would sponsor and manage a concession contract exclusively for BRT. This might make sense in the short run, but over the longer term, integration with other service types and other operators will become vital – yet it may be difficult to integrate once BRT has already been up and running as an independent service. A desire to maintain status quo may render this integration more difficult later.

A fourth model would be to amend an existing JPA for a non-operating agency, such as SPRTA. SPRTA could receive operating authority under such a JPA, and potentially contract for the service operation with PCT, Roseville Transit, or some other entity.

7.5 Preliminary Conclusions for Institutional Model

This above discussion provides an overview of institutional arrangements before complete information about the scale of the BRT operation has been developed. Management and institutional questions can be fully addressed when fleet and facility size are determined and when financial and implementation plans have been prepared. While these conclusions regarding institutional structure are preliminary, several key findings have emerged:

- BRT and local bus services will be better integrated if they are operated by the same agency; coordinating fares, schedules, passenger information, dispatching and driver familiarization.

- A demonstration deployment of BRT should be administered by an existing transit agency already serving South Placer County.

- Phased implementation of BRT will be accomplished most successfully if one agency handles the transition from stage to stage.

- A starter BRT system serving only Roseville, Rocklin, and the County will likely expand service to more jurisdictions in the future. For example, the City of Lincoln has requested expansion with a route serving Lincoln.

- The municipal transit service providers in the County have already considered the potential of consolidation. The Transit Master Plan for South Placer County concludes that consolidation of transit infrastructure and services would, owing to economies of scale, yield a more efficient transit system and structure, enabling provision of route services in a more cost-effective fashion.

- The County is developing rapidly, with growth pressures creating the need to consider the role transit will play in the County's transportation system over the next 30 years. Determining the vision for transit in Placer County over the long term needs to be carried out at the County level – first and foremost with PCTPA – given its countywide transportation planning and decision-making mandate. As stated at PCTPA's website:

  > *"Placer County Transportation Planning Agency (PCTPA) is the forum for making decisions about the regional transportation system in Placer County. The decisions made are reflected in PCTPA's planning and programming of the area's state and federal transportation funds. In developing and adopting plans and strategies, we not only make the best use of these funds, but also fulfill the requirements of our state designation as the Regional Transportation Planning Agency (RTPA) for Placer County."*

- Given their geographic jurisdictions, funding, and existing roles as a transit service providers, PCT and Roseville Transit are the most appropriate existing agencies to consider for undertaking BRT service implementation.

- As noted, geographic expansion of BRT, commuter, fixed route, and other transit service types should be anticipated over time. This is certainly likely to include additional BRT beyond the Rocklin and Roseville areas. Such future demand for geographic expansion of services may mean that a new or amended JPA would be an appropriate operating entity for the BRT services.

8.0 Financial Plan

8.1 Capital Costs and Operating and Maintenance Costs

A summary of capital and operating costs for the proposed implementation phasing (presented in Section 6.0) is provided in Tables 30 and 31. The costs shown in these tables were developed as a proposed phased implementation strategy leading from initial implementation of starter BRT services ("BRT Light"), with minimal infrastructure in Phase 1, through full implementation of BRT on three lines in Phase 4, as envisioned in the BRT Implementation Study for South Placer County (2006).[17, 18]

[17] South Placer Regional Transportation Authority, Bus Rapid Transit (BRT) Implementation Study for South Placer County, prepared by Fehr & Peers, September 2006.

[18] SPRTA was included as a potential funding source in previous planning documents. However, money from this agency has been reallocated to an HOV project on I-80 and would not be available for BRT.

Table 30 - Summary of Estimated Capital Costs by Phase
In Constant 2008 dollars ('000)

		Vehicles*		Stops/ Stations		ROW Improvements		Signal Priority		Total Capital Cost	
		Low	High	Low	High	Low	High	Low	High	Low	High
Phase 1	BRT 1 Light (short)	$1,400	$1,700	$220	$330	$0	$0	$0	$0	$1,620	$2,030
	BRT 3 Light	$1,750	$2,125	$400	$600	$0	$0	$0	$0	$2,150	$2,725
	Subtotal	$3,150	$3,825	$620	$930	$0	$0	$0	$0	**$3,770**	**$4,755**
Phase 2	BRT 1 Light	$1,750	$2,125	$280	$420	$0	$0	$136	$185	$2,166	$2,730
	BRT 3 Light	$1,750	$2,125	$400	$600	$0	$0	$329	$446	$2,479	$3,171
	Subtotal	$3,500	$4,250	$680	$1,020	$0	$0	$465	$631	**$4,645**	**$5,901**
Phase 3	BRT 1 Light	$2,025	$2,685	$280	$420	$0	$0	$136	$185	$2,441	$3,290
	BRT 2 Light	$2,025	$2,685	$360	$540	$0	$0	$151	$208	$2,536	$3,433
	BRT 3 Light	$2,025	$2,685	$400	$600	$0	$0	$329	$446	$2,754	$3,731
	Subtotal	$6,075	$8,055	$1,040	$1,560	$0	$0	$616	$839	**$7,731**	**$10,454**
Phase 4	BRT 1 Full Build Out	$3,464	$4,568	$3,230	$5,220	$76,550	$132,200	$549	$751	$83,793	$142,739
	BRT 2 Full Build Out	$3,897	$5,139	$4,010	$6,540	$36,150	$69,600	$610	$844	$44,667	$82,123
	BRT 3 Full Build Out	$3,464	$4,568	$4,300	$7,080	$4,900	$5,600	$1,319	$1,796	$13,983	$19,044
	Subtotal	$10,825	$14,275	$11,540	$18,840	$117,600	$207,400	$2,477	$3,391	**$142,442**	**$243,906**

* Vehicle costs are based on TCRP Report 118: BRT Practitioner's Guide and escalated from 2007 to 2008 dollars at a rate of 3.5%.

Source: PCTPA, Capital Requirements Technical Memorandum, prepared by URS, March 2008.

Table 31 - Summary of Estimated Operating Costs by Phase
In current 2008 dollars

	RVH	Hourly cost (Low Estimate)	Hourly cost (High Estimate)	Operating costs (Low Estimate)	Operating costs (High Estimate)
Phase 1					
BRT 1 "Light" (Short): CSU – Galleria	10,266	$61.06	$110.23	$626,842	$1,131,621
BRT 3 "Light": Galleria – Sunrise LRT	11,772	$61.06	$110.23	$718,798	$1,297,628
Total	22,038			$1,345,640	$2,429,249
Phase 2					
BRT 1 "Light": CSU – Watt/I-80 LRT	11,772	$61.06	$110.23	$718,798	$1,297,628
BRT 3 "Light": Galleria – Sunrise LRT	11,772	$61.06	$110.23	$718,798	$1,297,628
Total	23,544			$1,437,597	$2,595,255
Phase 3					
BRT 1 "Light": CSU – Watt/I-80 LRT	11,772	$61.06	$110.23	$718,798	$1,297,628
BRT 2 "Light": CSU – Watt/I-80 LRT	11,772	$61.06	$110.23	$718,798	$1,297,628
BRT 3 "Light": Galleria – Sunrise LRT	11,772	$61.06	$110.23	$718,798	$1,297,628
Total	35,316			$2,156,395	$3,892,883
Phase 4					
BRT 1	22,038	$61.06	$110.23	$1,345,640	$2,429,249
BRT 2	23,544	$61.06	$110.23	$1,437,597	$2,595,255
BRT 3	22,038	$61.06	$110.23	$1,345,640	$2,429,249
Total	67,620			$4,128,877	$7,453,753

8.2 Funding Sources

8.2.1 Current and Potential Funding Sources for South Placer County

South Placer County transit operators currently use a combination of the following federal, state and local sources to fund current transit services:

Federal

- FTA Urbanized Areas Formula Grants (Section 5307)
- FTA Discretionary Bus and Bus Facilities Grants (Section 5309)
- FTA Transportation for the Elderly and Persons with Disabilities (Section 5310)
- FTA Other than Urbanized Area Formula Program (Section 5311)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)

State

- State Transportation Development Act (TDA)/Local Transportation Fund Program (LTF)
- State Transportation Development Act (TDA)/State Transit Assistance (STA)

Local

- Fare Revenue
- General Funds
- Local Transportation Sales Tax (proposed)

The funds listed above are currently used and represent a portion of the funding programs that could be used to fund expanded transit services. Some sources that are eligible to be used for transit are currently used by local jurisdictions for other purposes, such as streets and roads.

A brief overview of the current, potential, and new funding sources for all transportation purposes that could be used to fund a BRT project is provided below in Sections 8.3.1, 8.3.2, 8.3.3 and 8.3.4 and summarized in Table 32. Sources currently used to fund public transit operations or public transit capital projects within Placer County are listed as “current source.” Sources currently authorized by legislation and used within the county, but for other purposes, such as streets and roads, are listed as “potential source.” In most cases, these sources could potentially be reprogrammed to transit purposes through programming actions of local agencies or policy decisions. Sources that would require new legislation are listed as “possible new source.”

Table 32 - Summary of Current and Potential Funding Sources

Programming Agency	Annual Program Size	Applicability	Possible Source?	Description/ Comment
FTA	$734,000 annually (Placer County share) (1)	Capital, Preventative Maintenance	Current source	FTA Section 5307 funds are distributed to regions based on an urbanized area formula. In general, large urbanized area formula funds can be used for transit capital and preventative maintenance purposes. Small urbanized area formula funds can be used for both transit capital and transit operations. South Placer is eligible for funding under the large urbanized area formula.
FTA	$309,000 annually (Placer County share) (1)	Capital	Current source	FTA Section 5309 Bus and Bus Facilities funds are earmarked by Congress and provide funding to capital projects such as the replacement or expansion of buses or bus facilities.
FTA	$229,000 annually (Placer County share) (1)	Capital	Current source	FTA Section 5310 formula funds are distributed to private nonprofit groups that provide transportation services to the elderly and disabled populations when such services are lacking or unavailable. Funding allocation is based on the number of elderly and disabled individuals in the state.
FTA	$184,000 annually (Placer County share) (1)	Capital, O&M	Current source	FTA Section 5311 fund public transportation in areas with populations under 50,000, with funds apportioned based on the state's non-urbanized population. Funds may be used for capital, operating, state administration and project administration expenses. Colfax, Lincoln and rural Placer County are areas that are eligible for these funds. The City of Lincoln uses FTA 5311 to fund operating purposes only.
FHWA/FTA	Approximately $3.8 million annually (FY 2009/10 Placer County Fair Share) (2)	Capital	Current source	Jointly administered by FHWA and FTA and reauthorized in 2005 under SAFETEA-LU, the Congestion Mitigation and Air Quality Improvement Program (CMAQ) provides funds to State DOTs, MPOs, and transit agencies for projects that reduce transportation-related emissions in air quality non-attainment and maintenance areas for ozone, carbon monoxide, or particulate matter. As a part of the Sacramento Valley air basin, Placer County is eligible for its fair-share of CMAQ funds.
FHWA	$221,000 annually (Placer County share) (1)	Capital	Potential source	The County's jurisdictions currently use 100 percent of RSTP funds toward road rehabilitation purposes. RSTP provides funding to a variety of transportation projects and modes including: highway projects, bridges, transit capital improvements, surface transportation planning, and transportation enhancement activities.

Programming Agency	Annual Program Size	Applicability	Possible Source?	Description/ Comment
State of California	$20.2 million (FY 2006-07 for Placer County Western Slope jurisdictions) (3)	Capital, O&M	Current source and potential source	Funds are generated by a statewide quarter cent sales tax on diesel and gasoline. Eligible uses include transit operating assistance and capital projects. Public transit operators, cities and counties can claim the funds. Under TDA Article 4, in urban counties, 100 percent of LTF is used for transit operations. In rural counties, LTF can be used for local streets and roads if there are no unmet transit needs. In Western Placer County, approximately 43 percent of LTF ($8.7 million annually) currently funds local streets and roads.
State of California	$948,060 (FY 2007-08 for Placer County) (4)	Capital, O&M	Current source	STA funds are distributed by formula statewide, and then apportioned regionally to local public transit agencies. Can be used for either O&M or capital. PCTPA administers the TDA funds.
State of California	$1.1 million (FY 2007-08 for Placer County) (5)	Capital	Current source	Approved by voters in 2006, Proposition 1-B includes $3.6 billion of funding for the creation of a Public Transportation Modernization, Improvement and Service Enhancement Account (PTMISEA). PTMISEA appropriates funds to eligible transportation projects over a ten year period from FY 2007-08 through 2017-18. Eligible projects include bus rapid transit improvements, new capital projects, capital service enhancements or expansions, rehabilitations, safety or modernization improvements. Funds may also be used for rolling stock procurement, rehabilitation or replacement.
State of California	$229,743 (FY 2007-08 for Placer County) (6)	Capital	Current source	Proposition 1B includes $1 billion to be deposited into the Transit System Safety, Security and Disaster Response Account to fund capital projects that increase protection against security and safety threats and to capital expenditures that support the development of disaster response transportation systems that support the movement of goods and people in the event of a disaster.
Varies	Varies	Capital, O&M	Current source	Transit fare revenue can be used for any transit capital or operations/maintenance purpose.

a potential funding source in previous planning documents. However, money from this agency has been reallocated to an HOV project available for BRT.

Programming Agency	Annual Program Size	Applicability	Possible Source?	Description/ Comment
Placer County Board of Supervisors/ various city councils	Varies	Capital, O&M	Current source	General funds, which are mainly generated from the collection of local sales and property taxes, may be used as a funding source for transportation projects at the discretion of the County Board of Supervisors or any of the city councils for cities served by the transit operation.
PCTPA	Varies	Capital, O&M	Current source	Developer impact fees from new specific plan areas that include: Placer Vineyards, Placer Ranch and Regional University. Currently being used for local/commuter bus services.
PCTPA	Varies	Capital, O&M	Possible new source	Proposed half-cent sales tax increase to 7.75 percent in Placer County to generate an estimated $1.25 billion over 30 years. Proposed for 2012 ballot and would require 2/3 vote.

rogram revenues derived from SACOG MTP (2005-2027) estimates of revenue by county, escalated from 2004 to 2008 at 3.5% annually.
portionment from PCTPA Summary of CMAQ Fair Share Jurisdiction Allocation Recommendations, dated February 27, 2008.
lope jurisdiction LTF from the Placer County Transportation Planning Agency, FY 2007-2008 Unmet Transit Needs Analysis and Recommendations
09, escalated from 2006 to 2008 at 3.5 percent annually.
TA funding from the Governor's 2007-08 California State Regional Fact Sheet for Placer County (May 2007 Revision), escalated from 2007 to 2008 at

roposition 1B (PTMISEA) funds from the Caltrans Prop 1B website. http://www.dot.ca.gov/hq/transprog/ibond/ptmisea_projects_list_022708.pdf
roposition 1B (Transit System Safety, Security and Disaster Response Account) from the CA Office of Homeland Security website.
f/FY2007-2008_CTSGP-CTAF.pdf

8.3 Funding Forecast

8.3.1 Summary of Available Funding Estimates

The complete range of annual funding available to the transit operators in the County from existing sources is summarized in Table 33. The funding estimates are divided into capital and operations/maintenance costs (in 2008 dollars).

The available funding estimates are based on the following assumptions:[20]

- **Fare revenue** – Based on the assumed farebox recovery ratio of 20% of the overall O&M costs for Phases 1 and 2 and 25% of the overall O&M costs for Phases 3 and 4. The most recent National Transit Database data available (for 2007) for both Placer County Transit and for Roseville Transit shows farebox recovery ratios of approximately 13% for each agency.[21] 20 to 25% represents a significant but not insurmountable increase assumption, and is an appropriate planning assumption for a more urban type of service than the current PCT and Roseville Transit services. Assumptions of higher farebox recovery ratios are not recommended at this time.
- **TDA/LTF** – Based on FY 2006-2007 unmet transit needs estimates prepared by PCTPA in the FY 2007-08 Unmet Transit Needs Analysis and Recommendations Final Report for FY 2008-2009 (February 2008). The TDA/LTF funding estimates were escalated from 2006 dollars to 2008 dollars at an annual rate of 3.5 percent.

  The sales tax growth assumes constant revenue per capita and future yield will take into account projected population growth. Shows separate line-items for LTF receipts that are currently allocated to transit purposes and assumes funding currently allocated to streets and roads could be transferred to fund transit purposes. This reallocation would require going through the unmet needs process.
- **TDA/STA, FTA 5309 Bus, FTA 5310, FTA 5311** – Based on the Placer County estimates prepared by SACOG for 2035 MTP.
- **FTA 5311** – Assumed any eligible 5311 funds would be applied to operating purposes only, as in the case of funds used by the City of Lincoln.
- **FTA 5307** – Based on regional estimate provided by SACOG for the Metropolitan Transportation Plan (2035).
- **CMAQ** – Assumed 20 percent of total CMAQ funding for Placer County, estimate provided by SACOG for its 2035 MTP.
- **Developer Impact Fees** – Based on $98 million in 2006 constant dollars from 2006-2035 ($64.4 million for operations and maintenance purposes and $33.6 million in capital purposes) provided by PCTPA in the table entitled, West Placer Developments – Transit Costs and Funding. The developer fees were escalated from 2006 dollars to 2008 dollars at an annual rate of 3.5 percent and distributed evenly over a 30-year period to create the annual estimate; however, actual revenue generation is dependent on population growth and market conditions.

[20] SPRTA was included as a potential funding source in previous planning documents. However, money from this agency has been reallocated to an HOV project on I-80 and would not be available for BRT.
[21] Federal Transit Administration, National Transit Database, 2007.

- All funding estimates in Table 3.3 were escalated to 2008 dollars at an annual rate of 3.5 percent. With the exception of SPRTA and TDA/LTF and developer impact fees, all existing funding sources are based on projected funding estimates (in 2006 dollars) established in the Transit Master Plan.[22]

Table 33 - Projected Availability of Funding from Existing Sources (Annual)
Current 2008 Dollars (in '000)

	Scenario 1		Scenario 2		Scenario 3	
Available Funding (1)	**Capital**	**O&M**	**Capital**	**O&M**	**Capital**	**O&M**
Fare	–	$2,063	–	$3,549	–	$5,527
TDA/LTF (2)	–	–	–	–	–	–
- Currently allocated to Transit	–	$12,322	–	$12,322	–	$12,322
- Transferred from Streets and Roads (3)	–	$9,392	–	$9,392	–	$9,392
TDA/STA	–	$968	–	$968	–	$968
FTA 5307	$2,349	–	$2,349	–	$2,349	–
FTA 5309 Bus	$340	–	$340	–	$340	–
FTA 5310	$233	–	$233	–	$233	–
FTA 5311 (4)	–	$207	–	$207	–	$207
CMAQ	$561	–	$561	–	$561	–
Developer Impact Fees (5)	1,200	$2,300	1,200	$2,300	1,200	$2,300
Total Funding	**$4,683**	**$27,252**	**$4,683**	**$28,738**	**$4,683**	**$30,715**

Notes:
(1) For detailed funding assumptions, see Section 3.2.1 text. Unless noted, it is assumed funding estimates were taken from the Transit Master Plan.
(2) TDA/LTF funding split assumptions are from Placer County Transportation Planning Agency, FY 2007-08 Unmet Transit Needs Report, February 2008.
(3) TDA/LTF currently used for streets and roads purposes. Could be transferred to transit uses through unmet needs process.
(4) It is assumed that FTA 5311 would be used only for operating purposes, as in the case of the City of Lincoln.
(5) Developer Impact Fee assumptions provided by PCTPA in table entitled, *West Placer Developments - Transit Costs and Funding (2006-2035)*. Fees were escalated from $2006 to $2008 at rate of 3.5 percent annually and distributed evenly over a 30-year period to create the annual estimate; however, actual revenue generation is dependent on population growth and market conditions.

SPRTA was included as a potential funding source in previous planning documents. However, money from this agency has been reallocated to an HOV project on I-80 and would not be available for BRT.

8.4 Funding Strategy

The funding strategy described in this section would fund O&M costs for the BRT service first and then fund capital needs. First, O&M costs are funded with available resources eligible for that purpose. After fully funding O&M costs from eligible sources, capital-only funds and remaining funds that could be used for either capital or O&M are then applied to the funding needs for capital purposes. This strategy recognizes that O&M funds are often more difficult to identify but are crucial to the start-up of new services.

Both the capital and the operations and maintenance funding strategies rely on the use of TDA/LTF that is now used for streets and roads. This totals $282 million for the West Slope of

[22] Placer County Transportation Planning Agency, Transit Master Plan for South Placer County, prepared by URS Corporation with assistance from DKS Associates, Inc., June 2007.

Placer County, or $9.4 million annually for 30 years. Of that amount, $116.2 million would go to operating and $165.8 million would go to capital purposes over a 30-year period.

8.4.1 Operations and Maintenance Funding Strategy

The annual funding strategy for operations and maintenance by phase is summarized in Table 34. It is assumed that a 20 percent farebox recovery ratio would be achieved during Phases 1 and 2, and a 25 percent farebox recovery ratio would be achieved as ridership builds during Phases 3 and 4.[23] This funding strategy assumes that new TDA/LTF transit (LTF currently used for streets and roads) would cover the remaining operations and maintenance costs, with LTF covering 80 of the operating costs of applied to BRT during Phases 1 and 2 and 75 percent of the operating costs of BRT during Phases 3 and 4.

Table 34 - Operations and Maintenance Funding Strategy (Annual)
(Current 2008 dollars in millions)

Phase	Fares (1)		"New" LTF (1,2)		Total Annual O&M Funding Need (3)
	20%	25%	75%	80%	
1	$0.48			$1.92	**$2.4**
2	$0.52			$2.08	**$2.6**
3		$0.98	$2.93		**$3.9**
4		$1.88	$5.63		**$7.5**

Notes:
(1) Assumed a 20% farebox recovery and 80% LTF distribution for Phases 1-2; 25% farebox recovery and 75% LTF distribution for Phases 3-4.
(2) LTF now used for streets and roads.
(3) Annual "high scenario" O&M funding assumptions from Table 2.2.

Table 35 summarizes the 30-year need for operating funding, and calculates the total amount of TDA/LTF needed for the 30-year operating budget, once the assumed fare revenues are subtracted from the total need. This study assumes that TDA/LTF transferred from streets and roads will be applied to the annual BRT system operations and maintenance budget, as shown in Table 35. Phase 1 is assumed to span a two-year period, Phase 2 would span a five-year period, Phase 3 would span a ten-year period, and Phase 4 would span a 13-year period. It is estimated that operations and maintenance funds would require a total of $154.42 million over 30 years, with $37.8 million of that coming from fare revenues and the remaining $116.62 million coming from the re-directed TDA/LTF. If any of the first three phases last longer than the number of years anticipated here, it is expected that the funding need for the TDA/LTF funds over the 30-year period would be reduced.

The total amount of TDA/LTF available in South Placer County available to be redirected from streets and roads to transit is $282 million. If the $116.2 million discussed above is used for operating, this leaves $165.8 million available for potential use as a capital source for the BRT system.

It is important to note that if TDA/LTF funds for streets and roads are reallocated to annual BRT operations and maintenance, PCTPA would need to identify a backfill source of revenue for

[23] David Melko, PCTPA, Email communication with Duncan Watry of URS, April 24, 2008.

streets and roads activities. One candidate source would be from the potential 30-Year Sales Tax funds, which would require a change in the most recent draft sales tax expenditure plan.

Table 35 - 30-Year Operations and Maintenance Funding Strategy – LTF Need
(Current 2008 dollars in millions)

Phase	Phase Years	No. of Years	Total Annual Operating Cost	Annual Fare Revenue	Annual Additional Need	Total Fare Revenue	Total TDA/LTF	Total Operating Funding
1	1-2	2	$2.4	0.48	1.92	0.96	3.84	4.80
2	3-7	5	$2.6	0.52	2.08	2.60	10.40	13.00
3	8-17	10	$3.9	0.98	2.93	9.80	29.25	39.05
4	18-30	13	$7.5	1.88	5.63	24.44	73.13	97.57
30-Year Total						**37.80**	**116.62**	**154.42**

8.4.2 Capital Funding Strategy

The capital funding strategy applies the high-estimate scenario for the full build out of the BRT System (Scenario 3) and is summarized in Table 36. The total capital cost is $243.9 million for the four phases of the project over 30 years. This capital funding strategy is based on the following assumptions:[24]

- **TDA/LTF –** It is estimated that $165.8 million in TDA/LTF would be applied to capital purposes for the BRT system. It is assumed that $9.4 million annually of new TDA/LTF would be available to transit (see Table 3.3), which would be transferred from streets and roads for total of $282 million over 30 years. O&M funds require $116.62 million over 30 years (see Table 35), leaving $165.8 million potentially available for capital purposes.
- **Potential Transportation Sales Tax** – It is estimated that $76.1 million of the potential 30 year sales tax could go to capital purposes for the BRT System. It is assumed that these funds would be applied to BRT after 2012 and be used for Phase 4 only. This is based on the 30-year sales tax amount identified for BRT in the Draft Placer Transportation Expenditure Plan (2007), escalated from 2006 to 2008 at a rate of 3.5 percent annually. The current funding plan shown in Table 36 assumes that $52.2 million of that $76.1 million is used for Phases 1-4 of the BRT system. The remainder could be used for later capital projects related to BRT, or could be applied to streets and roads as a backfill for a portion of the TDA/LTF used for transit.
- **FTA** – It is estimated that $10.7 million in FTA funds would be applied to capital purposes for the BRT system. This is based on FTA funding for BRT identified in the Draft Placer Transportation Expenditure Plan (2007), escalating FTA dollars from 2006 to 2008 at a rate of 3.5 percent annually.

[24] As SPRTA will not be in existence in 2026, it is not included here as a potential funding source.

- **CMAQ** – Assumed 100 percent of Placer County annual CMAQ allocation of $3.8 million (as noted in Table 36) would fund BRT implementation for four years. This is approximately $15.2 million.

Table 36 - Capital Funding Plan (Initial Strategy) (2009-2038)
Current 2008 dollars (in millions)

	Phase				
	1	2	3	4	Total
Total Cost of Phase (1)	$4.7	$5.9	$10.5	$243.9	
Incremental Cost over Prior Phase	**$4.7**	**$1.2**	**$4.6**	**$233.4**	**$243.9**
Funding Source					
- CMAQ (2)	$2.0	$0.5	$0.6	$12.1	$15.2
- FTA (3)	$0.5	$0.0	$0.0	$10.2	$10.7
- TDA/LTF (4)	$2.2	$0.7	$4.0	$158.9	$165.8
- Potential Sales Tax (5)	$0.0	$0.0	$0.0	$52.2	$52.2
Total Funding	**$4.7**	**$1.2**	**$4.6**	**$233.4**	**$243.9**
Additional Funding Needed	$0.0	$0.0	$0.0	**$0.0**	

(1) Total Capital Cost based on 'high scenario' in Table 2.1: Estimated Capital Cost by Phase

(2) Assumed 100 percent of Placer County annual CMAQ allocation of $3.8 million goes to BRT implementation for 4 years, which is approximately $15.2 million.

(3) FTA funding estimates for BRT System. Escalated from 2006 to 2008 at rate of 3.5 percent. Source: PCTPA, Draft Placer Transportation Expenditure Plan, June 2007.

(4) TDA funding for BRT System. Assumes $9.392 million of new TDA/LTF available to transit (see Table 3.3) that would be transferred from streets and roads for total of $282 million over 30 years. O&M funds require $116.62 million over 30 years, leaving $165.8 million available for capital purposes.

(5) Sales tax funding for BRT System. Escalated from 2006 to 2008 at rate of 3.5 percent. Source: PCTPA, Draft Placer Transportation Expenditure Plan, June 2007. Assumed to start after 2012 and be used for Phase 4 only.

Note: SPRTA was included as a potential funding source in previous planning documents. However, funds from this agency have been reallocated to an HOV project on I-80 and would not be available for BRT. Thus, SPRTA is not currently included as a potential funding source for BRT.

9.0 Recommended Next Steps

This report presented an overview of items that are needed for implementation of BRT service for South Placer County, including ridership estimates; capital needs and technology opportunities; an implementation phasing strategy; institutional models to manage the service; and a financial plan. The next action items and potential responsible parties would include the following:

- **Funding commitments**: Capital and operating funding sources need to be secured for Phase 1. This will require addressing the TDA/LTF issue in the first phase if the project is to proceed. Many potential funding sources are presented above as future sources. For sources controlled by other agencies, PCTPA should continue discussions with SACOG and other responsible funding agencies to make financial commitments that would fund capital expenses for BRT services. Additionally, PCTPA would need to work with County officials to ensure that expenditure plans for the potential local sales tax would contain sufficient funding for capital and operating costs.

- **ROW reservation**: Dedicated running ways are an integral part of any BRT system, and it is critical that streets on the proposed routes have sufficient roadway reserved for future BRT service. Placer County and the City of Roseville should work to ensure that proposed development plans allow for sufficient BRT right-of-way along the primary BRT routes and on any secondary routes that may be proposed for future BRT services. Additionally, new wider overpasses over Industrial , the Union Pacific Railroad, and SR-65 may be needed in order to create sufficient width to reserve right-of-way for BRT running ways. Placer County and Caltrans should coordinate on planning activities for projects such as this that may have a long lead time, and require coordination with other roadway projects in the area. Placer County also should work with Sacramento County on right-of-way reservation along Watt Avenue.

- **Management entity:** PCTPA, PCT, and Roseville Transit should work toward development of ann institutional model for how the BRT service will be managed. This step is important as it precedes many other decisions and discussions, including implementing the proposed phasing plan, planning for future maintenance facility capacity, and holding discussions with entities such as the Galleria about shared use of parking spaces.

- **Maintenance capacity**: The operating entity would need to ensure that sufficient maintenance and storage capacity exists for the BRT system. Planning for facility expansion, if needed, should proceed as early as possible, as this is another project with a long lead time.

- **Refined ridership data**: There is limited hard information available to further break down the ridership estimates presented in Section 3.0 above. Additional data that would be helpful in further development of the service plan would include directional ridership information. Also, additional backup information to support the Transit Master Plan's assumption that there would be no peaking of loads in the peak period would be helpful in refining scheduling and vehicle needs. Table 3-A from the interim version of the Transit Master Plan shows that the BRT service day is assumed to be 12 hours per day. Two 3-hour peaks are assumed, for a total of 6 hours of peak service, and one mid-day period of 6 hours is assumed. The expected ridership calculation in Table 5 shows that the ridership from the model is fairly evenly split between mid-day and peaks, which means that the BRT routes would be expected to carry similar loads all day. This is not the norm in the transit industry, and warrants further study and refinement.

Credits
PCTPA Project Manager – David Melko
URS Project Manager – Duncan Watry
URS Planners – Julia Chan, Howard Smith, Tam Tran

June 18, 2008

Configuration	# of buses at stop location	Transfer opportunities	P&R Lot	Notes
treet transit center	2-3	--	Y	300 spaces in P&R lot
an bus lane or curb	1	--	N	
Curb	1	--	N	
Curb	1	--	N	Existing development on Nichols. Could propose going down on Duluth to Foothills, instead of creating new roadway through existing development.
Curb	1	--	N	
Curb	1	--	N	H-P Campus. Proposed stop (southbound) is about 0.1 mile north of the intersection.
ight inside lane	1	--	N	Corporate Center. Queue jump.
ight inside lane	1	--	N	Queue jump
Boarding island	1	--	N	
astbound: Curb und: Right inside lane	1	RoseT	N	Queue jump for westbound direction
treet transit center	3-4	PCT, RoseT	Y	100 spaces in P&R lot
Curb	1	--	N	
Curb	1	--	N	
treet transit center	3-4	PCT, SacRT	Y	243 spaces in P&R lot
treet transit center	3-4	--	Y	300 spaces in P&R lot
Curb	1	--	N	
Curb	1	--	N	Queue jump for southbound direction
Curb	1	--	N	
ight inside lane	1	RoseT	N	Queue jump
Curb	1	RoseT	N	Queue jump for southbound direction
an bus lane or curb	1	--	N	West Roseville Town Center
Curb	1	--	N	T-intersection
an bus lane or curb	1	--	N	Queue jump for northbound direction
an bus lane or curb	1	--	N	Placer Vineyards Center; T-intersection
Curb	1	--	N	T-intersection; queue jump for southbound direction
ight inside lane	1	SacRT	N	Queue jump
ight inside lane	1	SacRT	N	Queue jump
ight inside lane	1	--	N	Queue jump
Curb	1	--	N	
Curb	1	--		
Curb	1	SacRT	N	Queue jump
treet transit center	3-4	PCT, SacRT	Y	243 spaces in P&R lot
Off-street stop	3-4	PCT, RoseT	Y	100 spaces in P&R lot
ight inside lane	1	--	N	Queue jump
ight inside lane	3-4	RoseT	Y	Queue jump
ight inside lane	1	RoseT	N	Queue jump; Sutter Roseville Medical Complex
und: Right inside lane outhbound: Curb	1	--	N	T-intersection; Queue jump for northbound direction
ight inside lane	1	--	N	Queue jump
und: Median bus lane estbound: Curb	1	RoseT	N	Queue jump for westbound direction
und: Median bus lane astbound: Curb	1	RoseT	N	Queue jump for eastbound direction
ight inside lane	1	RoseT	N	Queue jump
ight inside lane	1	--	N	Queue jump
Curb	1	--	N	T-intersection
Curb	1	SacRT	N	
Curb	1	--	N	
ight inside lane	1	SacRT	N	Queue jump
ight inside lane	1	--	N	Queue jump
ight inside lane	1	--	N	Queue jump
ound: Right inside lane orthbound: Curb	1	SacRT	N	T-intersection; queue jump for southbound direction
Curb	1	--		Queue jump
Off-street stop	2	--	Y	432 spaces in P&R lot
Off-street stop	2	SacRT	Y	487 spaces in P&R lot

South Placer Bus Rapid Transit
Appendix B1: Calculations for Operating Speeds -- On Dedicated Bus Lanes in Local Streets

June 18, 2008

OPERATING SPEED ON DEDICATED BUS LANE ON LOCAL STREETS IN PLACER COUNTY

	2.40	minutes per mile	Stops spaced 1/2 mile apart with 10-second dwell time[1]
+	2.73	minutes per mile	Stops spaced 1/2 mile apart with 20-second dwell time[1]
	5.13	minutes per mile	
/	2		Interpolation
	2.6	minutes per mile	Stops spaced 1/2 mile apart with 15-second dwell time[1]
+	0.7	minutes per mile	Estimated time loss due to operating environment[1]
	3.3	**minutes per mile**	**Basic bus running time on dedicated bus lanes in Placer County**
	or		
	18.2	miles per hour	

[1] Bus Rapid Transit, Volume 2: Implementation Guidelines, (TCRP Report 90), 2003, p. 8-8.

South Placer Bus Rapid Transit
Appendix B2: Calculations for Operating Speeds -- In Mixed Traffic
June 18, 2008

OPERATING SPEED IN MIXED TRAFFIC IN PLACER COUNTY

	2.40	minutes per mile	Stops spaced 1/2 mile apart with 10-second dwell time[1]
+	2.73	minutes per mile	Stops spaced 1/2 mile apart with 20-second dwell time[1]
	5.13	minutes per mile	
/	2		Interpolation
	2.6	minutes per mile	Stops spaced 1/2 mile apart with 15-second dwell time[1]
+	1.2	minutes per mile	Estimated time loss due to operating environment[1]
	3.8	**minutes per mile**	**Basic bus running time in mixed traffic in Placer County**
	or		
	15.8	miles per hour	

OPERATING SPEED IN MIXED TRAFFIC IN SACRAMENTO COUNTY

	2.40	minutes per mile	Stops spaced 1/2 mile apart with 10-second dwell time[1]
+	2.73	minutes per mile	Stops spaced 1/2 mile apart with 20-second dwell time[1]
	5.13	minutes per mile	
/	2		Interpolation
	2.6	minutes per mile	Stops spaced 1/2 mile apart with 15-second dwell time[1]
/	2		Interpolation for stops spaced 1 mile apart with 15-second dwell time[1]
	1.3	minutes per mile	
+	1.2	minutes per mile	Estimated time loss due to operating environment[1]
	2.5	**minutes per mile**	**Basic bus running time in mixed traffic in Sacramento County**
	or		
	24.0	miles per hour	

[1] Bus Rapid Transit, Volume 2: Implementation Guidelines, (TCRP Report 90), 2003, p. 8-8.

Proposed Lane Widening (1)	Number of lanes in 2035	BRT ROW Type (1)	Operating speed: Minutes per mile (2)	Operating speed: Miles per hour, average including stops (3)	Dwell Time (seconds) (4)	Basic Travel Time (minutes)
2	2	Proposed dedicated median bus lane	3.3	18.2	15	8.3
2	2	Proposed dedicated median bus lane	3.3	18.2	15	5.6
0	4	Dedicated median bus lane	3.3	18.2	15	3.0
0	6	HOV lane	1.3	46.2	15	1.7
0	6	Mixed traffic	3.8	15.8	15	2.3
0	6	Mixed traffic	3.8	15.8	15	4.8
0	4	Mixed traffic	3.8	15.8	15	2.2
0	4	HOV lane	1.3	46.2	15	1.2
2	8-10	HOV lane	1.3	46.2	15	14.4
						43.3
2	2	Proposed dedicated median bus lane	3.3	18.2	15	1.7
2	4	Dedicated median bus lane	3.3	18.2	15	11.9
2-4	2-4	Mixed traffic	3.8	15.8	15	8.7
2	6	Dedicated median bus lane	3.3	18.2	15	8.3
0	4-6	Mixed traffic	2.5	24.0	15	15.1
						45.6
0	6	Mixed traffic	3.8	15.8	15	4.1
0	2	Mixed traffic	3.8	15.8	15	1.1
0	2	Mixed traffic	3.8	15.8	15	1.1
0	6	Mixed traffic	3.8	15.8	15	7.2
0	6	Mixed traffic	3.8	15.8	15	1.9
2	6	Mixed traffic	3.8	15.8	15	7.1
0	4	Mixed traffic	2.5	24.0	15	15.3
0	4	Mixed traffic	2.5	24.0	30	8.3
						46.2

Continued

ide CBD

l Travel vings TSP tes)	# of major traffic generators	Additional dwell time per traffic generator (seconds)	Total additional dwell time (seconds) (4)	Total additional dwell time (minutes)	Total travel time (minutes)	Notes
	1	45	45	0.75	8.9	CSU Placer
	1	15	15	0.25	5.8	HP Campus
	1	15	15	0.25	3.2	Corporate Center
	0	0	0	0	1.6	
	0	0	0	0	2.3	
	1	45	45	0.75	5.4	Galleria
	0	0	0	0	2.1	
	0	0	0	0	1.2	
	1	45	45	0.75	14.9	LRT station
				2.8	*46.0*	
	1	45	45	0.75	2.4	CSU Placer
	0	0	0	0	11.7	
	1	15	15	0.25	8.8	West Roseville Town
	1	15	15	0.25	8.4	Placer Vineyards Center
	1	45	45	0.75	15.6	LRT station
				2.0	*47.0*	
	1	45	45	0.75	4.8	Galleria
	1	45	45	0.75	1.8	Taylor P&R
	1	45	45	0.75	1.9	
	1	15	15	0.25	7.4	Sutter Roseville Medical Complex
	0	0	0	0	1.9	
	0	0	0	0	7.0	
	1	45	45	0.75	15.8	LRT station
	1	45	45	0.75	8.9	LRT station
				4.0	*50.0*	

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RT

y	Woodcreek Oaks	Foothills @ Nichols Drive	Foothills @ Winding Creek	Foothills @ Blue Oaks	Blue Oaks @ Washington	Pleasant Grove @ Highland Pointe	Pleasant Grove @ Roseville Pkwy	Roseville Pkwy @ Gibson/Castaic Drive	Galleria	Gallelria Blvd @ Roseville Pkwy	Stanford Ranch Rd	Watt/I-80 LRT
	0.8	*0.6*	*0.7*	*0.5*	*0.5*	*1.5*	*0.4*	*0.7*	*0.5*	*0.5*	*0.4*	*12.5*
	2.6	*2.0*	*2.3*	*1.7*	*1.6*	*2.0*	*1.3*	*2.7*	*1.9*	*1.9*	*1.5*	*16.3*
	0	*0*	*0*	*0*	*0.25*	*0.25*	*0*	*0*	*0*	*0.75*	*0*	*0*
	2.6	*2.0*	*2.3*	*1.7*	*1.8*	*2.3*	*1.3*	*2.7*	*1.9*	*2.7*	*1.5*	*16.3*
	6:06	6:08	6:10	6:12	6:14	6:17	6:19	6:22	6:24	6:27	6:29	6:46
	6:21	6:23	6:25	6:27	6:29	6:32	6:34	6:37	6:39	6:42	6:44	7:01
	6:36	6:38	6:40	6:42	6:44	6:47	6:49	6:52	6:54	6:57	6:59	7:16
	6:51	6:53	6:55	6:57	6:59	7:02	7:04	7:07	7:09	7:12	7:14	7:31
	7:06	7:08	7:10	7:12	7:14	7:17	7:19	7:22	7:24	7:27	7:29	7:46
	7:21	7:23	7:25	7:27	7:29	7:32	7:34	7:37	7:39	7:42	7:44	8:01
	7:36	7:38	7:40	7:42	7:44	7:47	7:49	7:52	7:54	7:57	7:59	8:16
	7:51	7:53	7:55	7:57	7:59	8:02	8:04	8:07	8:09	8:12	8:14	8:31
	8:06	8:08	8:10	8:12	8:14	8:17	8:19	8:22	8:24	8:27	8:29	8:46
	8:21	8:23	8:25	8:27	8:29	8:32	8:34	8:37	8:39	8:42	8:44	9:01
	8:36	8:38	8:40	8:42	8:44	8:47	8:49	8:52	8:54	8:57	8:59	9:16
	8:51	8:53	8:55	8:57	8:59	9:02	9:04	9:07	9:09	9:12	9:14	9:31
	9:06	9:08	9:10	9:12	9:14	9:17	9:19	9:22	9:24	9:27	9:29	9:46
	9:36	9:38	9:40	9:42	9:44	9:47	9:49	9:52	9:54	9:57	9:59	10:16
	10:06	10:08	10:10	10:12	10:14	10:17	10:19	10:22	10:24	10:27	10:29	10:46
	10:36	10:38	10:40	10:42	10:44	10:47	10:49	10:52	10:54	10:57	10:59	11:16
	11:06	11:08	11:10	11:12	11:14	11:17	11:19	11:22	11:24	11:27	11:29	11:46
	11:36	11:38	11:40	11:42	11:44	11:47	11:49	11:52	11:54	11:57	11:59	12:16
	12:06	12:08	12:10	12:12	12:14	12:17	12:19	12:22	12:24	12:27	12:29	12:46
	12:36	12:38	12:40	12:42	12:44	12:47	12:49	12:52	12:54	12:57	12:59	13:16
	13:06	13:08	13:10	13:12	13:14	13:17	13:19	13:22	13:24	13:27	13:29	13:46
	13:36	13:38	13:40	13:42	13:44	13:47	13:49	13:52	13:54	13:57	13:59	14:16
	14:06	14:08	14:10	14:12	14:14	14:17	14:19	14:22	14:24	14:27	14:29	14:46
	14:36	14:38	14:40	14:42	14:44	14:47	14:49	14:52	14:54	14:57	14:59	15:16
	15:06	15:08	15:10	15:12	15:14	15:17	15:19	15:22	15:24	15:27	15:29	15:46
	15:36	15:38	15:40	15:42	15:44	15:47	15:49	15:52	15:54	15:57	15:59	16:16
	16:06	16:08	16:10	16:12	16:14	16:17	16:19	16:22	16:24	16:27	16:29	16:46
	16:21	16:23	16:25	16:27	16:29	16:32	16:34	16:37	16:39	16:42	16:44	17:01
	16:36	16:38	16:40	16:42	16:44	16:47	16:49	16:52	16:54	16:57	16:59	17:16
	16:51	16:53	16:55	16:57	16:59	17:02	17:04	17:07	17:09	17:12	17:14	17:31
	17:06	17:08	17:10	17:12	17:14	17:17	17:19	17:22	17:24	17:27	17:29	17:46
	17:21	17:23	17:25	17:27	17:29	17:32	17:34	17:37	17:39	17:42	17:44	18:01
	17:36	17:38	17:40	17:42	17:44	17:47	17:49	17:52	17:54	17:57	17:59	18:16
	17:51	17:53	17:55	17:57	17:59	18:02	18:04	18:07	18:09	18:12	18:14	18:31
	18:06	18:08	18:10	18:12	18:14	18:17	18:19	18:22	18:24	18:27	18:29	18:46
	18:21	18:23	18:25	18:27	18:29	18:32	18:34	18:37	18:39	18:42	18:44	19:01

chedule

CSU

d	Gallelria Blvd @ Roseville Pkwy	Galleria	Roseville Pkwy @ Gibson/Castaic Drive	Pleasant Grove @ Roseville Pkwy	Pleasant Grove @ Highland Pointe	Blue Oaks @ Washington	Foothills @ Blue Oaks	Foothills @ Winding Creek	Foothills @ Nichols Drive	Woodcreek Oaks	University Blvd	CSU Placer
	0.4	*0.5*	*0.5*	*0.7*	*0.4*	*1.5*	*0.5*	*0.5*	*0.7*	*0.6*	*0.8*	*0.9*
	1.5	*1.9*	*1.9*	*2.7*	*1.3*	*2.0*	*1.6*	*1.7*	*2.3*	*2.0*	*2.6*	*2.9*
	0	*0*	*0.75*	*0*	*0*	*0*	*0.25*	*0.25*	*0*	*0*	*0*	*0*
	1.5	*1.9*	*2.7*	*2.7*	*1.3*	*2.0*	*1.8*	*1.9*	*2.3*	*2.0*	*2.6*	*2.9*
	6:18	6:20	6:23	6:26	6:28	6:30	6:32	6:34	6:36	6:39	6:42	6:46
	6:33	6:35	6:38	6:41	6:43	6:45	6:47	6:49	6:51	6:54	6:57	7:01
	6:48	6:50	6:53	6:56	6:58	7:00	7:02	7:04	7:06	7:09	7:12	7:16
	7:03	7:05	7:08	7:11	7:13	7:15	7:17	7:19	7:21	7:24	7:27	7:31
	7:18	7:20	7:23	7:26	7:28	7:30	7:32	7:34	7:36	7:39	7:42	7:46
	7:33	7:35	7:38	7:41	7:43	7:45	7:47	7:49	7:51	7:54	7:57	8:01
	7:48	7:50	7:53	7:56	7:58	8:00	8:02	8:04	8:06	8:09	8:12	8:16
	8:03	8:05	8:08	8:11	8:13	8:15	8:17	8:19	8:21	8:24	8:27	8:31
	8:18	8:20	8:23	8:26	8:28	8:30	8:32	8:34	8:36	8:39	8:42	8:46
	8:33	8:35	8:38	8:41	8:43	8:45	8:47	8:49	8:51	8:54	8:57	9:01
	8:48	8:50	8:53	8:56	8:58	9:00	9:02	9:04	9:06	9:09	9:12	9:16
	9:03	9:05	9:08	9:11	9:13	9:15	9:17	9:19	9:21	9:24	9:27	9:31
	9:18	9:20	9:23	9:26	9:28	9:30	9:32	9:34	9:36	9:39	9:42	9:46
	9:48	9:50	9:53	9:56	9:58	10:00	10:02	10:04	10:06	10:09	10:12	10:16
	10:18	10:20	10:23	10:26	10:28	10:30	10:32	10:34	10:36	10:39	10:42	10:46
	10:48	10:50	10:53	10:56	10:58	11:00	11:02	11:04	11:06	11:09	11:12	11:16
	11:18	11:20	11:23	11:26	11:28	11:30	11:32	11:34	11:36	11:39	11:42	11:46
	11:48	11:50	11:53	11:56	11:58	12:00	12:02	12:04	12:06	12:09	12:12	12:16
	12:18	12:20	12:23	12:26	12:28	12:30	12:32	12:34	12:36	12:39	12:42	12:46
	12:48	12:50	12:53	12:56	12:58	13:00	13:02	13:04	13:06	13:09	13:12	13:16
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	15:18	15:20	15:23	15:26	15:28	15:30	15:32	15:34	15:36	15:39	15:42	15:46
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	18:18	18:20	18:23	18:26	18:28	18:30	18:32	18:34	18:36	18:39	18:42	18:46
	18:33	18:35	18:38	18:41	18:43	18:45	18:47	18:49	18:51	18:54	18:57	19:01

chedule

RT

nt d	Fiddyment @ Casa Sedona	Blue Oaks @ Fiddyment	Fiddyment @ Del Webb	Fiddyment @ Pleasant Grove	Pleasant Grove @ Unnamed Road	Unnamed Road @ Watt	Watt @ Baseline	Watt @ Straight	Watt @ PFE	Watt @ Elverta	Watt @ Antelope	Watt @ Elkhorn	Watt @ I Street	Watt @ A Street	Watt @ Roseville Rd	Watt/I-80 LRT
	0.5	*0.8*	*1.4*	*0.7*	*0.8*	*1.7*	*0.7*	*0.8*	*0.8*	*1.0*	*1.0*	*0.9*	*0.5*	*1.0*	*0.8*	*0.9*
	1.7	*2.8*	*4.6*	*2.4*	*2.7*	*6.5*	*2.5*	*2.6*	*2.5*	*2.5*	*2.4*	*2.3*	*1.3*	*2.5*	*1.9*	*2.3*
	0	*0*	*0*	*0*	*0*	*0.25*	*0*	*0*	*0.25*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	1.7	*2.8*	*4.6*	*2.4*	*2.7*	*6.7*	*2.5*	*2.6*	*2.7*	*2.5*	*2.4*	*2.3*	*1.3*	*2.5*	*1.9*	*2.3*
	6:05	6:08	6:13	6:15	6:17	6:24	6:26	6:28	6:30	6:32	6:34	6:36	6:38	6:40	6:42	6:46
	6:20	6:23	6:28	6:30	6:32	6:39	6:41	6:43	6:45	6:47	6:49	6:51	6:53	6:55	6:57	7:01
	6:35	6:38	6:43	6:45	6:47	6:54	6:56	6:58	7:00	7:02	7:04	7:06	7:08	7:10	7:12	7:16
	6:50	6:53	6:58	7:00	7:02	7:09	7:11	7:13	7:15	7:17	7:19	7:21	7:23	7:25	7:27	7:31
	7:05	7:08	7:13	7:15	7:17	7:24	7:26	7:28	7:30	7:32	7:34	7:36	7:38	7:40	7:42	7:46
	7:20	7:23	7:28	7:30	7:32	7:39	7:41	7:43	7:45	7:47	7:49	7:51	7:53	7:55	7:57	8:01
	7:35	7:38	7:43	7:45	7:47	7:54	7:56	7:58	8:00	8:02	8:04	8:06	8:08	8:10	8:12	8:16
	7:50	7:53	7:58	8:00	8:02	8:09	8:11	8:13	8:15	8:17	8:19	8:21	8:23	8:25	8:27	8:31
	8:05	8:08	8:13	8:15	8:17	8:24	8:26	8:28	8:30	8:32	8:34	8:36	8:38	8:40	8:42	8:46
	8:20	8:23	8:28	8:30	8:32	8:39	8:41	8:43	8:45	8:47	8:49	8:51	8:53	8:55	8:57	9:01
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	8:50	8:53	8:58	9:00	9:02	9:09	9:11	9:13	9:15	9:17	9:19	9:21	9:23	9:25	9:27	9:31
	9:05	9:08	9:13	9:15	9:17	9:24	9:26	9:28	9:30	9:32	9:34	9:36	9:38	9:40	9:42	9:46
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	10:05	10:08	10:13	10:15	10:17	10:24	10:26	10:28	10:30	10:32	10:34	10:36	10:38	10:40	10:42	10:46
	10:35	10:38	10:43	10:45	10:47	10:54	10:56	10:58	11:00	11:02	11:04	11:06	11:08	11:10	11:12	11:16
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	18:05	18:08	18:13	18:15	18:17	18:24	18:26	18:28	18:30	18:32	18:34	18:36	18:38	18:40	18:42	18:46
	18:20	18:23	18:28	18:30	18:32	18:39	18:41	18:43	18:45	18:47	18:49	18:51	18:53	18:55	18:57	19:01

chedule

CSU

e	Watt @ A Street	Watt @ I Street	Watt @ Elkhorn	Watt @ Antelope	Watt @ Elverta	Watt @ PFE	Watt @ Straight	Watt @ Baseline	Unnamed Road @ Watt	Pleasant Grove @ Unnamed Road	Fiddyment @ Pleasant Grove	Fiddyment @ Del Webb	Blue Oaks @ Fiddyment	Fiddyment @ Casa Sedona	Fiddyment @ Unnamed Road	CSU Placer
	0.8	*1.0*	*0.5*	*0.9*	*1.0*	*1.0*	*0.8*	*0.8*	*0.7*	*1.7*	*0.8*	*0.7*	*1.4*	*0.8*	*0.5*	*0.9*
	1.9	*2.5*	*1.3*	*2.3*	*2.4*	*2.5*	*2.5*	*2.6*	*2.2*	*6.5*	*3.1*	*2.4*	*4.6*	*2.8*	*1.7*	*2.9*
	0	*0*	*0*	*0*	*0*	*0*	*0*	*0.25*	*0*	*0*	*0.25*	*0*	*0*	*0*	*0*	*0*
	1.9	*2.5*	*1.3*	*2.3*	*2.4*	*2.5*	*2.5*	*2.9*	*2.2*	*6.5*	*3.4*	*2.4*	*4.6*	*2.8*	*1.7*	*2.9*
	6:04	6:07	6:09	6:11	6:13	6:15	6:17	6:20	6:22	6:29	6:32	6:34	6:39	6:42	6:44	6:47
	6:19	6:22	6:24	6:26	6:28	6:30	6:32	6:35	6:37	6:44	6:47	6:49	6:54	6:57	6:59	7:02
	6:34	6:37	6:39	6:41	6:43	6:45	6:47	6:50	6:52	6:59	7:02	7:04	7:09	7:12	7:14	7:17
	6:49	6:52	6:54	6:56	6:58	7:00	7:02	7:05	7:07	7:14	7:17	7:19	7:24	7:27	7:29	7:32
	7:04	7:07	7:09	7:11	7:13	7:15	7:17	7:20	7:22	7:29	7:32	7:34	7:39	7:42	7:44	7:47
	7:19	7:22	7:24	7:26	7:28	7:30	7:32	7:35	7:37	7:44	7:47	7:49	7:54	7:57	7:59	8:02
	7:34	7:37	7:39	7:41	7:43	7:45	7:47	7:50	7:52	7:59	8:02	8:04	8:09	8:12	8:14	8:17
	7:49	7:52	7:54	7:56	7:58	8:00	8:02	8:05	8:07	8:14	8:17	8:19	8:24	8:27	8:29	8:32
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	8:19	8:22	8:24	8:26	8:28	8:30	8:32	8:35	8:37	8:44	8:47	8:49	8:54	8:57	8:59	9:02
	8:34	8:37	8:39	8:41	8:43	8:45	8:47	8:50	8:52	8:59	9:02	9:04	9:09	9:12	9:14	9:17
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	9:34	9:37	9:39	9:41	9:43	9:45	9:47	9:50	9:52	9:59	10:02	10:04	10:09	10:12	10:14	10:17
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	10:34	10:37	10:39	10:41	10:43	10:45	10:47	10:50	10:52	10:59	11:02	11:04	11:09	11:12	11:14	11:17
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	11:34	11:37	11:39	11:41	11:43	11:45	11:47	11:50	11:52	11:59	12:02	12:04	12:09	12:12	12:14	12:17
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	12:34	12:37	12:39	12:41	12:43	12:45	12:47	12:50	12:52	12:59	13:02	13:04	13:09	13:12	13:14	13:17
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	14:34	14:37	14:39	14:41	14:43	14:45	14:47	14:50	14:52	14:59	15:02	15:04	15:09	15:12	15:14	15:17
	15:04	15:07	15:09	15:11	15:13	15:15	15:17	15:20	15:22	15:29	15:32	15:34	15:39	15:42	15:44	15:47
	15:34	15:37	15:39	15:41	15:43	15:45	15:47	15:50	15:52	15:59	16:02	16:04	16:09	16:12	16:14	16:17
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	16:19	16:22	16:24	16:26	16:28	16:30	16:32	16:35	16:37	16:44	16:47	16:49	16:54	16:57	16:59	17:02
	16:34	16:37	16:39	16:41	16:43	16:45	16:47	16:50	16:52	16:59	17:02	17:04	17:09	17:12	17:14	17:17
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	17:04	17:07	17:09	17:11	17:13	17:15	17:17	17:20	17:22	17:29	17:32	17:34	17:39	17:42	17:44	17:47
	17:19	17:22	17:24	17:26	17:28	17:30	17:32	17:35	17:37	17:44	17:47	17:49	17:54	17:57	17:59	18:02
	17:34	17:37	17:39	17:41	17:43	17:45	17:47	17:50	17:52	17:59	18:02	18:04	18:09	18:12	18:14	18:17
	17:49	17:52	17:54	17:56	17:58	18:00	18:02	18:05	18:07	18:14	18:17	18:19	18:24	18:27	18:29	18:32
	18:04	18:07	18:09	18:11	18:13	18:15	18:17	18:20	18:22	18:29	18:32	18:34	18:39	18:42	18:44	18:47
	18:19	18:22	18:24	18:26	18:28	18:30	18:32	18:35	18:37	18:44	18:47	18:49	18:54	18:57	18:59	19:02

chedule

LRT

e	Taylor P&R	East Roseville Pkwy @ Sunrise	East Roseville Pkwy @ Alexandra	East Roseville Pkwy @ Lead Hill	Douglas @ East Roseville Pkwy	Douglas @ Sierra College	Sierra College @ Eureka	Sierra College @ Old Auburn	Sierra College @ Cherry	Hazel @ Oak	Hazel @ Central	Hazel @ Greenback	Hazel @ Madison	Hazel @ Sunset	Hazel @ Winding Way	Hazel @ Curragh Downs	Hazel LRT	Sunrise LRT
	0.7	*0.3*	*0.7*	*0.4*	*0.6*	*0.5*	*0.6*	*1.0*	*0.7*	*0.7*	*0.9*	*0.5*	*1.0*	*0.6*	*0.5*	*0.5*	*1.2*	*3.3*
	2.7	*1.1*	*2.5*	*1.5*	*2.2*	*1.9*	*2.4*	*3.8*	*2.7*	*1.8*	*2.3*	*1.3*	*2.5*	*1.5*	*1.3*	*1.3*	*3.0*	*8.3*
	0	*0.25*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.75*
	2.7	*1.4*	*2.5*	*1.5*	*2.2*	*1.9*	*2.4*	*3.8*	*2.7*	*1.8*	*2.3*	*1.3*	*2.5*	*1.5*	*1.3*	*1.3*	*3.0*	*9.0*
	6:05	6:07	6:09	6:11	6:13	6:15	6:17	6:21	6:24	6:26	6:28	6:30	6:32	6:34	6:36	6:38	6:41	6:50
	6:20	6:22	6:24	6:26	6:28	6:30	6:32	6:36	6:39	6:41	6:43	6:45	6:47	6:49	6:51	6:53	6:56	7:05
	6:35	6:37	6:39	6:41	6:43	6:45	6:47	6:51	6:54	6:56	6:58	7:00	7:02	7:04	7:06	7:08	7:11	7:20
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	8:05	8:07	8:09	8:11	8:13	8:15	8:17	8:21	8:24	8:26	8:28	8:30	8:32	8:34	8:36	8:38	8:41	8:50
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	8:35	8:37	8:39	8:41	8:43	8:45	8:47	8:51	8:54	8:56	8:58	9:00	9:02	9:04	9:06	9:08	9:11	9:20
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chedule

Galleria

T	Hazel @ Curragh Downs	Hazel @ Winding Way	Hazel @ Sunset	Hazel @ Madison	Hazel @ Greenback	Hazel @ Central	Hazel @ Oak	Sierra College @ Cherry	Sierra College @ Old Auburn	Sierra College @ Eureka	Douglas @ Sierra College	Douglas @ East Roseville Pkwy	East Roseville Pkwy @ Lead Hill	East Roseville Pkwy @ Alexandra	East Roseville Pkwy @ Sunrise	Taylor P&R	Roseville Pkwy @ Creekridge	Galleria
	1.2	*0.5*	*0.5*	*0.6*	*1.0*	*0.5*	*0.9*	*0.7*	*0.7*	*1.0*	*0.6*	*0.5*	*0.6*	*0.4*	*0.7*	*0.3*	*0.7*	*0.6*
	3.0	*1.3*	*1.3*	*1.5*	*1.3*	*1.3*	*2.3*	*1.8*	*2.7*	*3.8*	*2.4*	*1.9*	*2.2*	*1.5*	*2.5*	*1.1*	*2.7*	*2.3*
	0.75	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.25*	*0*
	3.8	*1.3*	*1.3*	*1.5*	*1.3*	*1.3*	*2.3*	*1.8*	*2.7*	*3.8*	*2.4*	*1.9*	*2.2*	*1.5*	*2.5*	*1.1*	*2.9*	*2.3*
	6:12	6:13	6:15	6:17	6:19	6:21	6:23	6:25	6:28	6:32	6:34	6:36	6:38	6:40	6:42	6:44	6:47	6:50
	6:27	6:28	6:30	6:32	6:34	6:36	6:38	6:40	6:43	6:47	6:49	6:51	6:53	6:55	6:57	6:59	7:02	7:05
	6:42	6:43	6:45	6:47	6:49	6:51	6:53	6:55	6:58	7:02	7:04	7:06	7:08	7:10	7:12	7:14	7:17	7:20
	6:57	6:58	7:00	7:02	7:04	7:06	7:08	7:10	7:13	7:17	7:19	7:21	7:23	7:25	7:27	7:29	7:32	7:35
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ut s	New parking spaces	Queue jump lane	Notes
	300		300 spaces in new P&R lot
	100		H-P Campus. Proposed stop (southbound) is about 0.1 mile north of the intersection. Queue jump in both directions.
	200		Corporate Center. Queue jump in both directions.
	100		100 spaces in new parking structure
		1	Queue jump and queue jump lane
			243 spaces in existing P&R lot
	300		300 spaces in existing P&R lot
		1	Queue jump in both directions and one queue jump lane on Pleasant Grove (eastbound).
	50		West Roseville Town Center with 50 parking spaces
		1	T-intersection. Queue jump for southbound direction and queue jump lane.
	200		Placer Vineyards Center with 200 parking spaces; T-intersection
			T-intersection
			243 spaces in existing P&R lot

ut s	New parking spaces	Queue jump lane	Notes
	100		100 spaces in new parking structure
			Signalization
			Sutter Roseville Medical Complex
			T-intersection
		1	Queue jump in eastbound direction and queue jump lane.
		1	Queue jump in both directions and queue jump lane.
			T-intersection
			T-intersection
			432 spaces in existing P&R lot
			487 spaces in existing P&R lot
	950	5	

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