Memorandum

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To	Barrow Emerson, SamTrans Melissa Reggiardo, SamTrans	Date	14 November 2014
Copies		Reference number	
From	Corey Wong, Arup Steve Crosley, Fehr + Peers	File reference	
Subject	ECR BRT Implementation and Phasing Plan		

1 Introduction

This memo presents the conceptual implementation plan (i.e., schedule) for the proposed 2020 and 2040 service concepts. This implementation plan is high-level and provides generalized timeframes for implementation activities. Furthermore, the plan does not delve into durations for all detailed activities expected in the future – rather umbrella activities will be represented with indicative timeframes. For instance, a broad "construction" activity represents all construction-related activities that could include preliminary site surveys, removal of asphalt, implementation of new bus stops, and repaving of roadways, as well as testing and commissioning.

The memo also discusses potential conditions that would trigger consideration of Rapid/Hybrid service against conditions on the ECR Corridor today. Furthermore, conditions that would trigger consideration of Full BRT (i.e., Concept 10 2040 Full BRT) after initial implementation of 2020 enhancements are discussed as well.

2 Service Concepts

Illustrative timeframes are presented in this memo for three service concepts:

Table 1: Service Concepts and Key Assumptions

Concept	Description	Key Assumptions
Concept 2: 2020 Full Rapid	• The 2020 Full Rapid service concept consists of 15-minute headways, and 37 stops in each direction from Daly City to Palo Alto. • The ECR local service (i.e., the existing ECR) continues to operate its existing schedule and serves the current stop pattern (15-minute headways and 102 existing northbound (NB) stops and 104 existing southbound (SB) stops).	• 74 enhanced stops (37 in each direction) • 17 new (additional) vehicles • Transit Signal Priority (TSP) at 120 intersections • No pavement or right-of-way (ROW) improvements • No ROW acquisition
Concept 5: 2020 Hybrid A	• The 2020 Hybrid A service concept consists of 12-minute headways and 76 stops between Daly City and Palo Alto.	• 74 enhanced stops (37 in each direction) • 78 stops with minor

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Concept	Description	Key Assumptions
(76 stops with 12-minute service frequencies)	• Hybrid service provides faster service than the ECR local service and provides more local access than the Full Rapid in higher demand segments. • ECR local service is discontinued in this concept.	improvements (39 in each direction) • 3 new (additional) vehicles • TSP at 120 intersections • No pavement or ROW improvements • No ROW acquisition
Concept 10: 2040 Full BRT	• The 2040 Full BRT (Bus Rapid Transit) consists of 15-minute headways and 37 stations in each direction from Daly City to Palo Alto. • This concept retains the ECR local service with 15-minute headways and 102 existing NB stops and 104 existing SB stops.	• 74 BRT stations (37 in each direction) • Stations are equipped with real-time information, ticket vending machines (TVMs), and a higher level of passenger amenities than either those for Concepts 2 or 5 • 14 new (additional) vehicles • 10.9 miles of dedicated bus lanes (either median or curb) • 6 queue jump lanes • TSP has already been installed in previous stages • Some ROW acquisition assumed at this point (to be determined in later engineering/design stages)

3 Implementation Timeframes by Concept

3.1 Key Assumptions

Implementation activities run the gamut from preliminary engineering, to environmental analysis, to approval, to procurement, to construction and finally operation. **It is assumed for each of the three service concepts, the implementation timeline begins once SamTrans Board approval is given to study the concept in greater detail.** Therefore, preliminary conceptual planning activities prior to SamTrans Board approval are assumed to have already occurred and are not included in the implementation timeframes presented below.

Furthermore, the timeframes depicted here are indicative and could change significantly depending on public processes, the political and community atmosphere, as well as unforeseen delays in approvals, particularly during the engineering/design, environmental and construction stages.

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3.2 Concept 2: 2020 Full Rapid

Key activities for implementing Full Rapid service by 2020 are as follows (note conceptual planning and feasibility study have been undertaken under this study):

- **Engineering and Design** - Once the Board approves further studies, engineering and design will occur for about 9 months. Engineering and design will principally focus on station improvements, vehicle specifications and requirements, and related TSP specifications. Activities under this task will include utility coordination, permits and approvals.
- **Funding** - Funding activities will start concurrently with engineering and design and become more urgent once reliable cost estimates are developed. The funding activity may take up to 12 months and will likely continue after engineering and design are done. Funding activities include identifying sources, applying for funding, and procuring or obtaining agreements for funding.
- **Contractor Procurement** - Once funding is procured, the project will move into contractor procurement immediately, which is expected to take about 3 months (including notice to bid, bidding evaluation, and approval).
- **Construction** - Once the contractor is selected, construction, testing and commissioning activities will take place for the next 12 months. This will include construction of enhanced stops and installation of the TSP systems. It is noted that the construction timeframe is based on a conservative estimate of resource deployment to minimize costs – a quicker construction timeframe could be achieved, with deployment of multiple work crews simultaneously and additional costs (including those for additional traffic management crews).
- **Vehicle Procurement** - Vehicle procurement for the 17 new vehicles will begin concurrently with construction. This activity will include notice to bid, evaluation of bids, and selection of a preferred vendor. This process, including testing of the vehicles, will take about 12 months. This timeframe is based on research that the bus delivery backlog is about 9 to 12 months to build and equip the buses to typical SamTrans requirements. It is assumed that the vehicles procured by SamTrans are similar to current models already being produced and do not require a new design (or assembly line) that would take longer to develop, build and deliver.
- **Opening** - Overall, the timeframe from initial Board approval to study to the first day of service will be about **two and a quarter years or 27 months**.

Figure 1 depicts a conceptual timeline for implementation. Potential factors to consider that may delay or elongate implementation include:

- **Local Coordination** - Coordination with local jurisdictions and coming to an agreement on the final design may result in longer than anticipated implementation timelines. Coordination may revolve around stop design, TSP, etc.
- **Caltrans Coordination** – El Camino Real is a state highway under Caltrans's ultimate jurisdiction. Negotiation over any changes along the corridor must be undertaken and could result in delays to the project.
- **Funding** – Procurement of full funding could take longer than expected as well.

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Figure 1: Concept-Level Implementation Timeframe (Service Concept 2: 2020 Full Rapid)

Concept 2: 2020 Full Rapid			Year 1												Year 2												Year 3											
#	Task Name	Duration / Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	Board Approval to Study																																					
2	Engineering / Design	9 Months	■	■	■	■	■	■	■	■	■																											
3	Funding	12 Months	■	■	■	■	■	■	■	■	■	■	■	■																								
4	Contractor Procurement	3 Months													■	■	■																					
5	Construction (including Testing & Commissioning)	12 Months																■	■	■	■	■	■	■	■	■	■	■	■									
6	Vehicle Procurement	12 Months																■	■	■	■	■	■	■	■	■	■	■	■									
7	Opening																												★									

Notes:
Timeframes are indicative and could differ depending on various factors as noted.

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3.3 Concept 5: 2020 Hybrid A

Key activities for implementing Hybrid A service by 2020 are as follows (note conceptual planning and feasibility study has been undertaken under this study):

- **Engineering and Design** - Once the Board approves further studies, engineering and design will occur for about 9 months. Engineering and design will principally focus on station improvements, vehicle specifications and requirements, and related TSP specifications. Activities will also include utility coordination, permits and approvals.
- **Funding** - Funding activities will start concurrently with engineering and design, and become more urgent once cost estimates are developed. The funding activity may take up to 12 months and will likely continue after engineering and design is done. Funding activities include identifying sources, applying for funding, and procuring or obtaining agreement for funding.
- **Contractor Procurement** - Once funding is procured, the project will move into contractor procurement immediately, which will take about 3 months (including notice to bid, bidding evaluation, and approval).
- **Construction** - Once the contractor is selected, construction, testing and commissioning activities will take place for the next 15 months. This will include construction of the enhanced stops, implementation of minor improvements at other stops, as well as installation of the TSP systems. Minor stop improvement works will lengthen construction duration by three months compared to the 2020 Full Rapid timeframe. It is noted that the construction timeframe is based on a conservative estimate of resource deployment to minimize costs – a quicker construction timeframe could be achieved by deploying multiple work crews simultaneously which would raise costs (including those for additional traffic management crews).
- **Vehicle Procurement** - About 6 months into the construction period, vehicle procurement for the 3 new vehicles will begin. This activity will include notice to bid, evaluation of bids, and selection of a preferred vendor. This process, including testing of the vehicles, will take about 9 months. This timeframe is based on research that the bus delivery backlog is about 9 to 12 months to build and equip the buses to typical SamTrans requirements. It is assumed that the vehicles procured by SamTrans are similar to current models already being produced and do not require a new design (or assembly line) that would take longer to develop, build and deliver.
- **Opening** - Overall, the timeframe from initial Board approval to study to the first day of service will be about **two and a half years or 30 months**.

Figure 2 depicts a conceptual timeline for implementation. Potential factors to consider that may delay or elongate implementation include:

- **Local Coordination** - Coordination with local jurisdictions and coming to an agreement on the final design may result in longer than anticipated implementation timelines. Coordination may revolve around stop design, TSP, etc.
- **Caltrans Coordination** – El Camino Real is a state highway under Caltrans's ultimate jurisdiction. Negotiation over any changes along the corridor must be undertaken and could result in delays to the project.

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- **Funding** – Procurement of full funding could take longer than expected as well.

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Figure 2: Concept-Level Implementation Timeframe (Service Concept 5: 2020 Hybrid A)

Concept 5: 2020 Hybrid A		
#	Task Name	Duration / Months
1	Board Approval to Study	
2	Engineering / Design	9 Months
3	Funding	12 Months
4	Contractor Procurement	3 Months
5	Construction (including Testing & Commissioning)	15 Months
6	Vehicle Procurement	9 Months
7	Opening	

Notes:
Timeframes are indicative and could differ depending on various factors as noted.

3.4 Concept 10: 2040 Full BRT

Key activities for implementing Full BRT service by 2040 are as follows:

- **Draft Environmental Studies and Conceptual Engineering (15%)** – Once the Board approves further studies, draft environmental studies and conceptual engineering will be conducted for 36 months or 3 years. Activities under this task will include 15% design for bus lanes and stations, fleet planning and initial specifications, operating plan development and cost development (operating and capital). For this three year duration, the majority of time will be spent developing the draft environmental studies, including public outreach and the collection and response to public comments. A preferred alternative will be identified and then vetted.
- **Preferred Alternative and Preliminary Engineering** – In this stage, the preferred alternative will be confirmed following outreach and finalization of the environmental studies. Preliminary engineering for the preferred alternative will follow, which represents the 35% design stage to refine conceptual engineering to improve the project scope, cost estimates, and traffic management plan. Preliminary engineering will also identify whether ROW acquisition is required and, if so, the extent and location of these proposed acquisitions. Overall, this activity will take up to 18 months.
- **Final Design, Construction Documents, and Funding** – About halfway through preliminary engineering, funding activities will commence. Once preliminary engineering is finalized, final design as well as production of construction documents will occur. This task thus includes preparing the full engineering package including the project management plan, quality control/quality assurance for construction, utility relocation, and obtaining permits, etc. Funding activities will include identifying sources, applying for funding, and procuring or obtaining agreement for funding. This stage will take about 24 months.
- **ROW Acquisition** – ROW acquisition will start about halfway through the Final Design, Construction and Funding task, once the majority of funding has been arranged and the locations for potential ROW acquisition are finalized. ROW acquisition will include valuating property and seeking to purchase this ROW. ROW acquisition is estimated to take up to 18 months, although this could be highly variable depending on the extent of acquisition required.
- **Contractor Procurement** - Once final design, construction documents and ROW acquisition are complete, the project will move into the contractor procurement immediately, which will take about 6 months (including notice to bid, bidding evaluation, and approval).
- **Construction** - Once the contractor is selected, construction, testing and commissioning activities will take place for the next 48 months. This will include construction of the new BRT stations, the bus lanes, as well as the queue jumps lanes. This activity also includes minor pavement improvements to mixed flow lanes, as well as final activities once the bus lanes are ready, including final signage and striping. It is noted that the construction timeframe is based on a conservative estimate of resource deployment to minimize costs – a quicker construction timeframe could be achieved however, with deployment of multiple work crews simultaneously which would raise costs (including those for additional traffic management crews).

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- **Vehicle Procurement** – Twelve (12) months prior to initiation of BRT service, vehicle procurement for the 14 new vehicles will begin. This activity includes notice to bid, evaluation of bids, and selection of a preferred vendor. This process, including testing of the vehicles, will take about 12 months. This timeframe is based on research that the bus delivery backlog is about 9 to 12 months to build and equip the buses to typical SamTrans requirements. It is assumed that the vehicles procured by SamTrans are similar to current models already being produced and do not require a new design (or assembly line) that would take longer to develop, build and deliver.
- **Opening** – Overall, the timeframe from initial Board approval to study to the first day of service will be about **10 and a quarter years or 123 months**.

Figure 3 depicts a conceptual timeline for implementation. Potential factors to consider that may delay or elongate implementation include:

- **Local Coordination** - Coordination with local jurisdictions and coming to an agreement on the final design may result in longer than anticipated implementation timelines. Coordination may revolve around stop design, TSP, etc.
- **Caltrans Coordination** – El Camino Real is a state highway under Caltrans's ultimate jurisdiction. Negotiation over any changes along the corridor must be undertaken and could result in delays to the project – particularly if design exceptions are required. It is unclear, however, if Caltrans will still hold jurisdiction over El Camino Real at this stage in the future.
- **Funding** – Procurement of full funding could take longer than expected as well.
- **Environmental Approvals** – Depending on the level of changes to the street and right-of-way, the environmental approval process (along with right-of-way acquisition) have the greatest chance of impacting and thus delaying implementation of the 2040 Full BRT.
- **Right-of-Way Acquisition** – The larger the amount of land required in sensitive or dense areas, the higher the likelihood for implementation delays due to potential litigation (from residents, businesses, etc.) as well as potential utility conflicts and relocation issues.

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Figure 3: Concept-Level Implementation Timeframe (Service Concept 10: 2040 Full BRT)

Concept 10: 2040 Full BRT		
#	Task Name	Duration / Months
1	Board Approval to Study	
2	Draft Environmental Studies and Conceptual Engineering (15%)	36 Months
3	Preferred Alternative and Preliminary Engineering	18 Months
4	Final Design, Construction Documents, and Funding	24 Months
5	ROW Acquisition	18 Months
6	Contractor Procurement	6 Months
7	Construction (including Testing & Commissioning)	48 Months
8	Vehicle Procurement	12 Months
9	Opening	

Notes:
Timeframes are indicative and could differ depending on various factors as noted.

4 Phasing Considerations

The evolution of bus transit on the ECR corridor today – from ECR service to a Rapid/Hybrid (intermediate term) to Full BRT service (long-term) is not set in stone. Certain conditions, thresholds, and performance must be met to even consider enhancing service with more capitally-intensive investments. In other words, certain "triggers" must be met in order to start considering and discussing enhancing service beyond what is provided today. Potential triggers are discussed below (note – this section is meant to discuss a few primary triggers, however, this does not mean that other triggers including business and political interests are not also important in this discussion).

4.1 Land Use

4.1.1 General Sampling of Land Use Thresholds

Currently, land use throughout the corridor is largely low-density, with built-up pockets around certain downtown areas. Minimum and appropriate land use densities and development are required along the corridor to generate sustainable, all-day ridership to justify more capitally-intensive concepts. Table 2 presents a sampling of minimum target density thresholds for different tiers of transit service in North America.

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Table 2: Minimum Target Land Use Thresholds for Different Tiers of Transit in Select Regions in North America

			Minimum Target Threshold (by Service Tier)			
Region	**Unit**	**Source/ Entity**	**Metro**	**Light Rail Transit (LRT)**	**BRT**	**Local Bus**
Alameda County, CA	Persons / Square Mile	Alameda County Transit (AC Transit)			20,000 +	10,000-20,000
San Francisco Bay Area	Housing Units / Station Area	Metropolitan Transportation Commission	3,850	3,300	2,750	2,200
San Jose, CA	Dwelling Units / Acre	VTA		35	25-32	
Toronto, ON	Jobs + Residents / Hectare	Metrolinx	300+	200-400	100-250	50-150
United States (Average)	Dwelling Units / Acre (Employees per Acre)	Kane County Bus Rapid Transit Primer	30 (50)		15 (30)	12 (15)
Unites States (Average)	Dwelling Units / Acre	Transit Cooperative Research Program 102		30		15

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4.1.2 VTA Land Use Thresholds

The table above identifies minimum target thresholds for residential density for the Santa Clara Valley Transportation Authority (VTA)'s BRT and LRT services. The thresholds, however, are much more detailed. The VTA's Service Design Guidelines were developed to guide system development and govern minimum service performance and productivity. These guidelines have been used to provide an impetus for developing both Rapid as well as Full BRT type services on the El Camino Real, Alum Rock, and Stevens Creek BRT corridors around Santa Clara County. Furthermore, land use conditions (including character and nature of the corridor, and population and job densities in most areas) along the Santa Clara portion of the El Camino Corridor are similar to that in San Mateo County, making land use thresholds developed by VTA one of, if not the most, comparable case to ECR-types of transit service. These guidelines thus serve as a potential framework for land use considerations on the ECR Corridor in San Mateo County.

Table 3 presents VTA's Transit Sustainability Policy (TSP), which defines minimum (and recommended) residential density targets for different tiers of transit service (with higher densities required for LRT and BRT than local bus, for instance). As is clear, different on-the-ground conditions can dictate different density threshold values.

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Table 3: VTA Density Targets for Existing and New BRT Routes

Table 4 Residential Density Targets along New BRT Corridors

Line Type	Optimal Densities (DUA) (Within 1–2 blocks or 330–660 feet of corridor)		
	Minimum[A]	Target	Optimal
BRT	12–16	25–32	30–50+

Table Notes:
Source: Based on CDT Manual, Table D-1.
[A] Considerations will be allowed if there are signs that efforts are being made to increase residential densities along the corridor.
[B] Envisioned BRT station area guidelines will be similar to those for LRT stations.
[C] Based on the Optimal and Minimum FARs.

Table 5 Residential Density Targets around New BRT Stations

	Optimal New Residential Project Density (DUA within 1/3 mile of BRT station)		
	Minimum[A,B]	Target[C]	Optimal
BRT Station (Regional)	20	27.5	35+
BRT Station (Local)	10	15	20+

Table Notes:
Source: Based on CDT Manual, Table D-1.
[A] Considerations will be allowed if there are signs that efforts are being made to increase residential densities along the corridor.
[B] Envisioned BRT station area guidelines will be similar to those for LRT stations.
[C] Based on the Optimal and Minimum FARs.

Table 6 Commercial Density Targets along New BRT Corridors

Line Type	Target Floor Area Ratio (Within 1–2 blocks or 330–660 feet of corridor)	
	Train Station or Transit Corridor	Major BRT stations
BRT	2.0	1.0

Table Notes:
Source: Based on CDT Manual, Table D-1.
[A] Considerations will be allowed if there are signs that efforts are being made to increase residential densities along the corridor.
[B] Envisioned BRT station area guidelines will be similar to those for LRT stations.
[C] Based on the Optimal and Minimum FARs.

Table 7 Commercial Density Targets around New BRT Stations

Line Type	Target Floor Area Ratios (FAR within 1/3 mile of BRT station)		
	Minimum[A,B]	Target[C]	Optimal
BRT Station (Regional)	1.0	1.5	2.0
BRT Station (Local)	0.5	0.75	1.0

Table Notes:
Source: Based on CDT Manual, Table D-1.
[A] Considerations will be allowed if there are signs that efforts are being made to increase residential densities along the corridor.
[B] Envisioned BRT station area guidelines will be similar to those for LRT stations.
[C] Based on the Optimal and Minimum FARs.

VTA TRANSIT SUSTAINABILITY PO

Source: VTA Transit Sustainability Policy (TSP), Bus Rapid Transit Service Design Guidelines, 2007.

Based on the similarities in land use and development scope, it is recommend that SamTrans develop its own density thresholds for both Rapid/Hybrid, but especially BRT service tiers (both residential and job densities) based on the VTA Service Design Guidelines (thus similar density thresholds as shown in Table 2 and Table 3). It is essential that BRT have supportive densities due to the capital costs that would conceivably be incurred with additional fixed route infrastructure such as BRT stations, queue jump lanes, and dedicated bus lanes.

Land use triggers thus may occur when the corridor on a whole starts to approach defined housing and job densities – designed to provide more supportive conditions and hopefully sustainable levels of ridership for higher investment services on the ECR corridor. The land use triggers will start the discussion – this discussion though also must include close collaboration between SamTrans and the local jurisdictions to assure supportive land use policies and that the “right” type of development is encouraged along the corridor.

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4.2 Ridership / Performance

Increasing the amount and level of service on the corridor can be rationalized if certain levels of performance (in terms of boardings per revenue hour, etc.) are being met and/or exceeded. Routes/corridors that perform below expectations should not be considered for additional service investments until they meet minimum performance thresholds.

Different operators/agencies use different metrics to assess ridership and performance thresholds. Most commonly used metrics include: (i) ridership per revenue hour; (ii) load factor; and (iii) farebox recovery. The examples below show that although there is no set agreement on the thresholds for minimum performance as each system is different, all operators clearly differentiate performance expectations among local, Rapid, and BRT service tiers.

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Table 4: Minimum Ridership/Performance Thresholds for Different Tiers of Transit in Select Regions in North America

Agency / Location	Service	Tier	Ridership/Performance Threshold
AC Transit / Alameda County, CA	Local	Local	30 boardings / weekday revenue hour
	Rapid	Rapid	40 boardings / weekday revenue hour
Kansas City Area Transportation Authority (KCATA) Kansas City, MO	Urban Local Bus	Local	15 boardings / weekday revenue hour
	MAX	Rapid	30 boardings / weekday revenue hour
VTA / San Jose, CA	Local Bus	Local Bus Primary Grid	30 boardings / weekday revenue hour
	Rapid	Rapid	45 boardings / weekday revenue hour 200 boardings / route mile
	BRT	BRT	55 boardings / weekday revenue hour 350-475 boardings / route mile
Big Blue Bus / Santa Monica, CA	Local Bus	Local	20 boardings / weekday revenue hour $5.00 maximum cost/boarding 12% farebox recovery
	Big Blue Bus	Rapid	40 boardings / weekday revenue hour $4.50 maximum cost/boarding 16% farebox recovery
TransLink / Vancouver, BC, Canada	Local Bus	Local	30% weekday peak load factor 25% weekend mid-day load factor
	B-Line	Rapid	50% weekday peak load factor 30% weekday mid-day load factor

Source:
AC Transit – Service Standards and Design Policy (2008) http://www.actransit.org/wp-content/uploads/board_policies/board_policy_96.pdf
KCATA – KCATA Comprehensive Service Analysis (2011)
http://www.kcata.org/images/uploads/DraftServiceGuidelines.pdf
VTA – VTA Service Design Guidelines (2007)
Santa Monica Big Blue Bus - Service Design, Performance, and Evaluation Guidelines, Big Blue Bus (2013)
http://www.smgov.net/departments/Council/agendas/2013/20130924/s2013092408-B-1.pdf
Vancouver - TransLink Transit Service Guidelines (2004)

It is recommended that SamTrans develop service standards for both Rapid and BRT services for its refined service design guidelines. From a review of other operators, it appears that a minimum 20% increase in performance is typically expected between local and Rapid services (with an even more pronounced increase in performance expected for BRT). It is recommended that the VTA thresholds serve as a guide for potential service thresholds (50% increase in boardings per revenue hour for the Rapid over the local, and an additional 20% increase in boardings per revenue hour for the BRT over the Rapid). Performance can thus trigger the need to consider service upgrades when local services meet and significantly exceed service standards for several consecutive years.

4.3 Congestion and Travel Time Triggers

Traffic congestion and mixed flow conflicts can significantly reduce bus operating speeds and elongate trip times. While the Rapid/Hybrid service concepts call for longer stop spacing and TSP

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to reduce stopping and increase average travel speeds, future traffic conditions may significantly reduce bus operating speeds and negate some of the enhancement measures put in place. Increasing physical segregation of buses from mixed flow traffic (i.e., one element of Full BRT) may be one strategy to increase operating speeds in the face of more serious congestion.

Thus one trigger for considering service enhancements on a corridor could be the amount of congestion and delay that is experienced in the corridor. For instance, if total bus running time consists of XX% of time spent in delay or on-time performance falls well below stated SamTrans standards, this could be a sign that new measures must be undertaken to improve reliability and speeds (such as TSP and reduced stops (i.e., the Rapid or Hybrid) or bus lanes (i.e., the Full Rapid). Furthermore, if XX% of intersections operate at LOS E/F, then this could also be a trigger.

A more concrete means of considering congestion is travel time savings and operating speed. The following examples identify average travel time savings or increases in average operating speed observed for various Rapid and BRT systems (versus that for the local bus services). While these systems do not specify a target operating speed or travel time savings to be achieved in their respective service design guidelines, these examples are noteworthy for illustrating the extent of benefits that may be generated when upgrading transit services on a corridor.

Table 5: Minimum Target Operating Speeds for Different Tiers of Transit in Select Regions in North America

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Tier	Location	Service	Location
BRT	Cleveland	Health Line	• 25% travel time savings over local
BRT	Eugene	EmX	• 6% travel time savings over local
BRT	Las Vegas	MAX	• 25% peak travel time savings over local
Rapid	Alameda County	San Pablo Rapid	• 21%/17% travel time savings over local/limited
Rapid	Boston	Silver Line (Washington Street)	• 9% travel time savings over local
Rapid	Kansas City	MAX	• 25% travel time savings over local • On-time performance improved from 80% to 90%
Rapid	Los Angeles	Metro Rapid (Venture)	• 23% increase in operating speeds over local
Rapid	Los Angeles	Metro Rapid (Wilshire/ Whittier)	• 29% increase in operating speeds over local
Rapid	San Jose	522 Rapid	• 25% expected travel time savings over local

Source:
San Jose: VTA Factsheet Rapid 522, 2006.
Others: Bus Rapid Transit Applications Phase 2, Florida Department of Transportation, District IV, 2011.

From the examples in the table, in general, a minimum travel time savings of 20% was generated for most operators when upgrading from local to Rapid or local to BRT. Therefore, it is recommended that SamTrans quantify an approximate increase in travel speed or travel time savings between local and Rapid services, as well as Rapid and BRT services. Thus, one trigger to consider upgrading from Rapid to BRT service on the El Camino Corridor could be if operating speeds for the Rapid are falling well below the

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expected premium speed differential between the local (thus speed in this case acts as a proxy for corridor congestion and delay). It should be noted, however, that few operators quantified a speed target in their service guidelines, as speed and travel time are subject to many different variables besides just the amount of transit priority provided along the route.

5 Summary

Based on the analysis above, the expected implementation timeframes for the three service concepts, as well as potential factors that could impact implementation are depicted below. As noted before, environmental approvals and right-of-way acquisition for Concept 10 appear have the most potential to elongate the timeframe from what has been shown.

Table 6: Summary of Implementation Timeframes

Concept	Indicative Implementation Timeframe	Potential Factors to Consider that Could Impact Implementation Timeframe
Concept 2: 2020 Full Rapid	27 months	• Coordination with local jurisdictions and coming to agreement on final design for bus stops • Coordination with Caltrans during design and engineering • Difficulties in procuring full funding for improvements
Concept 5: 2020 Hybrid A	30 months	• Coordination with local jurisdictions and coming to agreement on final design for bus stops • Coordination with Caltrans during design and engineering • Difficulties in procuring full funding for improvements
Concept 10: 2040 Full BRT	123 months	• Coordination with local jurisdictions and coming to agreement on final design for bus stops • Coordination with Caltrans during design and engineering • Difficulties in procuring full funding for improvements • Environmental approvals (potential to have serious schedule implications) • Right of way acquisition (potential to have serious schedule implications)

Key implementation triggers were discussed including land use, performance and congestion (travel time). Key phasing considerations for upgrading the corridor from local to Rapid/Hybrid and/or BRT service are noted below:

Table 7: Summary of Key Phasing Consideration and Triggers

Key Potential Trigger	Key Phasing Considerations and Triggers
Land Use	• Based on the similarities in land use and development scope, it is recommended that SamTrans develop its own density thresholds for both Rapid/Hybrid, but especially BRT service tiers (both residential and job densities) based on the VTA Service Design Guidelines (similar density

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Key Potential Trigger	Key Phasing Considerations and Triggers
	thresholds as shown in Table 2 and Table 3). • Land use triggers thus may occur when the corridor on a whole starts to approach defined housing and job densities – designed to provide more supportive conditions and hopefully sustainable levels of ridership for higher investment services on the ECR corridor.
Ridership / Performance	• It is recommended that SamTrans develop service standards for both Rapid and BRT services for its refined service design guidelines. It is recommended that the VTA thresholds serve as a guide for potential service thresholds (50% increase in boardings per revenue hour for the Rapid over the local, and an additional 20% increase in boardings per revenue hour for the BRT over the Rapid). • Performance can thus trigger the need to consider service upgrades when local services meet and significantly exceed service standards for several consecutive years.
Congestion / Travel Time	• It is recommended that SamTrans quantify an approximate increase in travel speed or travel time savings between local and Rapid services, as well as Rapid and BRT services. • Thus, one trigger to consider upgrading from Rapid to BRT service on the El Camino Corridor could be if operating speeds for the Rapid are falling well below the expected premium speed differential between the local (thus speed in this case acts as a proxy for corridor congestion and delay).

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