Appendix B

Demand Memos

B1 Preliminary Travel Demand Memo

B2 Airport Passenger Demand Analysis Memo

B3 Origin-Destination Matrix

Memorandum

ARUP

To	Manuel Pineda Laura Stuchinsky Henry Servin	**Date**	February 9, 2011
Copies	Thomas Paige, Aerospace Everett L. Midkiff, Aerospace	**Reference number**	214704/GH
From	Gary Hsueh x 27209 (SF) Will Baumgardner	**File reference**	4-05
Subject	San José ATN Feasibility Study: Preliminary Travel Demand	**Page** 1 **of** 4	

This memo contains a brief discussion of the preliminary travel demand shared with City staff at the February 2, 2011 meeting for the San José Automated Transit Network (ATN) Feasibility Study. Table 1 and Table 2 provide an initial approximation of the total daily trips for the key travel movements that an ATN might be designed to serve. Table 1 provides calculation for existing conditions (between 2005 and 2010 depending on data source) and Table 2 provides estimates for year 2030 based on the VTA model forecast of the City's General Plan buildout (which correlates roughly with the Airport's forecast of 17.6 million annual passengers in 2027). Figure 1 is a diagram that illustrates graphically the information presented in Table 1 and Table 2. The location of long-term parking in Figure 1 reflects the construction projects currently underway to relocate long-term parking from west side of the airfield to the east side.

Methodology

The methodology used for calculating the numbers presented in the tables consists of the steps listed below. Further information about each step is provided at the end of this memo.

- Assessing total demand from the airport terminals. The total demand from each terminal was based on the VTA model baseline and checked against annual air passengers in 2009.
- Identifying key travel movements. Key travel movements were identified using Measure A objectives and a review of other movements that could be served by a potential ATN system.
- Combining total volumes from each terminal with mode share data. The total demand was split between air passengers and employees based on the information gathered from passenger intercept surveys conducted in 2005 for the Airport. The future condition estimates presented in Table 2 do not assume a change in mode share.

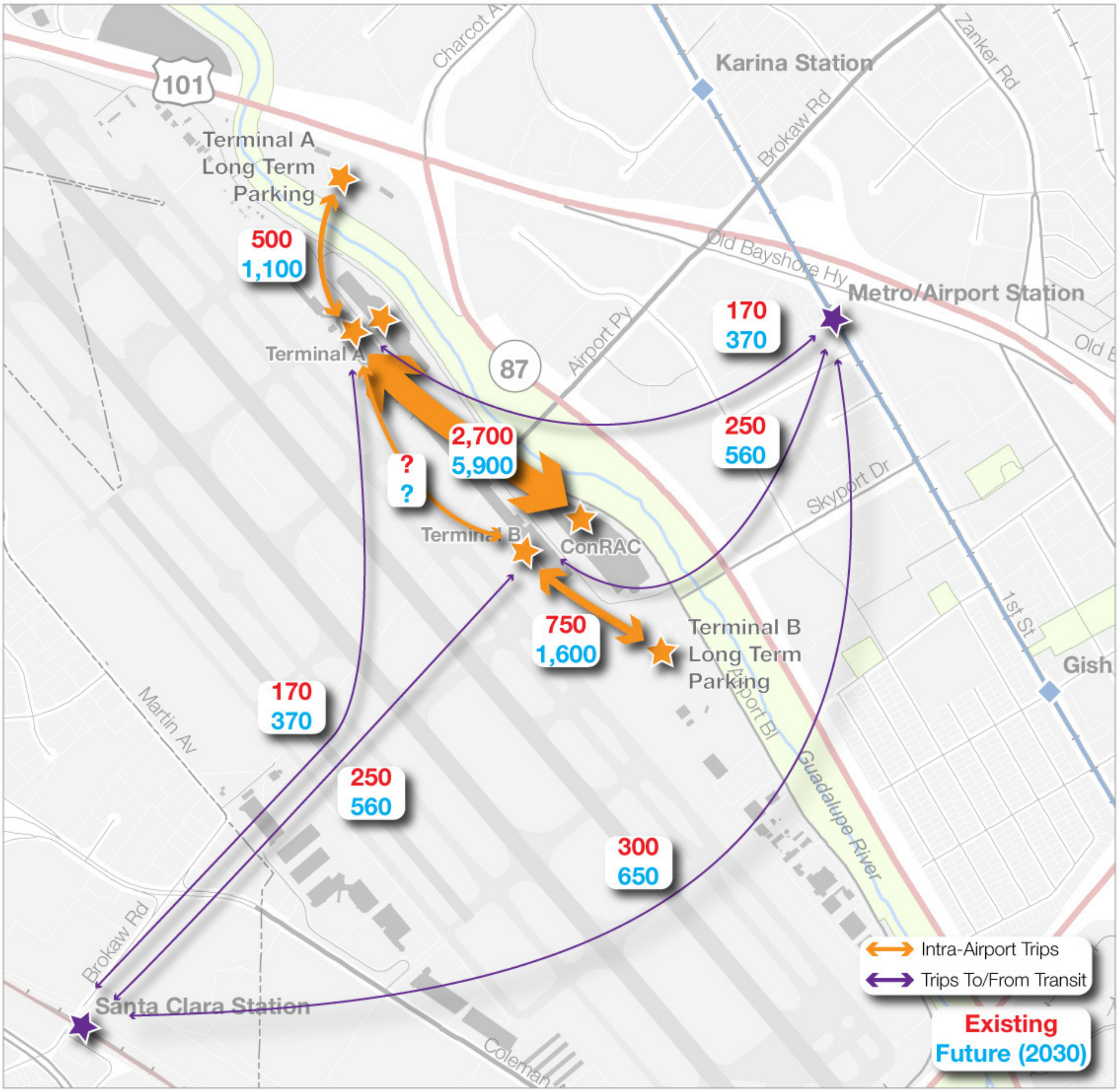
Table 1. Approximate Daily Trips for Key Movements (Existing)

	Terminal B	ConRAC	Term. A Long-Term Parking	VTA LRT	Santa Clara Caltrain
Terminal A	?	2,700	500	170	170
Terminal B		n/a (walk)	750	250	250
VTA LRT					300

Table 2. Average Daily Trips for Key Movements (2030)

	Terminal B	ConRAC	Term. A Long-Term Parking	VTA LRT	Santa Clara Caltrain
Terminal A	?	5,900	1,100	370	370
Terminal B		n/a (walk)	1,600	560	560
VTA LRT					650

Figure 1. Total Daily Trip Demand Between Selected Destinations, Existing and Future



Diridon Station

A cursory review of potential demand for an ATN system that would connect to Diridon Station in lieu of Santa Clara Station reveals that there is potentially greater demand due to High Speed Rail customers, particularly with respect to long-term parking (on the order of 5,500 additional daily trips) and access to rental cars (2,300 additional daily trips). However, it is unknown whether High Speed Rail customers would ride an ATN system between Diridon Station and the current long-term parking locations planned by the Airport or the ConRAC, because the travel time or distance may be too long. Separately, access to Caltrain and LRT are not anticipated to be key drivers of increased demand, though further study is likely warranted (Diridon offers more transit connections and higher transit service levels).

Additional Notes on Methodology

As mentioned above, this section provides more details of the methodology used to generate the travel demand presented in Table 1 and Table 2.

- Assessing total demand from the airport terminals. The total demand from each terminal was based on the VTA model baseline and checked against annual air passengers in 2009. A split was applied based on statements from Airport staff estimating that 40 percent of passengers travel through Terminal A and 60 percent of passengers travel through Terminal B. Employees were assumed to be concentrated in the terminal areas and were assumed to be split in the same proportion as air passengers. Demand at LRT and Caltrain transit stations was also taken into consideration using the VTA Route 10 on/off data from the VTA 2006 Comprehensive Operations Analysis.
- Identifying key travel movements. Key travel movements were identified using Measure A objectives and a review of other movements that could be served by a potential ATN system. These included the following:
    - Travel between the Airport terminals, VTA LRT, and Santa Clara Station (future BART connection).
    - Travel between the Airport terminals and the soon-to-be (April 2011) Terminal A Long-Term parking lot, which will only be accessible by Airport shuttle (not walkable by air passengers). This is comparable to previous conditions, where long-term parking was provided on the west side of the airfield and passengers were served by Airport shuttle.
    - Travel between Terminal A and the Consolidated Rental Car Facility (ConRAC), which is currently split between Airport shuttles and air passengers who choose to walk. Starting June 2011, employees will begin parking in the Terminal A garage and will also be given the choice of taking the Airport shuttle to Terminal B or walking. They currently park on the west side of the airfield and take an Airport shuttle.
- Combining total volumes from each terminal with mode share data. The total demand was split between air passengers and employees based on the information gathered from passenger intercept surveys conducted in 2005 for the Airport. The future condition estimates presented in Table 2 do not assume a change in mode share.
    - Approximately 1 percent of air passengers were estimated to connect to VTA LRT and Caltrain via transit. The mode share of employees is higher, but the total number of employees is approximately one-tenth that of air passengers. Employees are also

assumed to take two trips per day. Overall, employees account for approximately half of all transit connection trips to LRT and Caltrain.

- All air passengers arriving through Terminal A and renting a car, or returning a car and departing through Terminal A, are included in Table 1 and Table 2. Passengers renting a car and traveling through Terminal B are not counted because they have a short walk to the ConRAC.
- All air passengers using on-Airport long-term parking are included in Table 1 and Table 2. Excluded are on-Airport short-term parkers, who can walk directly to their terminal, and off-Airport long-term parkers, who are served by the off-Airport parking lot operator shuttles.
- The remainder of ridership on VTA Route 10 is attributed to through transit trips between LRT and Caltrain (not traveling to or from the Airport).

Memorandum

ARUP

To	Thomas Paige, Aerospace Everett L. Midkiff, Aerospace	Date	April 29, 2011
Copies	Laura Stuchinsky, CSJ Henry Servin, CSJ	Reference number	214704
From	Maulik Vaishnav, Arup Gary Hsueh, Arup Will Baumgardner, Arup	File reference	4-05
Subject	San José ATN Feasibility Study Airport Passenger Demand Analysis		

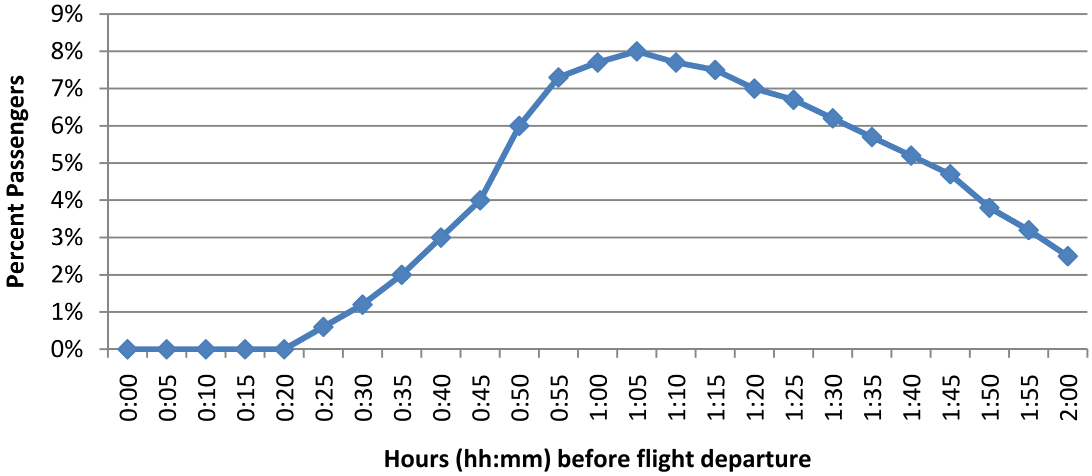
This memo presents an estimated temporal profile of passenger demand for the San José ATN Feasibility Study. Passenger volumes are estimated using departing and arriving flights at terminals A and B of Norman Y. Mineta San Jose International Airport (Airport, or SJC). The analysis was completed using the February 2011 weekday flight schedule. The temporal profiles are used in conjunction with daily forecasts to estimate future peak demand for the ATN. The employees working at the Airport are included in the daily forecasts. The term “at curb” is used here to describe the volume of passengers at terminal entrances and exits.

Passenger Demand Analysis

Based on a typical current weekday flight schedule provided by the Airport, 35 flights depart and 34 flights arrive at Terminal A and 99 flights depart and 102 flights arrive at Terminal B. The following assumptions were made to calculate passenger arrivals and departures near terminal entrances:

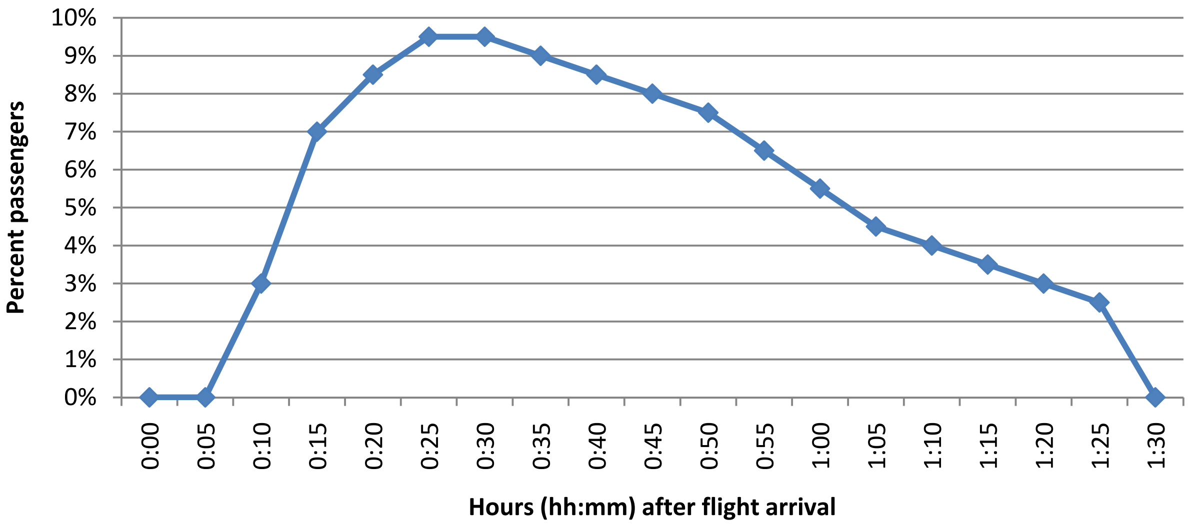
- A load factor of 0.7973 for SJC (FAA, 2010)
- A transfer rate of 0% at Terminal A and 7.5% at Terminal B (FAA, 2010)
- A departure profile (Figure 1) and arrival profile (Figure 2) for passengers arriving at the terminal entrances (not aircraft gates), based on typical profiles at other airports, knowledge of the configuration of SJC, and an informal conversation with Airport staff.

- **Figure 1: Assumed Departure Profile**



Note: Typical domestic flight departure profile

- **Figure 2: Assumed Arrival Profile**



Given these assumptions, each terminal's arrival and departure profiles are included in Figure 3 through Figure 6. Peak 15-minute and peak-hour demand for passengers at the curbs is shown in Table 1.

Figure 3: Profile of Departing Passengers at Curb, Terminal A

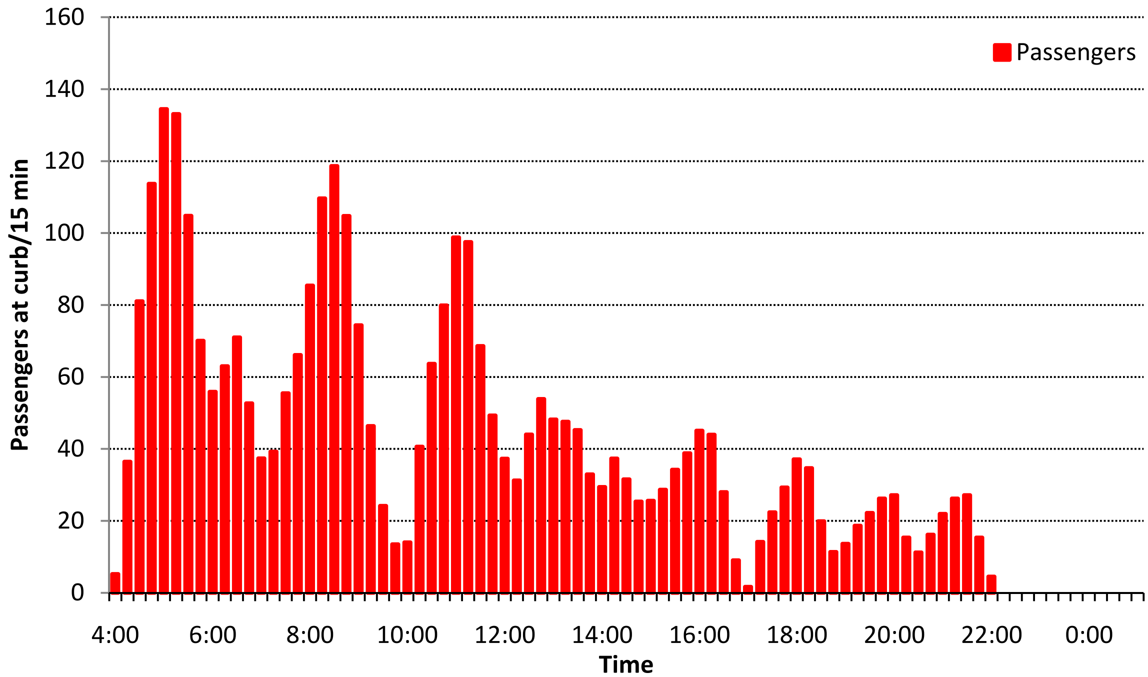


Figure 4: Profile of Arriving Passengers at Curb, Terminal A

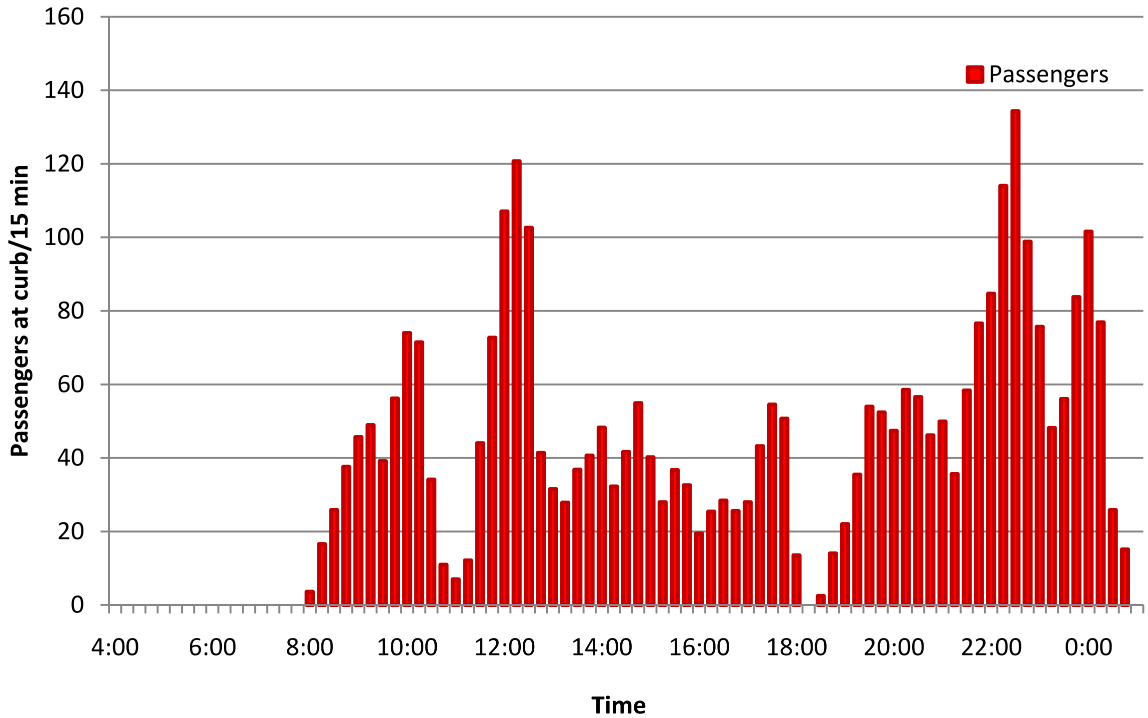


Figure 5: Profile of Departing Passengers at Curb, Terminal B

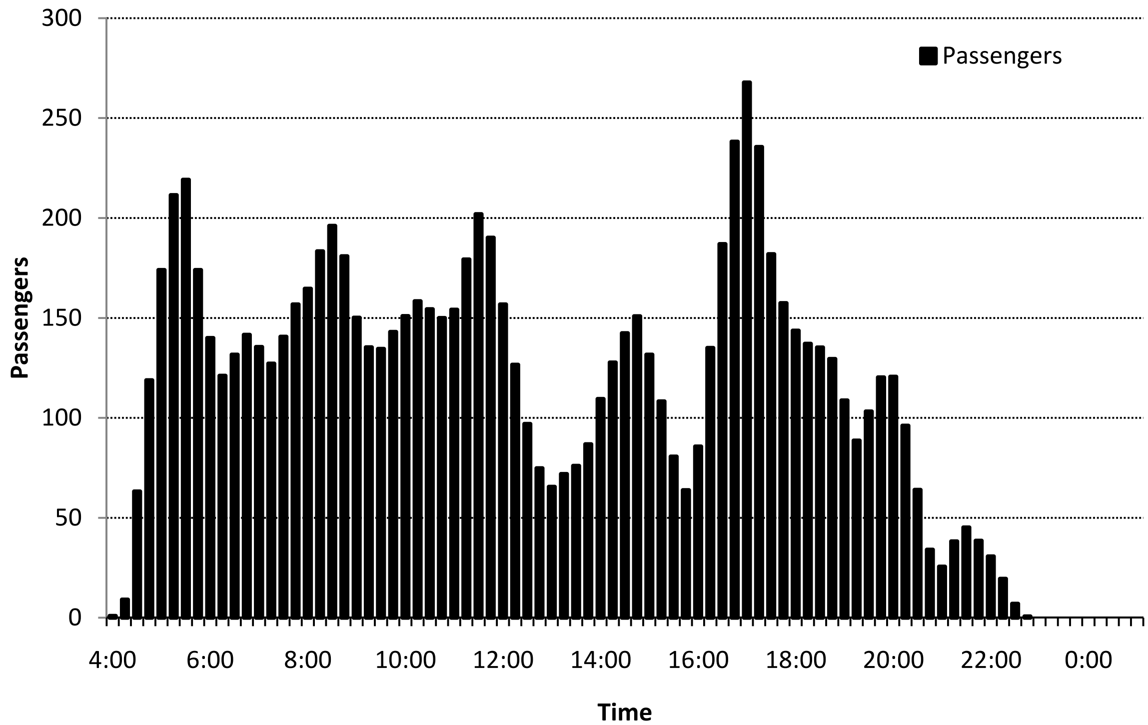


Figure 6: Profile of Arriving Passengers at Curb, Terminal B

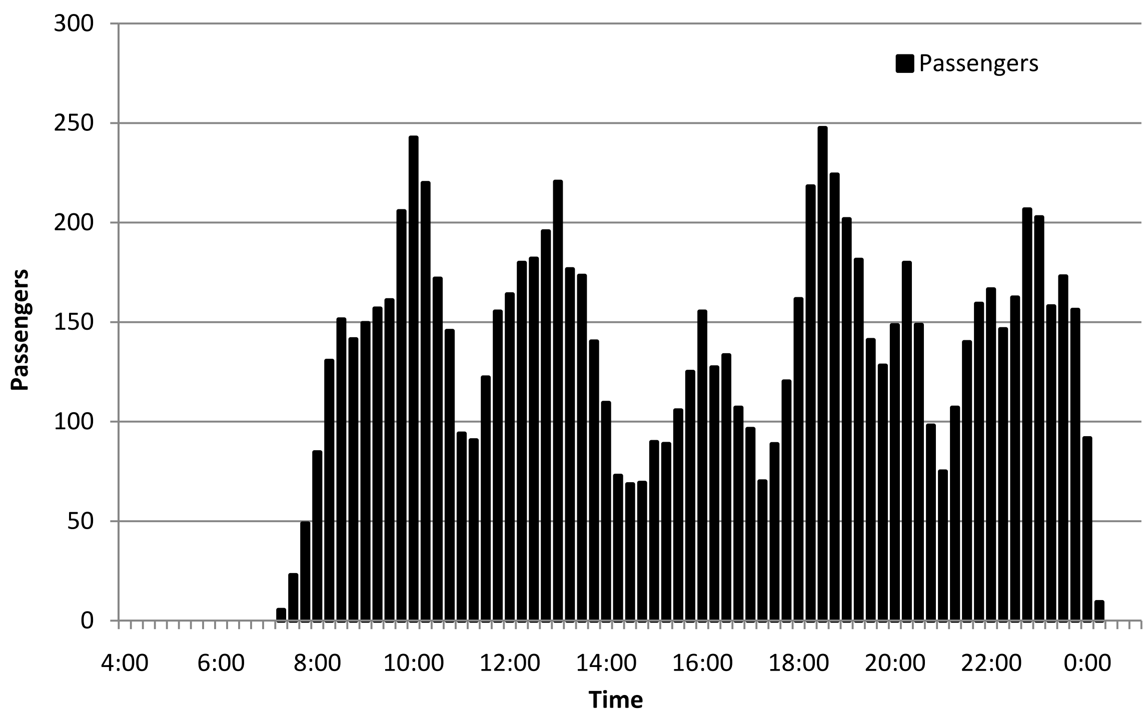


Table 1: Peak At-Curb Passengers at Terminals A and B

	Terminal A		Terminal B		Combined	
	Departing passengers	Arrived Passengers	Departing passengers	Arrived passengers	Departing passengers	Arrived passengers
Total Passengers	3,341	3,237	9,341	9,593	12,682	12,830
Peak Hour (Time)	486 4:45-5:45	431 22:00-23:00	936 16:30-17:30	891 18:15-19:15	1,220 5:00-6:00	1,111 22:15-23:15
Peak 15-min	134	134	268	248	344	317
(Time)	5:00-5:15	22:30-22:45	17:00-17:15	18:30-18:45	5:15-5:30	10:00-10:15

ATN Demand Analysis

As shared in previous documents, Table 2 presents daily ATN demand. A 100 percent walking share is assumed between Terminal B and ConRAC, and therefore is not assumed to contribute to ATN ridership demand.

Table 2: ATN Daily Demand

	Terminal B	ConRAC	Term. A Long-Term Parking	VTA LRT	Santa Clara Caltrain
Terminal A	?	2,700	500	170	170
Terminal B		n/a (walk)	750	250	250
VTA LRT					300

The four origins/destinations analyzed for peak period travel are Terminal A, Terminal B, ConRAC, and VTA LRT. Tables 3 through 6 present ATN demand between the origins and destinations during each terminal's peak hour and peak 15-minute period. Table 7 presents the ATN demand during the peak periods of combined departure activity at the terminals, while Table 8 presents the ATN demand during the peak periods of combined arrival activity. Table 9 presents the ATN demand during the peak periods for overall passenger activity at the Airport.

Because the demand between Terminal A and ConRAC is high compared to other movements, peak ATN demand is based on the peak passenger activity at Terminal A (as shown in Tables 3 and 4, and when compared to Tables 5 and 6). When passenger activity at the two terminals is combined, the peak periods shift because of the high passenger volume at Terminal B, and the overall demand for the ATN at that time is reduced. This is the effect exhibited in Tables 7 through 9.

Table 3: ATN Demand, During Terminal A Departing Passenger Peak

Peak Hour Time: 4:45-5:45 a.m.

Peak 15-minute Time: 5:00-5:15 a.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**196**	**12**	208
	15-min	**54**	**3**	57
Terminal B	Hour	n/a	**10**	10
	15-min	n/a	**2**	2

Table 4: ATN Demand, During Terminal A Arriving Passenger Peak

Peak Hour Time: 10:00-11:00 p.m.
Peak 15-minute Time: 10:30-10:45 p.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**180**	**11**	191
	15-min	**56**	**4**	60
Terminal B	Hour	n/a	**9**	9
	15-min	n/a	**2**	2

Table 5: ATN Demand, During Terminal B Departing Passenger Peak

Peak Hour Time: 4:30-5:30 p.m.
Peak 15-minute Time: 5:00-5:15 p.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**21**	**1**	22
	15-min	**1**	**0**	1
Terminal B	Hour	n/a	**12**	12
	15-min	n/a	**4**	4

Table 6: ATN Demand, During Terminal B Arriving Passenger Peak

Peak Hour Time: 6:15-7:15 p.m.
Peak 15-minute Time: 6:30-6:45 p.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**32**	**2**	34
	15-min	**1**	**0**	1
Terminal B	Hour	n/a	**12**	12
	15-min	n/a	**3**	3

Table 7: ATN Demand, During Airport Departing Passenger Peak

Peak Hour Time: 5:00-6:00 a.m.
Peak 15-minute Time: 5:15-5:30 a.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**130**	**8**	138
	15-min	**37**	**2**	39
Terminal B	Hour	n/a	**12**	12
	15-min	n/a	**3**	3

Table 8: ATN Demand, During Airport Arriving Passenger Peak

Peak Hour Time: 10:15-11:15 p.m.
Peak 15-minute Time: 10:00-10:15 a.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**120**	**8**	128
	15-min	**33**	**2**	35
Terminal B	Hour	n/a	**11**	11
	15-min	n/a	**3**	3

Table 9: ATN Demand, During Overall Airport Peak

Peak Hour Time: 11:30-12:30 p.m.
Peak 15-minute Time: 8:30-8:45 a.m.

O/D		ConRAC	VTA	Total
Terminal A	Hour	**97**	**6**	103
	15-min	**26**	**2**	28
Terminal B	Hour	n/a	**9**	9
	15-min	n/a	**2**	2

San Jose ATN Feasibility Study
O-D Matrix **2011 and 2030 ATN Demand, Daily**
11/8/2011

2011 ATN Demand, Daily

	Term A/GTC	Term B/ConRAC	Economy Lot	Daily Lot 4	VTA	Santa Clara	**Total ATN Origins**
Term A/GTC		1470	250	80	85	85	1970
Term B/ConRAC	1470		400	120	125	125	2240
Economy Lot	250	400					650
Daily Lot 4	80	120					200
VTA	85	125				150	360
Santa Clara	85	125			150		360
Total ATN Destinations	1970	2240	650	200	360	360	**5780**

2030 ATN Demand, Daily

	Term A/GTC	Term B/ConRAC	Economy Lot	Daily Lot 4	VTA	Santa Clara	**Total ATN Origins**
Term A/GTC		3960	690	220	235	235	5340
Term B/ConRAC	3960		735	220	230	230	5375
Economy Lot	690	735					1425
Daily Lot 4	220	220					440
VTA	235	230				325	790
Santa Clara	235	230			325		790
Total ATN Destinations	5340	5375	1425	440	790	790	**14160**

San Jose ATN Feasibility Study
O-D Matrix **2011 Peak Hour of ATN Demand**
11/8/2011

1) 2011 Peak Hour of ATN Demand Overall, 11:45 a.m.-12:45 p.m.

2) 2011 Peak Hour of ATN Demand Between Terminal A and Terminal B/ConRAC Two-Way), 11:45 a.m.-12:45 p.m.

	Term A/GTC	Term B/ConRAC	Economy Lot	Daily Lot 4	VTA	Santa Clara	**Total ATN Origins**
Term A/GTC	0	190	30	10	10	10	**250**
Term B/ConRAC	85	0	30	10	10	10	**145**
Economy Lot	10	25	0	0	0	0	**35**
Daily Lot 4	5	5	0	0	0	0	**10**
VTA	5	10	0	0	0	25	**40**
Santa Clara	5	10	0	0	25	0	**40**
Total ATN Destinations	**110**	**240**	**60**	**20**	**45**	**45**	520

3) 2011 Peak Hour of ATN Demand Between Terminal A and Terminal B/ConRAC (One-Way), 8-9 a.m.

	Term A/GTC	Term B/ConRAC	Economy Lot	Daily Lot 4	VTA	Santa Clara	**Total ATN Origins**
Term A/GTC	0	55	5	0	0	0	**60**
Term B/ConRAC	190	0	20	5	5	5	**225**
Economy Lot	30	30	0	0	0	0	**60**
Daily Lot 4	10	10	0	0	0	0	**20**
VTA	10	10	0	0	0	25	**45**
Santa Clara	10	10	0	0	25	0	**45**
Total ATN Destinations	**250**	**115**	**25**	**5**	**30**	**30**	455

San Jose ATN Feasibility Study
O-D Matrix **2030 Peak Hour of ATN Demand**
11/8/2011

1) 2030 Peak Hour of ATN Demand Overall, 11:45 a.m.-12:45 p.m.
2) 2030 Peak Hour of ATN Demand Between Terminal A and Terminal B/ConRAC Two-Way), 11:45 a.m.-12:45 p.m.

	Term A/GTC	Term B/ConRAC	Economy Lot	Daily Lot 4	VTA	Santa Clara	**Total ATN Origins**
Term A/GTC	0	505	85	30	30	30	**680**
Term B/ConRAC	225	0	50	15	15	15	**320**
Economy Lot	35	45	0	0	0	0	**80**
Daily Lot 4	10	15	0	0	0	0	**25**
VTA	10	15	0	0	0	50	**75**
Santa Clara	10	15	0	0	50	0	**75**
Total ATN Destinations	**290**	**595**	**135**	**45**	**95**	**95**	**1255**

3) 2030 Peak Hour of ATN Demand Between Terminal A and Terminal B/ConRAC (One-Way), 8-9 a.m.

	Term A/GTC	Term B/ConRAC	Economy Lot	Daily Lot 4	VTA	Santa Clara	**Total ATN Origins**
Term A/GTC	0	145	20	5	5	5	**180**
Term B/ConRAC	505	0	40	10	10	10	**575**
Economy Lot	85	55	0	0	0	0	**140**
Daily Lot 4	30	15	0	0	0	0	**45**
VTA	30	20	0	0	0	50	**100**
Santa Clara	30	20	0	0	50	0	**100**
Total ATN Destinations	**680**	**255**	**60**	**15**	**65**	**65**	**1140**

Appendix C

Cost and Revenue Memos

Memorandum

ARUP

To	Laura Stuchinksy, Henry Servin	Date	October 18, 2012
Copies	William Baumgardner, Austin Smith, Gary Hsueh	Reference number	214704-00
From	Bill Maddex, Dave Brogan	File reference	
Subject	San José ATN Feasibility Study Rough Order of Magnitude Cost Estimate (Revision H)		

1 Basis of Capex Cost Estimate

1.1 General Introduction

This document has been prepared by Arup for the City of San José to provide a rough order of magnitude cost estimate for the proposed Automated Transit Network Project (ATN) at Norman Y. Mineta San José International Airport.

1.2 Basis and Content of Estimate

- The Estimated Cost is prepared in accordance with accepted professional standard and procedures agreed by organizations such as The Association for the Advancement of Cost Engineers (AACE), American Society of Professional Estimators (ASPE), and The Royal Institute of Chartered Surveyors (RICS);
- This estimate is classified as level 5 Rough Order of Magnitude estimate within the Arup estimate classification matrix which was developed using the Association for the Advancement of Cost Engineering (AACE) best practices;
- Capital costs have been provided in Federal Transit Administration - Standard Cost Categories summary format;
- The Estimate contained here is based on 1st Quarter 2012 rates and benchmark unit costs collected from comparable cost data;
- The estimate within this document is not intended to set the budget for the potential works, the budget can only be established once the Client's brief has been finalized, a design solution and program developed by the Project Team, and the Forecasted Costs subsequently approved by the Client;
- This project has been assumed to be procured through a Design and Build route;
- See the attached sketches for outline design information.

1.3 Exclusions

- The costs or impacts of latent environmental issues that result in litigations or development delays;
- Removal of any of the works at the end of their useful life – including allowance for any residual value;
- Planning and enquiry costs including legal expenses and fees;
- Local planning obligations and agreements;
- Financing charges;
- Credits for capital taxation allowances;
- Owners direct management costs, running and maintenance costs;
- Compensatory costs to other interested parties;
- Construction administration and project management and other soft costs;
- Hard rock excavations or the impact of encountering unfavorable soil conditions, hazardous materials, or poor working conditions during the construction process; and
- Right of Way costs.

1.4 Assumptions Made In The Preparation of This Estimate

- All costs are based on 1st Quarter 2012 rates and prices; no allowance has been included for inflation;
- The estimate has been prepared utilizing cost estimating reference books such as RS Means and Caltrans 2011 Contract Cost Data;
- The estimate assumes encountering normal ground conditions, and no allowances have been included for ground decontamination or discovery of archaeological artifacts and their consequential effect on the project;
- The estimate assumes the development will have no detrimental impact to neighboring residential areas and no allowance has been included for compensatory works within the estimates;
- The quantities in the estimate are preliminary in nature and are likely to change as more information becomes available and the design progresses;
- Unit rates reflect the cost of direct construction and are including such costs as labor, equipment, and materials;
- A Contingency allowance has been included. Contingency does not cover changes in scope; and
- Other assumptions are listed in section 1.7.

1.5 Information Used In The Preparation of This Estimate

1.5.1 Internal References

- Preliminary design information developed by Arup.
- Measures based on prior experience by Arup in the United Kingdom.

1.6 Indirects, Add-ons on Costs and Contingency

Arup has applied percentages based on experience to accommodate the following costs:

- Contractor Indirects have been included at 15% of the direct total cost;
- Contractor Overhead and Profit has been included at 15% of the direct total cost;
- Design Engineering has been included at 10% of the total job value;
- Project Insurance has been included at 3% of the total cost (direct and indirect);
- Tax has been included at 2% of the total cost (direct and indirect); and
- Bond has been included at 1.5% of the job value.

1.7 Structure of Estimate

1.7.1 Single Track Guideway

Due to the high level cost estimate required it has been assumed that all guideway is to be on elevated structure, as there is an insignificant quantity of guideway at grade.

Substructure

- 4’ diameter drilled concrete piles, 50’ deep, with 295 pounds of rebar per cubic yard of concrete. Piles at 80’ centers.

Superstructure

- Reinforced 2’6” diameter concrete columns, 18’ high from ground level. Columns at 80’ centers;
- Reinforced concrete Crossheads, 4’ by 3’ by deck width of guideway;
- Reinforced concrete elevated structure as per sketch provided as Attachment A;
- Arup developed a cost alternative for a steel supporting guideway with input from a specialized APM manufacturer, but this proved to be more expensive than the concrete option.

1.7.2 Double Track Guideway

Same assumptions as the single track guideway but doubled the price. See sketch provided as Attachment B.

1.7.3 Triple Track Guideway

Same assumptions as the single track guideway but tripled the price.

1.7.4 Minor Station

The estimate is based on a 3 berth station with angled berths similar to the design of the Heathrow ATN station.. The elevated station concourse measure is 131’ by 42’. The unit price has been derived from comparable material cost data in California.

1.7.5 Major Station

The estimate is based on a 20 berth station with four banks of five angled berths each.. The elevated station concourse measure is 262’ by 42’ multiplied by two to account for each side of the platform. The unit price has been derived from comparable construction cost data in California.

1.7.6 Maintenance Facility

An estimated square foot measure has been derived from information supplied by vendors and is based on a fleet size of 300 vehicles. The maintenance facility is assumed to have 16 maintenance bays and additional storage for 30 vehicles, and will house a control center and other staff facilities. The unit price has been derived from comparable construction cost data in California.

1.7.7 Utility Relocations

No design information is available for this, thus an allowance of $4,000,000 has been included based on prior experience, which is subject to change as the design progresses.

1.7.8 Subcontractor

Little design information is available on minor works packages, such as lighting, safety fencing, landscaping, retaining walls, etc. Therefore allowances totaling $12,500,000 have been included based on previous experience, which is subject to change as the design progresses.

1.7.9 Control Systems

Control system details are unknown at this stage but a review of ATN projects around the world suggests costs should be in the region of 25% of the base construction costs not including the stations and maintenance facility costs.

1.7.10 Vehicles

Cost data has been gathered from similar projects around the world and a large range was discovered from USD$63,000 to USD$200,000 per vehicle. A mean price of USD$130,000 was chosen for the Capex estimate. A maximum fleet size of 300 vehicles has been assumed at buildout based on input from Aerospace Corporation. Vehicles are assumed to be purchased in batches by alignment segment.

2 Basis of Opex Cost Estimate

2.1 General Introduction

The operational costs are calculated based on four areas:

- Staffing;
- Maintenance;
- Periodic Renewals; and
- Energy use.

Opex costs have been estimated based on Operational Cost per annum, which has been split between the Segments for clarity. The overall operational life is 30 years from 2015, giving an intended operational end life of 2047.

2.2 Exclusions

- Financing charges;
- Credits for capital taxation allowances.

2.3 Assumptions Made In The Preparation of This Estimate

- All costs are based on 1st Quarter 2012 rates and prices; no allowance has been included for inflation;
- A contingency between 8% and 37% has been included based on the level of detail known. This contingency does not cover scope changes or items not currently included in the estimate;
- The quantities in the estimate are preliminary in nature and are likely to change as more information becomes available and the operational process develops; and
- Other assumptions are listed in section 2.5.

2.4 Information Used In The Preparation of This Estimate

- Assumptions developed by Arup;
- Comparable data gathered from London Heathrow, Masdar and Morgantown ATN projects; and
- Bureau of Labor Statistics for wage estimates.

2.5 Structure of Estimate

2.5.1 Staffing

No detailed information is available on staffing levels, job duties or responsibilities. A "bottoms up" approach has therefore been employed in estimating an appropriate organizational structure. Actual staff salaries are taken from the United States Department of Labor website in the Bureau of Labor Statistics for California.

The following job roles with assumptions were developed:

- Chief Executive – One staff member, working day shift only. Constant through Segments 1, 2 and 3;
- Manager – One staff member, working day shift only. Constant through Segments 1, 2 and 3;
- Marketing, Financial Clerk and HR – 3 staff in total, working day shift only. Constant through Segments 1, 2 and 3;
- Supervisor – 2 staff members per manager, per shift. Supervisors to work full 22 hour operational day in 8 hour shifts, 40 hour weeks, rotating staff, no overtime allowed for;
- Controller – 1 staff member per 30 operational pods, per shift. Controllers to work full 22 hour operational day in 8 hour shifts, 40 hour weeks, rotating staff, no overtime allowed for;
- Service Engineer – Assumed 4 engineers per shift, working full 22 hour operational day in 8 hour shifts, 40 hour weeks, rotating staff, no overtime allowed for. This effort increases slightly in Segments 2 and 3;
- Administrative / Office Clerk – 1 staff member per 30 operational vehicles, working day shift only;
- Cleaners – 1 cleaner to clean 3 vehicles per hour; and
- Security Guards – 2 staff members in Segment 1 and 2 working 24 hours a day in 8 hour shifts, 40 hour weeks, rotating staff, no overtime allowed for. An additional security guard added for Segment 3.

Benchmark data has been reviewed from similar ATNs such as London Heathrow, Masdar and Morgantown.

2.5.2 Maintenance

Maintenance has been split into 5 main categories:

- Track maintenance, which is calculated pro-rata based on the length of track;
- Station maintenance, which is calculated pro-rata based on the number of berths;
- Depot maintenance, which is calculated pro-rata based on the number of berths in depot;

- Total vehicle maintenance, which is calculated pro-rata based on the number of vehicles; and
- Control system maintenance, which is calculated pro-rata based on the number of berths.

The unit costs estimated for maintenance are based on the information gathered for an ATN system in Europe, which have been pro-rated to be applicable for the San José application.

2.5.3 Periodic Renewals

In the absence of detailed information from operators, renewal costs are assumed to be broadly equivalent across all three systems and are based on information issued by one vendor for a possible European application. Estimates for renewals cost are based on four elements:

- New vehicles once every eight years at a cost of USD$131,000 per vehicle, which is calculated based on renewing 50% of the vehicle fleet in accordance to the predicted procurement timeline over the alignment segments
- IT system overhauls once every three years at a cost of USD$24,000 per control center, which is calculated pro-rata based on the number of control centers
- Digital signal processors replaced in each berth once every four years at a cost of USD$4,000 per berth, which is calculated pro-rata based on the number of berths; and
- Guideway inspections once every three years at a cost of USD$42,000 per mile, which is calculated pro-rata based on the length of guideway.

2.5.4 Energy

Energy data and assumptions are based on the energy consumption of a similar type of ATN project which has been converted to the San José ATN application, and energy cost for California is assumed at an average rate of $0.14 per kilowatt hour (kWh).

Subsequent, more detailed analysis has been conducted by Aerospace for vehicle propulsion and heating/cooling. Arup's energy cost estimate accommodates the majority of the ATN vehicle energy demand scenarios analyzed by Aerospace in addition to an allowance for station escalator and elevator energy consumption.

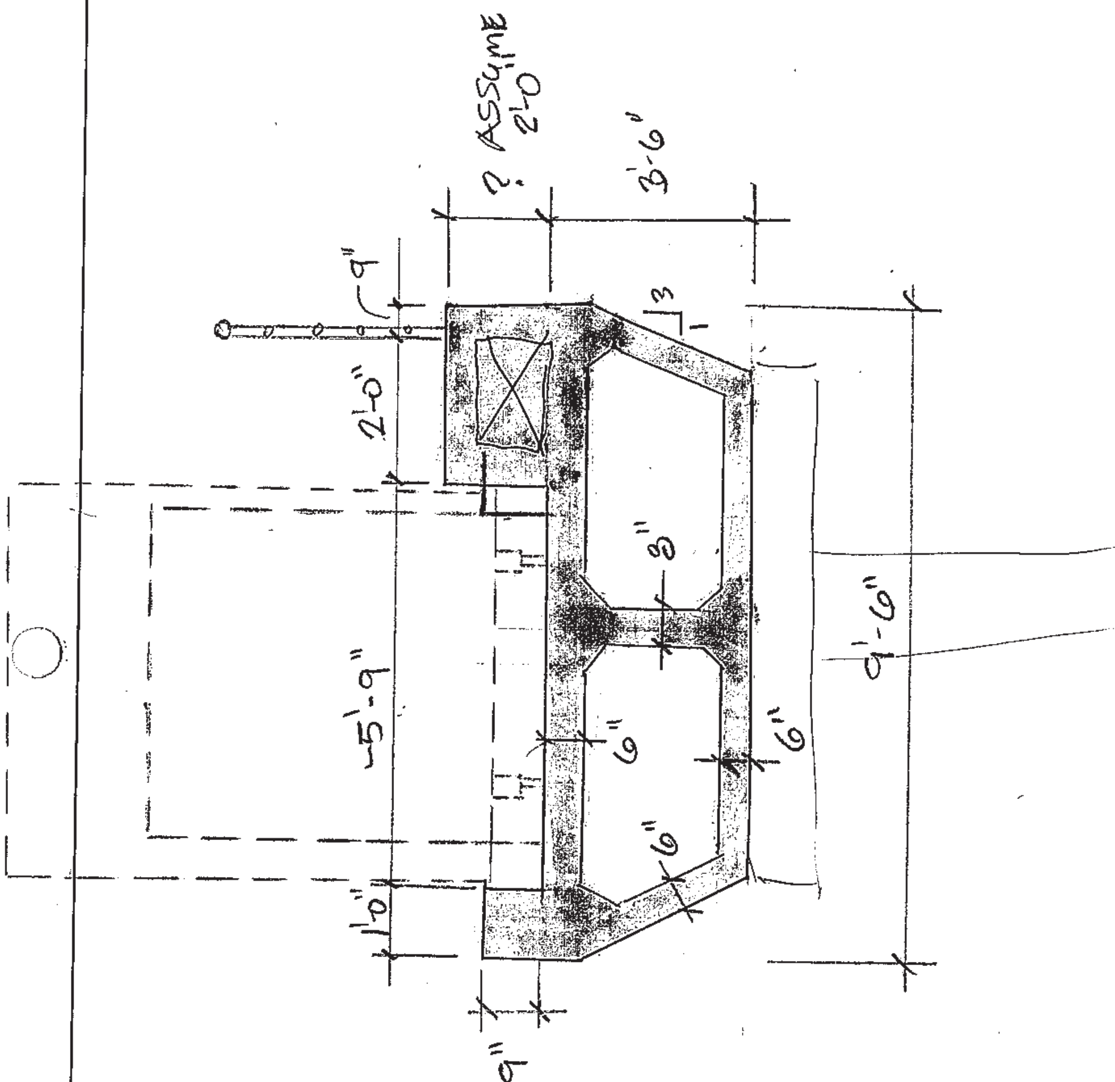
The Project system is operational per annum, which has been assumed to be 22 hours a day, 365 days a year.

Memorandum

Attachments
Table of Contents

ARUP

Job Title	SAN JOSE ATN	Job No.	214704	Sheet No.		Rev.
		Member-Location				
		Drg. Ref.				
		Made By	KC	Date	3.8.12	Chd.



ARUP

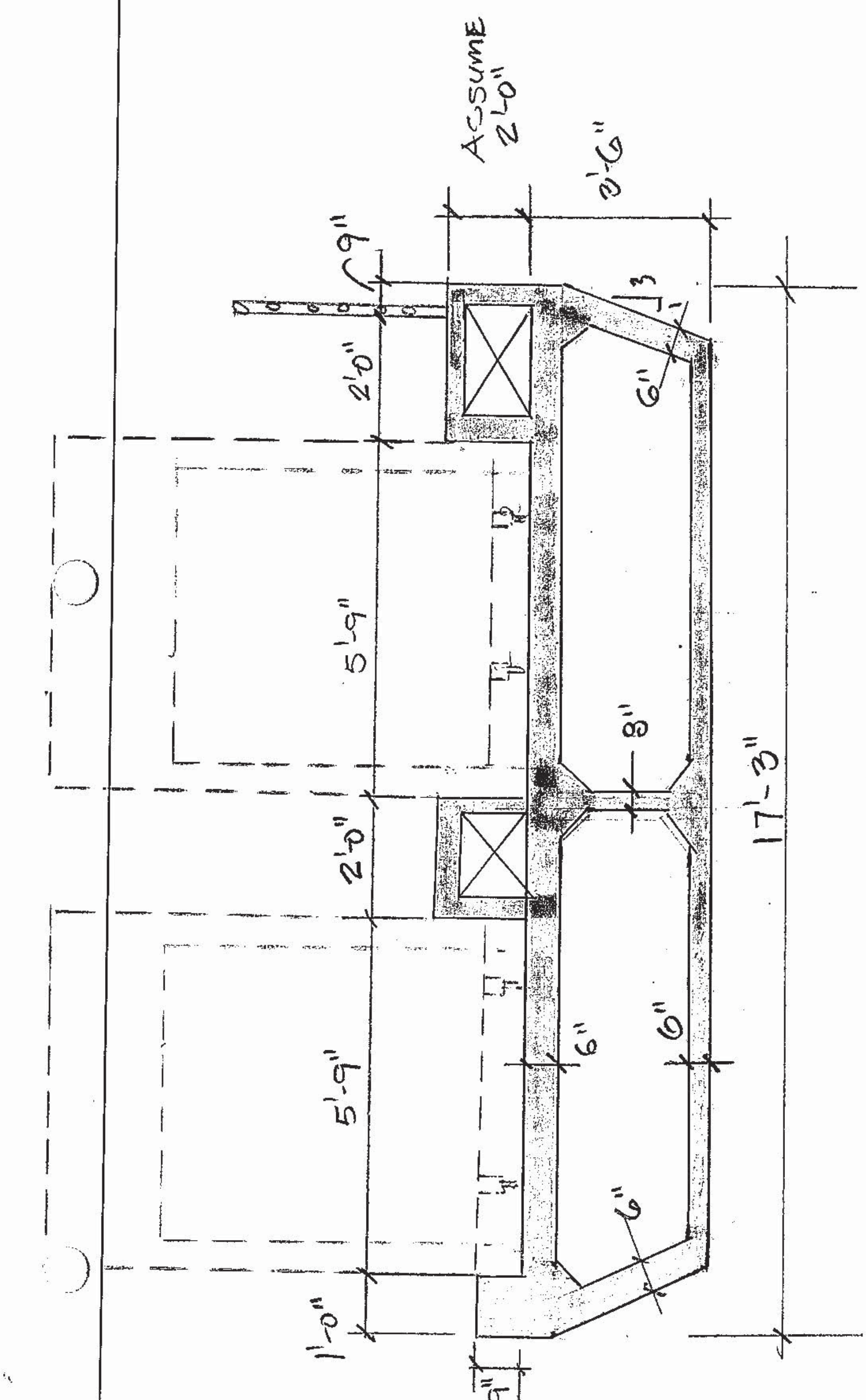
Job No.	Sheet No.	Rev.
214704		

Member-Location

Job Title SAN JOSE ATN

Drg. Ref.

Made By KC Date 3.20.12 Chd.



MAIN WORKSHEET-BUILD ALTERNATIVE		(Rev.14, August 5, 2011)
City of San Jose	Today's Date	**8/21/12**
San José ATN Feasibility Study	Yr of Base Year $	2012
	Yr of Revenue Ops	2047

	Quantity	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Unit Cost (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**6.39**	103,718	0	**103,718**	**$16,233**	**51%**	**32%**
10.01 Guideway: At-grade exclusive right-of-way				0			
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)				0			
10.03 Guideway: At-grade in mixed traffic				0			
10.04 Guideway: Aerial structure	6.39	103,718	0	103,718	$16,233		
10.05 Guideway: Built-up fill				0			
10.06 Guideway: Underground cut & cover				0			
10.07 Guideway: Underground tunnel				0			
10.08 Guideway: Retained cut or fill				0			
10.09 Track: Direct fixation				0			
10.10 Track: Embedded				0			
10.11 Track: Ballasted				0			
10.12 Track: Special (switches, turnouts)				0			
10.13 Track: Vibration and noise dampening				0			
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**10**	38,901	0	**38,901**	**$3,890**	**19%**	**12%**
20.01 At-grade station, stop, shelter, mall, terminal, platform				0			
20.02 Aerial station, stop, shelter, mall, terminal, platform	10	38,901	0	38,901	$3,890		
20.03 Underground station, stop, shelter, mall, terminal, platform				0			
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.				0			
20.05 Joint development				0			
20.06 Automobile parking multi-story structure				0			
20.07 Elevators, escalators				0			
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	6.39	8,518	0	**8,518**	**$1,333**	**4%**	**3%**
30.01 Administration Building: Office, sales, storage, revenue counting				0			
30.02 Light Maintenance Facility		8,518	0	8,518			
30.03 Heavy Maintenance Facility				0			
30.04 Storage or Maintenance of Way Building				0			
30.05 Yard and Yard Track				0			
40 SITEWORK & SPECIAL CONDITIONS	6.39	21,750	0	**21,750**	**$3,404**	**11%**	**7%**
40.01 Demolition, Clearing, Earthwork				0			
40.02 Site Utilities, Utility Relocation		5,085	0	5,085			
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments				0			
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks				0			
40.05 Site structures including retaining walls, sound walls		5,297	0	5,297			
40.06 Pedestrian / bike access and accommodation, landscaping		5,297	0	5,297			
40.07 Automobile, bus, van accessways including roads, parking lots		5,297	0	5,297			
40.08 Temporary Facilities and other indirect costs during construction		774	0	774			
50 SYSTEMS	6.39	31,819	0	**31,819**	**$4,980**	**16%**	**10%**
50.01 Train control and signals		31,819	0	31,819			
50.02 Traffic signals and crossing protection				0			
50.03 Traction power supply: substations				0			
50.04 Traction power distribution: catenary and third rail				0			
50.05 Communications				0			
50.06 Fare collection system and equipment				0			
50.07 Central Control				0			
Construction Subtotal (10 - 50)	6.39	204,705	0	**204,705**	**$32,039**	**100%**	**63%**
60 ROW, LAND, EXISTING IMPROVEMENTS	6.39	0	0	**0**	**$0**		**0%**
60.01 Purchase or lease of real estate				0			
60.02 Relocation of existing households and businesses				0			
70 VEHICLES (number)	**300**	39,000	0	**39,000**	**$130**		**12%**
70.01 Light Rail	300	39,000	0	39,000	$130		
70.02 Heavy Rail				0			
70.03 Commuter Rail				0			
70.04 Bus				0			
70.05 Other				0			
70.06 Non-revenue vehicles				0			
70.07 Spare parts				0			
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	6.39	36,721	0	**36,721**	**$5,747**	**18%**	**11%**
80.01 Preliminary Engineering				0			
80.02 Final Design		32,050	0	32,050			
80.03 Project Management for Design and Construction				0			
80.04 Construction Administration & Management				0			
80.05 Professional Liability and other Non-Construction Insurance		4,671	0	4,671			
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.				0			
80.07 Surveys, Testing, Investigation, Inspection				0			
80.08 Start up				0			
Subtotal (10 - 80)	6.39	280,426	0	**280,426**	**$43,891**		**87%**
90 UNALLOCATED CONTINGENCY				**43,700**			**13%**
Subtotal (10 - 90)	6.39			**324,126**	**$50,730**		**100%**
100 FINANCE CHARGES				**0**			**0%**
Total Project Cost (10 - 100)	6.39			**324,126**	**$50,730**		**100%**
ESTIMATED COST SCENARIO 1 (30th @Risk Percentile)				**537,030**			
ESTIMATED COST SCENARIO 2 (80th @Risk Percentile)				**757,645**			
ESTIMATED COST SCENARIO 3 (95th @Risk Percentile)				**909,449**			
Allocated Contingency as % of Base Yr Dollars w/o Contingency				0.00%			
Unallocated Contingency as % of Base Yr Dollars w/o Contingency				15.58%			
Total Contingency as % of Base Yr Dollars w/o Contingency				15.58%			
Unallocated Contingency as % of Subtotal (10 - 80)				15.58%			
YOE Construction Cost per Mile (X000)							
YOE Total Project Cost per Mile Not Including Vehicles (X000)							
YOE Total Project Cost per Mile (X000)							

MAIN WORKSHEET-BUILD ALTERNATIVE

(Rev.14, August 5, 2011)

City of San Jose — Today's Date: **8/21/12**

San José ATN Feasibility Study — Yr of Base Year $: 2012

Yr of Revenue Ops: 2047

	Quantity	SEGMENT 1 Base Year Dollars w/o Contingency (X000)	SEGMENT 2 Base Year Dollars w/o Contingency (X000)	SEGMENT 3 Base Year Dollars w/o Contingency (X000)	Base Year Dollars w/o Contingency (X000)	Base Year Dollars Allocated Contingency (X000)	Base Year Dollars TOTAL (X000)	Base Year Dollars Unit Cost (X000)	Base Year Dollars Percentage of Construction Cost	Base Year Dollars Percentage of Total Project Cost
10 GUIDEWAY & TRACK ELEMENTS (route miles)	**6.39**	39,586	19,624	44,509	103,718	0	**103,718**	**$16,233**	**51%**	**32%**
10.01 Guideway: At-grade exclusive right-of-way							0			
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)							0			
10.03 Guideway: At-grade in mixed traffic							0			
10.04 Guideway: Aerial structure	6.39	39,586	19,624	44,509	103,718	0	103,718	$16,233		
10.05 Guideway: Built-up fill							0			
10.06 Guideway: Underground cut & cover							0			
10.07 Guideway: Underground tunnel							0			
10.08 Guideway: Retained cut or fill							0			
10.09 Track: Direct fixation							0			
10.10 Track: Embedded							0			
10.11 Track: Ballasted							0			
10.12 Track: Special (switches, turnouts)							0			
10.13 Track: Vibration and noise dampening							0			
20 STATIONS, STOPS, TERMINALS, INTERMODAL (number)	**10**	23,024	13,462	2,415	38,901	0	**38,901**	**$3,890**	**19%**	**12%**
20.01 At-grade station, stop, shelter, mall, terminal, platform							0			
20.02 Aerial station, stop, shelter, mall, terminal, platform	10	23,024	13,462	2,415	38,901	0	38,901	$3,890		
20.03 Underground station, stop, shelter, mall, terminal, platform							0			
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.							0			
20.05 Joint development							0			
20.06 Automobile parking multi-story structure							0			
20.07 Elevators, escalators							0			
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	6.39	8,518	0	0	8,518	0	**8,518**	**$1,333**	**4%**	**3%**
30.01 Administration Building: Office, sales, storage, revenue counting							0			
30.02 Light Maintenance Facility		8,518	0	0	8,518	0	8,518			
30.03 Heavy Maintenance Facility							0			
30.04 Storage or Maintenance of Way Building							0			
30.05 Yard and Yard Track							0			
40 SITEWORK & SPECIAL CONDITIONS	6.39	9,217	4,754	7,779	21,750	0	**21,750**	**$3,404**	**11%**	**7%**
40.01 Demolition, Clearing, Earthwork							0			
40.02 Site Utilities, Utility Relocation		2,047	1,153	1,886	5,085	0	5,085			
40.03 Haz. mat'l, contam'd soil removal/mitigation, ground water treatments							0			
40.04 Environmental mitigation, e.g. wetlands, historic/archeologic, parks							0			
40.05 Site structures including retaining walls, sound walls		2,132	1,201	1,964	5,297	0	5,297			
40.06 Pedestrian / bike access and accommodation, landscaping		2,132	1,201	1,964	5,297	0	5,297			
40.07 Automobile, bus, van accessways including roads, parking lots		2,132	1,201	1,964	5,297	0	5,297			
40.08 Temporary Facilities and other indirect costs during construction		774	0	0	774	0	774			
50 SYSTEMS	6.39	12,007	6,610	13,201	31,819	0	**31,819**	**$4,980**	**16%**	**10%**
50.01 Train control and signals		12,007	6,610	13,201	31,819	0	31,819			
50.02 Traffic signals and crossing protection							0			
50.03 Traction power supply: substations							0			
50.04 Traction power distribution: catenary and third rail							0			
50.05 Communications							0			
50.06 Fare collection system and equipment							0			
50.07 Central Control							0			
Construction Subtotal (10 - 50)	6.39	92,351	44,450	67,904	204,705	0	**204,705**	**$32,039**	**100%**	**63%**
60 ROW, LAND, EXISTING IMPROVEMENTS	6.39	0	0	0	0	0	**0**	**$0**		**0%**
60.01 Purchase or lease of real estate							0			
60.02 Relocation of existing households and businesses							0			
70 VEHICLES (number)	**300**	31,980	5,200	1,820	39,000	0	**39,000**	**$130**		**12%**
70.01 Light Rail	300	31,980	5,200	1,820	39,000	0	39,000	$130		
70.02 Heavy Rail							0			
70.03 Commuter Rail							0			
70.04 Bus							0			
70.05 Other							0			
70.06 Non-revenue vehicles							0			
70.07 Spare parts							0			
80 PROFESSIONAL SERVICES (applies to Cats. 10-50)	6.39	15,372	7,732	13,617	36,721	0	**36,721**	**$5,747**	**18%**	**11%**
80.01 Preliminary Engineering							0			
80.02 Final Design		13,417	6,748	11,885	32,050	0	32,050			
80.03 Project Management for Design and Construction							0			
80.04 Construction Administration & Management							0			
80.05 Professional Liability and other Non-Construction Insurance		1,955	984	1,732	4,671	0	4,671			
80.06 Legal; Permits; Review Fees by other agencies, cities, etc.							0			
80.07 Surveys, Testing, Investigation, Inspection							0			
80.08 Start up							0			
Subtotal (10 - 80)	6.39	139,703	57,381	83,341	280,426	0	**280,426**	**$43,891**		**87%**
90 UNALLOCATED CONTINGENCY							**43,700**			**13%**
Subtotal (10 - 90)	6.39						**324,126**	**$50,730**		**100%**
100 FINANCE CHARGES							**0**			**0%**
Total Project Cost (10 - 100)	6.39						**324,126**	**$50,730**		**100%**
ESTIMATED COST SCENARIO 1 (30th @Risk Percentile)							**537,030**			
ESTIMATED COST SCENARIO 2 (80th @Risk Percentile)							**757,645**			
ESTIMATED COST SCENARIO 3 (95th @Risk Percentile)							**909,449**			
Allocated Contingency as % of Base Yr Dollars w/o Contingency							0.00%			
Unallocated Contingency as % of Base Yr Dollars w/o Contingency							15.58%			
Total Contingency as % of Base Yr Dollars w/o Contingency							15.58%			
Unallocated Contingency as % of Subtotal (10 - 80)							15.58%			
YOE Construction Cost per Mile (X000)										
YOE Total Project Cost per Mile Not Including Vehicles (X000)										
YOE Total Project Cost per Mile (X000)										

ARUP	Job No: 214704-00.0	Sheet No:
Job Title: **San José ATN Feasibility Study**	Element: ***Unit Cost Summary***	Base Date of Estimate ***Q1 2012***
Cost Plan: **Rough Order of Magnitude Cost Estimate**	Made by: **DB**	Date: **Tuesday, August 21, 2012**

Description			Quantity	Unit	Unit Rate	Total $
GRAND SUMMARY						
SINGLE TRACK GUIDEWAY			15,625	FT	1,500	23,437,500
DOUBLE TRACK GUIDEWAY			15,564	FT	3,000	46,692,000
TRIPLE TRACK GUIDEWAY			2,546	FT	4,500	11,457,000
MINOR STATION (3 BERTH)			8	EACH	1,900,000	15,200,000
MAJOR STATION (20 BERTH)			2	EACH	7,700,000	15,400,000
MAINTENANCE FACILITY			1	EACH	6,700,000	6,700,000
UTILITY RELOCATIONS			1	LS	4,000,000	4,000,000
SUBCONTRACT			1	LS	12,500,000	12,500,000
		Total Direct Cost				**135,386,000**
INDIRECT COSTS	15.0%	of Direct Cost				20,308,000
		Total Cost				**155,694,000**
OTHER ADDITIONS						
DESIGN ENGINEERING	10.0%	of Job Value				32,050,000
CONTRACTORS OVERHEAD & PROFIT	15.0%	of Total Cost				23,354,000
INSURANCE	3.0%	of Total Cost				4,671,000
CONTINGENCY / ELEMENTAL RISK						43,700,000
BOND						1,135,000
VEHICLES						39,000,000
CONTROL SYSTEMS						24,522,000
		Sub-Total of OTHER ADDITIONS				**168,432,000**
		Total Estimated Job Value				**324,126,000**
ESTIMATED COST SCENARIO 1 (30th @Risk Percentile)						**537,030,000**
ESTIMATED COST SCENARIO 2 (80th @Risk Percentile)						**757,645,000**
ESTIMATED COST SCENARIO 3 (95th @Risk Percentile)						**909,449,000**

ARUP	Job No: 214704-00.0		Sheet No:	
Job Title: San José ATN Feasibility Study	Element: *Segment Capex Summary*		Base Date of Estimate *Q1 2012*	
Cost Plan: Rough Order of Magnitude Cost Estimate	Made by: DB		Date: Tuesday, August 21, 2012	
Description	**SEGMENT 1 $**	**SEGMENT 2 $**	**SEGMENT 3 $**	**Total $**
GRAND SUMMARY				
SINGLE TRACK GUIDEWAY	12,601,500	8,317,500	2,518,500	23,437,500
DOUBLE TRACK GUIDEWAY	9,525,000	4,674,000	32,493,000	46,692,000
TRIPLE TRACK GUIDEWAY	11,457,000	0	0	11,457,000
MINOR STATION (3 BERTH)	1,900,000	11,400,000	1,900,000	15,200,000
MAJOR STATION (20 BERTH)	15,400,000	0	0	15,400,000
MAINTENANCE FACILITY	6,700,000	0	0	6,700,000
UTILITY RELOCATIONS	1,674,500	842,200	1,483,300	4,000,000
SUBCONTRACT	5,232,700	2,631,900	4,635,400	12,500,000
Total Direct Cost	64,490,700	27,865,600	43,030,200	**135,386,000**
INDIRECT COSTS **15.0%**	8,501,200	4,275,900	7,530,800	20,308,000
Total Cost	**72,991,900**	**32,141,500**	**50,561,000**	**155,694,000**
OTHER ADDITIONS				
DESIGN ENGINEERING 10.0%	13,416,600	6,748,200	11,885,100	32,050,000
CONTRACTORS OVERHEAD & PROFIT 15.0%	9,776,400	4,917,300	8,660,400	23,354,000
INSURANCE 3.0%	1,955,400	983,500	1,732,200	4,671,000
CONTINGENCY / ELEMENTAL RISK	18,293,500	9,201,200	16,205,300	43,700,000
BOND	475,100	239,000	420,900	1,135,000
VEHICLE	31,980,000	5,200,000	1,820,000	39,000,000
CONTROL SYSTEMS	10,122,700	4,116,400	10,282,600	24,522,000
Sub-Total of OTHER ADDITIONS	**86,019,701**	**31,405,600**	**51,006,500**	**168,432,000**
Total Estimated Job Value	**159,011,601**	**63,547,100**	**101,567,500**	**324,126,000**
ESTIMATED COST SCENARIO 1 (30th @Risk Percentile)	**263,145,000**	**107,406,000**	**166,479,000**	**537,030,000**
ESTIMATED COST SCENARIO 2 (80th @Risk Percentile)	**371,246,000**	**151,529,000**	**234,870,000**	**757,645,000**
ESTIMATED COST SCENARIO 3 (95th @Risk Percentile)	**445,630,000**	**181,890,000**	**281,929,000**	**909,449,000**

ARUP

Job Title: San José ATN Feasibility Study	Job No: 214704-00.0	Sheet No:
Cost Plan: Rough Order of Magnitude Cost Estimate	Element: *Segment Opex Summary*	Base Date of Estimate *Q1 2012*
	Made by: DB	Date: Tuesday, August 21, 2012

Description	SEGMENT 1 $	SEGMENT 2 $	SEGMENT 3 $	Total $
GRAND SUMMARY				
STAFF COST	4,461,200	639,500	184,000	5,284,700
MAINTENANCE COST	1,755,100	423,300	190,800	2,369,200
PERIODIC RENEWAL COST	1,686,100	285,500	146,000	2,117,600
ENERGY COST	221,600	91,000	33,300	345,900
Sub-total	8,124,000	1,439,300	554,100	**10,117,400**
CONTINGENCY / ELEMENTAL RISK (incl below)				
Total Estimated Cost per Annum	**8,124,000**	**1,439,300**	**554,100**	**10,117,400**
ESTIMATED COST SCENARIO 1		**8% @ RISK CONTINGENCY**		**10,967,000**
ESTIMATED COST SCENARIO 2		**24% @RISK CONTINGENCY**		**12,509,000**
ESTIMATED COST SCENARIO 3		**37% @RISK CONTINGENCY**		**13,640,000**

Memorandum

ARUP

To	Laura Stuchinsky Henry Servin	Date	July 26, 2012
Copies	Will Baumgardner, Bill Maddex, Ignacio Barandiaran, Richard Kerrigan, Eloise Jeanneau	Reference number	214704
From	Gary Hsueh, Dave Brogan	File reference	4-04
Subject	San José ATN Feasibility Study APM Cost Comparison Methodology		

This memorandum discusses in more detail the calculation for Airport People Mover Risk-Adjusted Construction Costs (2012 $, Million) referenced in Table 21 in the Arup Final Report, and Tables 4 and 25 in the Arup Preliminary Business Case Memo.

The cost for the AM is based on the San Jose International Airport APM Projects Conceptual Cost Estimate dated September 2001, page 1. The segments chosen for comparison are under the Elevated Alignment heading and consist of the following:

- VTA to Terminal B (which in the cost estimate is identified as "Initial System: North First Street to Terminal / Above Terminal Drive")
- Terminal B to Terminal A ("Extension: Terminal to Old Terminal A / Above Terminal Drive")
- Terminal A to Green Island ("Extension: Old Terminal A to Green Island / Above Terminal Drive")
- Green Island to Airport Boundary ("Extension to Santa Clara Station: Green Island to Airport Boundary / Elevated")
- Airport Boundary to Santa Clara ("Extension to Santa Clara Station: Airport Boundary to Santa Clara Station / Elevated")

For the cost estimate calculation, Arup included the Subtotal, E&I, and Real Estate costs from the 2001 estimate. Arup increased the construction contingency from 10% to 40% to reflect observed, historical construction cost overruns. Arup then added a categorical risk contingency of 40% (note the categorical risk contingency for ATN is 134%).

Arup then escalated the resulting total to 2012 dollars using the Engineering News Record Construction Cost Index (CCI). The annual CCI index value for San Francisco in 2001 was 7,399.07, and for Quarter 2, 2012 (since the annual was not yet available) the CCI was 10,386.04. The resulting increase factor was calculated to be 10386.04 divided by 7399.07, or 1.403695329 (approximately a 40% increase).

Attachments:

- San Jose International Airport APM Projects Conceptual Cost Estimate dated September 2001, p. 1
- APM Cost Estimate Summary

San Jose International Airport Automated People Mover Conceptual Cost Estimates									
Segment	**Guideway Location**	**Station(s) Location**	**Facilities Cost**	**Systems Cost**	**Subtotal**	**E&I**	**Construction Contingency**	**Real Estate**	**Total**
						33%	10%		
Elevated Alignment (Phased Construction)									
Initial System: North First Street to Terminal	Above Terminal	Above LRT and Above Terminal	$ 42,370,116	$ 25,000,000	$ 67,370,116	$ 22,232,138	$ 6,737,012	$ 10,000,000	$ 106,339,265
	Above Terminal Drive	Above LRT and Above Terminal Drive	$ 40,992,489	$ 25,000,000	$ 65,992,489	$ 21,777,522	$ 6,599,249	$ 10,000,000	$ 104,369,260
Extension: Terminal to Old Terminal A	Above Terminal	Above Existing Pedestrian Bridge	$ 28,933,900	$ 18,400,000	$ 47,333,900	$ 15,620,187	$ 4,733,390	N/A	$ 67,687,476
	Above Terminal Drive	Above Existing Pedestrian Bridge	$ 24,598,492	$ 18,400,000	$ 42,998,492	$ 14,189,502	$ 4,299,849	N/A	$ 61,487,843
Extension: Old Terminal A to Green Island	Above Terminal	Edge of Green Island Garage	$ 22,278,729	$ 16,000,000	$ 38,278,729	$ 12,631,981	$ 3,827,873	N/A	$ 54,738,583
	Above Terminal Drive	Edge of Green Island Garage	$ 20,648,517	$ 16,000,000	$ 36,648,517	$ 12,094,011	$ 3,664,852	N/A	$ 52,407,379
Extension to Santa Clara Station:									
Green Island to Airport Boundary	Elevated	N/A	$ 69,049,320	$ 47,800,000	$ 116,849,320	$ 38,560,275	$ 11,684,932	N/A	$ 167,094,527
Airport Boundary to Santa Clara Station	Elevated	Elevated	$ 36,034,372	$ 20,100,000	$ 56,134,372	$ 18,524,343	$ 5,613,437	TBD	$ 80,272,152
	Cut&Cover Tunnels	Below Grade	$ 58,211,361	$ 20,100,000	$ 78,311,361	$ 25,842,749	$ 7,831,136	TBD	$ 111,985,247
Tunnel Alignment									
Under Terminal	Cut&Cover Tunnels	Below Terminal	$ 11,744,368	Included Below	$ 11,744,368	$ 3,875,641	$ 1,174,437	N/A	$ 16,794,446
	Cut&Cover Tunnels	Below Apron	$ 3,578,516	Included Below	$ 3,578,516	$ 1,180,910	$ 357,852	N/A	$ 5,117,279
Edge of Terminal to Airport Boundary	Bored Tunnel	Below Terminal (No station cost)	$ 64,224,330	$ 25,900,000	$ 90,124,330	$ 29,741,029	$ 9,012,433	N/A	$ 128,877,792
	Bored Tunnel	Below Apron	$ 68,338,266	$ 25,900,000	$ 94,238,266	$ 31,098,628	$ 9,423,827	N/A	$ 134,760,721
	Cut&Cover Tunnels	Below Terminal (No station cost)	$ 42,905,560	$ 25,900,000	$ 68,805,560	$ 22,705,835	$ 6,880,556	N/A	$ 98,391,950
	Cut&Cover Tunnels	Below Apron	$ 48,140,640	$ 25,900,000	$ 74,040,640	$ 24,433,411	$ 7,404,064	N/A	$ 105,878,116
Airport Boundary to Santa Clara Station	Cut&Cover Tunnels	Below Grade	$ 58,211,361	$ 20,100,000	$ 78,311,361	$ 25,842,749	$ 7,831,136	TBD	$ 111,985,247

NB.

1. The stations and pedestrian tunnels constructed below the porposed terminal will be Cut&Cover Systems, the tunnels leading to the station will be either bored or cut&cover construction. The cut& cover tunnels will be simpler to construct because of the basement excavations and foundation work to the terminal.

2. Cost to extend bored twin tunnels below rental car parking structure: Twin Bored Tunnels $15M and Covered tunnels $13M - these costs are not included above and includes 33% E&I and 10% Construction Contingency.

3. Systems Costs and Real Estate Costs were estimated by Lea+Elliott, Inc.

APM Cost Estimate Summary
5/16/2012

ARUP

Based on San Jose International Airport APM Projects Conceptual Cost Estimate, September 24, 2001
Segments for Comparison with San Jose ATN Feasibility Study Alignment
Segment - Above grade alignment

	Subtotal	E&I	Construction Contingency	Categorical Risk Contingency	Real Estate	Total	
		33%	40%	40%			
VTA to Terminal B (above Terminal Dr)	$ 66,000,000	$ 21,780,000	$ 26,400,000	$ 26,400,000	$ 10,000,000	$ 150,580,000	
TB to TA (above Terminal Dr)	$ 43,000,000	$ 14,190,000	$ 17,200,000	$ 17,200,000		$ 91,590,000	
TA to Green Island (above Terminal Dr)	$ 37,000,000	$ 12,210,000	$ 14,800,000	$ 14,800,000		$ 78,810,000	
Green Island to Airport Boundary (Elevated)	$ 117,000,000	$ 38,610,000	$ 46,800,000	$ 46,800,000		$ 249,210,000	
Airport Boundary to SC (Elevated)	$ 56,000,000	$ 18,480,000	$ 22,400,000	$ 22,400,000		$ 119,280,000	
Total	**$ 319,000,000**	**$ 105,270,000**	**$ 127,600,000**	**$ 127,600,000**	**$ 10,000,000**	**$ 689,470,000**	
2012 PRICES	**$ 447,778,810**	**$ 147,767,007**	**$ 179,111,524**	**$ 179,111,524**	**$ 14,036,953**	**$ 689,000,000**	Rounded
						$ 967,146,082	2012 PRICES
						$ 967,000,000	2012 Rounded

Cost Escalation from 2001 to 2012

ENR CCI Data 2001 (San Francisco)	7399.07		
ENR CCI Data 2012 (San Francisco, Q2)	10386.04	1.403695329	INCREASE FACTOR

Memorandum

ARUP

To	Laura Stuchinsky, Henry Servin	Date	August 24, 2012
Copies	William Baumgardner	Reference number	214704
From	Gary Hsueh, David Watkins, Austin Smith	File reference	4-05
Subject	San José ATN Feasibility Study Alternative Revenue Sources		

This memo provides a summary and qualitative discussion of several potential operating revenue sources for the Norman Y. Mineta San José International Airport Automated Transit Network (ATN). This memo excludes traditional federal capital funding programs, and other major regional and state funding programs, as the City has stated that it does not intend for the ATN to compete with other regionally-prioritized transportation projects that would be eligible for those funding sources. Such projects currently include the BART extension to San José and the electrification of the Caltrain corridor.

Arup wrote a memo specifically addressing potential advertising revenue for ATN. That memo is titled San José ATN Feasibility Study Potential Advertising Revenue and is dated April 10, 2012.

The other potential operating revenue sources discussed in this memo include:

- Fare revenue
- Parking revenue
- Revenue from adjacent development
- Sales tax revenue

Fare Revenue

According to the Airport Master Plan Air Resources Board Certification Status Report for 2011, one of the conditions of continued certification is to "Provide free transportation connecting Airport terminal/parking lots and Caltrain/VTA train stations." This condition is currently met via the VTA Airport Flyer bus route, which would be replaced in function by the ATN. For this exercise, all ATN stations are assumed to serve Airport destinations except for the Santa Clara Caltrain and VTA Metro/Airport stations. In addition, all on-Airport shuttle bus trips, which connect the two terminals to parking lots and to the Consolidated Rent-a-Car center (ConRAC), are free. While all on-Airport trips and VTA Flyer trips are currently fare-free, trips for which fares might be reasonably collected would be direct trips between the Santa Clara Caltrain and VTA Metro/Airport stations. The estimated passenger demand for this link is 300 total daily passengers in 2011 and 650 total daily passengers in 2030, or approximately 5% of system total daily passenger trips in each case.

Currently the VTA Flyer is free for all trips, including between the Caltrain and LRT stations, while regular bus cash fares are $2. Monthly passes would reduce average per-trip fare revenue. Passenger price sensitivity is unknown for the ATN application and requires further study.

Opportunities include:

- ATN would offer a premium passenger experience compared to the VTA Flyer in terms of waiting time and travel time. ATN could reduce travel time between Light Rail and Caltrain in half.
- To lessen the impact of a fare to passengers, the ATN operator could arrange a fare reimbursement agreement with Caltrain and VTA. Passengers could ride ATN for free if they transfer to/from Caltrain or VTA, but the ATN operator would be reimbursed in part by the originating or destination transit agency for the fare. Both Caltrain and VTA offer their passengers free or discounted transfers for connecting transit services. On the other hand, the ATN operator would receive less revenue per passenger.
- The connection between Santa Clara Caltrain and VTA Metro/Airport station is a regional link. Although the two services meet at Diridon Station further south, there is a significant time penalty to make the transfer and travel through downtown San Jose via Light Rail. Therefore, passengers may be willing to pay for the convenience of traveling between Santa Clara Caltrain and VTA Metro/Airport stations.

Challenges include:

- Given the requirement for Airport trips to be free, only a very small proportion of ATN ridership has the potential to generate fare revenue.
- The existing VTA Flyer is free even for direct trips between Santa Clara Caltrain and VTA Metro/Airport station.
- Fare collection equipment and a fare media system would need to be provided, which carries additional capital and operating costs for equipment, media, and software integration and maintenance, including potential integration with the Bay Area's Clipper smart transit fare card. This also introduces a level of hassle not currently experienced by passengers using the VTA Flyer.

Given the challenges outlined above, and to provide the best possible passenger experience, revenue from fares has not been assumed in the Preliminary Business Case Analysis.

Parking Revenue

Preliminary data from the PRT operation at Heathrow Airport Terminal 5 indicates that since commencement of PRT service, parking revenue has increased by 10 percent at the two business-class surface parking lots served by PRT due to increased patronage and an increase in parking fees. While this is an encouraging data point, the applicability of the experience at Heathrow to the San José Airport is questionable and would benefit from more study. A variety of factors both support and discount potential applicability and warrant further study.

Opportunities include:

- Both Heathrow and San José Airport main terminal buildings are served by a large, multi-story parking garage. Despite this condition at Heathrow, parking demand and revenue at the remote parking lots served by PRT has increased.
- The travel time savings at Heathrow T5 are dramatic, with an average savings of 9.6 minutes (6.2 minute PRT trip compared to 15.8 minute shuttle bus trip)(Martin Lowson, 2010). At San José Airport, the Economy Lot offers great potential for reducing travel time and increasing travel time reliability. The lot is beyond walking distance from the terminals and it has a total of 7 bus stops arranged along its perimeter for the Airport shuttles, increasing trip time when multiple stops are served. In addition, the terminal-area roadways are one-way so trip times from the terminal area (7 to 16 minutes) are longer than trips from the Economy Lot to the terminals (2 to 13 minutes). The ATN could serve trips between the Economy Lot and the terminal area in as few as 3 minutes; could offer more balanced trip times; and offer better reliability because the ATN would not be subject to traffic congestion.
- The Heathrow surface lots served by PRT are intended for business customers, which value short travel times and convenience. They may also be reimbursed for travel expenses and therefore are less sensitive to fees. San José Airport notes that it serves a mix of business and non-business travelers and a number of its customers are sensitive to parking price. The people that do park on-Airport at San José essentially self-select by choosing the more expensive parking rates in exchange for quick access to terminals.
- The low travel times enabled by an ATN raises the possibility that the Airport could expand its parking capacity at surface parking lots located further from the terminal area, increasing its revenue-generating ability while avoiding substantial costs of building new structured parking close to the terminals.

Challenges include:

- Overall Airport passenger demand is unlikely to change as a result of the ATN (larger factors include the general economy, flight schedules, landing fees/pricing, etc.). Therefore, the ATN system is not expected to increase overall parking demand, though it may affect where people park.
- The Heathrow surface parking lots were previously underused and had spare capacity. The San José Airport Economy Lot, while having good potential for improvement, is well-used compared to other lots at the Airport, and it is unknown whether there is sufficient supply to recognize increases in revenue from increased demand at the Economy Lot.
- San José Airport staff acknowledges that on-Airport parking pricing is relatively high compared to off-Airport competitors. The Airport is currently limited in its ability to increase parking rates. A comparative parking pricing study could look at some of the factors discussed above.
- Because the ATN would connect to the VTA Light Rail station and to Santa Clara Caltrain/future BART station, the ATN may reduce parking demand and consequently parking revenue. On the other hand, it could be offset by creating capacity for travelers who value short, reliable travel times and convenience that on-Airport parking served by an ATN could provide.

Given the similarity of the passenger profile (high business travel), and the Airport's location in Silicon Valley, a modest one-time increase in parking revenue seems justified. However, further study is warranted to determine the level of increase more precisely. For the purposes of the Preliminary Business Case Analysis, the Project Team has assumed a one-time increase of 10% (with no parking rate increase), and subsequent annual increase of 1.5% linked to airport passenger growth. The base parking revenue in all cases is assumed to continue to be used for general Airport (non-ATN) operations.

Revenue from Adjacent Development

The Airport-area ATN system analyzed in the Feasibility Study locates one station at the VTA Metro/Airport station, one station at Santa Clara Caltrain, and the remaining eight ATN stations all on Airport property. However, in-line stations could be added to the alignment. The network could also be extended in length to serve other destinations. But, that is beyond the scope of the San José ATN Feasibility Study. Two perspectives regarding revenue from development adjacent to hypothetical in-line stations are offered below.

Preliminary Land Use Analysis

In early stages of the Feasibility Study, a GIS-based analysis identified walksheds from VTA LRT, Caltrain, and a hypothetical network of ATN stations to the west and east of the Airport. Walksheds for LRT and Caltrain were calculated assuming a maximum 1/3-mile walk from each station (consistent with City of San José and VTA planning guidance), and walksheds for ATN assumed a maximum ¼-mile walk from each station. ATN stations were placed with the intent of capturing as much development as possible except for avoiding the Guadalupe Gardens residential neighborhood immediately east of the Airport, which has in the past objected to the Airport APM.

Land use analysis of these walksheds revealed that land along the west edge of the Airport is zoned industrial, with the exception of the Santa Clara Caltrain/future BART station, which will be zoned to accommodate a mix of high-intensity retail, residential, and entertainment uses. Thus very low ridership would be expected at intermediate points between the Airport and the Santa Clara Caltrain station along a northern alignment. Ridership along a southern alignment could offer greater potential due to the anticipated redevelopment of the former FMC property bounded roughly by Brokaw Road, Coleman Avenue, the UPRR tracks, and Newhall Drive, which included discussion of building a new professional soccer stadium; however, for other reasons the northern alignment was chosen for further study. Land east of the Airport within the walksheds is zoned with a mix of industrial and commercial, although implementation of the Vision for North San Jose is expected to intensify land use along the North First Street corridor, particularly around each LRT station. See Figure 1 for a diagram of land use near the hypothetical ATN stations.

Ridership potential from adjacent land uses was assessed for three hypothetical ATN stations east of the Airport and one station south of the Airport (at Coleman Avenue near Hedding Street). Assumptions for the analysis were drawn from Arup's experience in transit station planning in the Bay Area and included the following:

- 65 percent of land is developed (remaining land is occupied by roadways, utilities, parks, etc.)
- Site commercial floor-area ratios range between 0.1 and 0.5 (to generate low/high range)
- Employment density is 400 square feet per worker (typical for office workers)

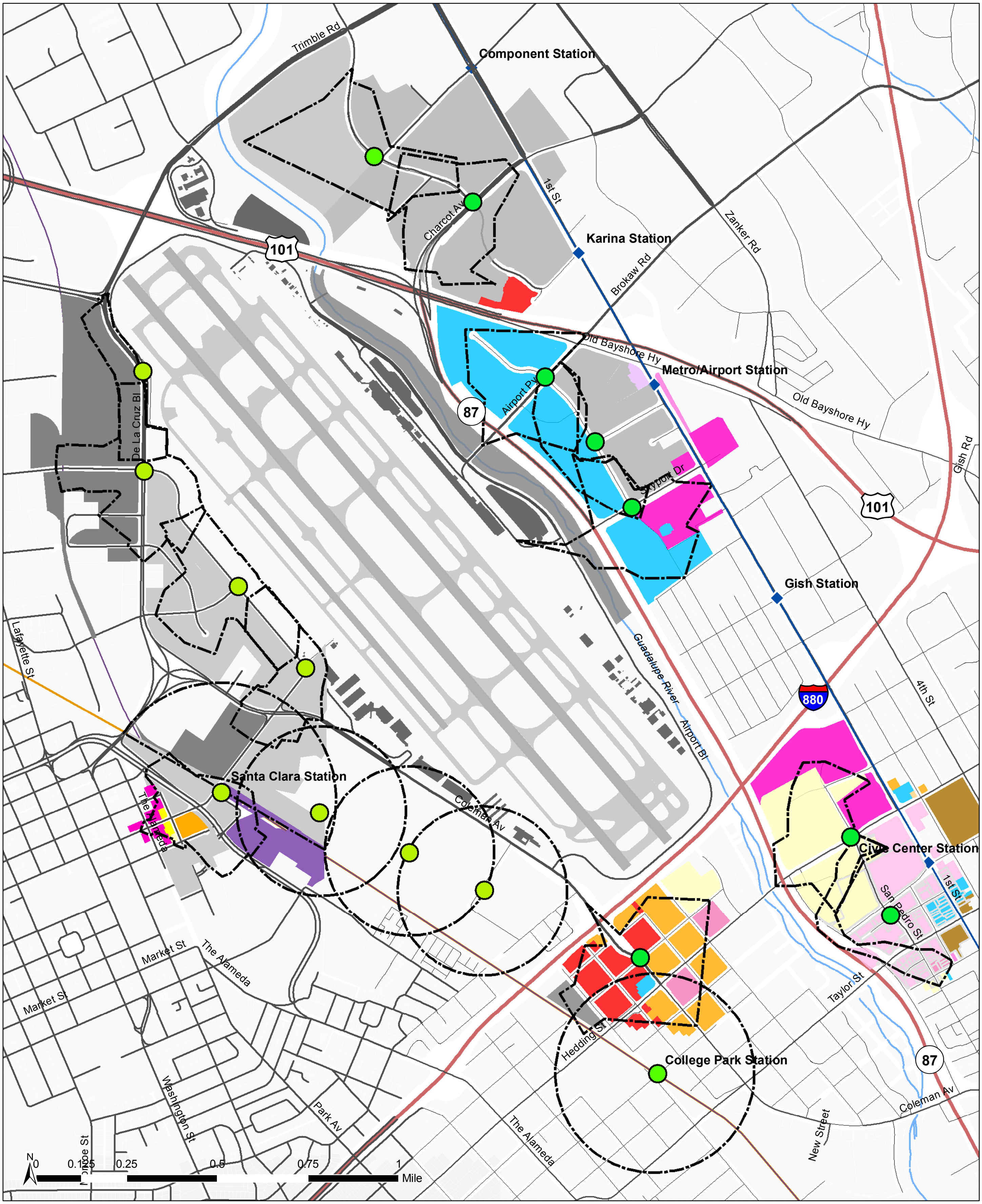
- There is an average of 1.5 trips per employee per day (accounting for 7 days a week and part-time workers)
- VTA system-wide (Santa Clara County) transit mode share is 3.5% of all transportation trips

The use of the above assumptions resulted in potential ridership ranges from 20 to 100 daily riders at hypothetical ATN stations. See Table 1 below. The low ridership is largely driven by the use of the VTA system-wide mode share. This is a reasonable assumption to use because the ATN analyzed in the Feasibility Study is primarily intended to serve specialized trips to the Airport, and any additional trips from last-mile connections would rely on the use of other transit services, namely LRT or Caltrain. The hypothetical ATN stations generally did not include residential areas, with the exception of the station near Coleman, so the opportunity for internal trip capture is limited. A predominance of commercial land uses at each of the hypothetical ATN station locations, some of which are offices oriented toward the North First Street corridor and others Airport-oriented such as hotels, indicates that work-destination trips are likely the largest component of the non-Airport-based trips.

An early conclusion from this analysis is that the relatively low magnitude of benefit (on the order of dozens or hundreds of riders a day), with the system analyzed in the Feasibility Study, would not likely drive developers to help fund an ATN.

Table 1. Early Analysis of Potential Ridership at Hypothetical ATN Stations

Hypothetical ATN Station	Population	Infill Employment		Total Employment		Potential Daily Trips	
		Low	High	Low	High	Low	High
Component	0	450	2200	450	2200	24	116
Karina	0	400	675	750	1025	39	54
Airport Pky	0	0	0	400	400	21	21
Coleman	525	65	275	75	285	32	42



Legend

San Jose Zoning

A(PD), CG, CN, CO, CO(PD), CP, HI, IP, IP(PD), LI, R-1-8, R-2, R-2(PD), R-M

Santa Clara Zoning

- Duplex
- Heavy Industrial
- Light Industrial
- Medium Density Multiple Dwelling
- Mixed Use

Exclusive ATN quarter mile walkshed

Potential ATN station

Figure 1: Land-use Zoning Map

San José ATN Feasibility Study

February 25, 2011

ARUP

Airport-Serving Hotels and Businesses

According to an analysis of the City of San José Official Visitor Guide 2010, out of the approximately 3,250 hotel rooms within 20 hotel properties located proximate to the east side of the Airport, 2,650 rooms (81%) are served by a hotel shuttle at 13 of the hotel properties, while 7 properties with a total of 615 rooms do not offer shuttle services. It has been suggested that if ATN stations could offer Airport access to nearby hotels, then those hotels could discontinue their own shuttle services and contribute operating funds to the ATN instead. Other businesses located in office buildings and business parks in the area may also contribute towards ATN to provide improved access to the Airport for employees and guests. One method for accomplishing this is for area hotels and businesses to voluntarily create a local area transportation management association (TMA), which could collect and direct member contributions toward improvements in the area, including subsidizing ATN operations. This mechanism is commonly used in office/business parks, retail centers, and transit station node areas to subsidize shuttle services to reduce traffic congestion, encourage transit use, and draw shoppers.

However, there are also several potential reasons that hotels and local businesses may not support ATN financially. Further investigation can examine these potential issues and establish whether there would be sufficient benefit for hotels and businesses proximate to the Airport that they would agree to help fund ATN operations. Challenges might include:

- Most hotels in the area are small (all but two are less than 200 rooms each), and the incremental cost for a hotel to operate a shuttle on a part-time basis is low.
- Existing shuttle services and taxis are flexible and are likely to cover additional destinations than the ATN system, and therefore may still be needed in addition to ATN.
- Hotel shuttles and taxis offer a high level of service. They pick up at the hotel door and can be demand-responsive. An ATN would likely be more responsive to demand than hotel shuttles, but would need great station coverage to achieve a comparable degree of walk accessibility.
- Hotels see a competitive advantage to offering in-house shuttle services if they can offer better services than other hotels, for example if they are located more conveniently to the Airport. If they pay into an ATN, some competitive advantages may be negated, such as the potential for increased travel time and hassle (e.g., level changes, walk distance). Further, if the ATN operates in a public, fare-free or low-fare setting, there is even less benefit for businesses that pay than neighboring businesses that don't pay.
- Even if area hotels and businesses were to pool resources via a transportation management association, they could decide to fund non-ATN services and projects, such as a jointly-funded shuttle bus system.

Further research is recommended to confirm attitudes and commitments of Airport-serving businesses. In the meantime, revenue from adjacent development has not been assumed in the Preliminary Business Case Analysis.

Sales Tax Revenue

The City of San José could consider levying a local sales tax measure to help fund ATN operations, or it could lobby VTA to include ATN on future county sales tax measures. A very strong political effort would be needed to convince local taxpayers to pay for ATN, considering the current economic climate, the fact that Santa Clara County already has sales tax measures in place for transportation, and larger regional projects need significant capital and operating funds (BART extension to San José and electrification of Caltrain). While this funding source does not seem to be a likely candidate in the near future, it may be worth revisiting later as the trend increases towards greater share of local funding for transportation. At this time, sales tax revenue has not been assumed in the Preliminary Business Case Analysis.

Summary

Table 2 summarizes the potential revenue sources discussed in this memo and whether revenues have been assumed in the Preliminary Business Case Analysis for the San José ATN Feasibility Study.

Table 2. Summary Table of Alternative Revenue Sources

Potential Revenue Source	Assumption in the San José ATN Feasibility Study	Notes
Fare Revenue	Not included	Currently there is little justification for fare-based revenue. All Airport-related trips would essentially be free. Non-Airport trips represent a very small percentage of trips, and those trips currently are also free.
Parking Revenue	Included	Parking revenues increased after the London-Heathrow Terminal 5 ATN began service, even after rates were raised. Further market study comparing San José to Heathrow may be justified.
Revenue from Adjacent Development	Not included	Early analysis indicated low potential ridership for non-Airport trips. Possibility for more in-depth analysis related to hotel shuttles, demonstration of benefit, and potential for TMA formation.
Sales Tax Revenue	Not included	Challenging environment to raise additional taxes to support ATN in the foreseeable future.

Memorandum

Sources Considered

- Market Demand and Economic Viability of a Personal Rapid Transit System in Stockholm – the Use of EMME/2, October 1999
- Viability of Personal Rapid Transit in New Jersey, February 2007
- Daventry PRT Scoping Study, Phase 2 Report, February 2008
- [Morgantown / West Virginia University] PRT Facilities Master Plan, June 2010
- Feasibility of PRT in Ithaca, New York, Final Report, September 2010
- [Mineta San José International Airport] Annual Status Report on the Airport Master Plan, March 2012
- PRT: Business Case and Revenue Generation, Martin Lowson, presentation to Passenger Terminal Expo, March 2010

Memorandum

ARUP

To	Laura Stuchinsky Henry Servin	Date April 10, 2012
Copies		Reference number 214704
From	Gary Hsueh Will Baumgardner	File reference 4-05
Subject	San José ATN Feasibility Study Potential Advertising Revenue	

This memo summarizes several methods for estimating potential advertising revenue for the ATN system.

These methods are drawn primarily from TCRP Synthesis 51 (2004), and recent consultation with VTA, the Airport, and Arup's global skills networks.

Applicable Notes from TCRP Synthesis 51

Factors for Consideration

- Media market: rates in the top 20 media markets are generally higher because of the higher level of national advertisers. San José (VTA) is in the San Francisco top 20 media market.
- Restrictions on billboards in the San Francisco area (notably San Mateo County) has helped make exterior bus advertisements more valuable.
- Revenue Guarantee: 92% of the 43 transit agencies surveyed included a minimum annual payment that their advertising sales contractor paid to the transit agency, regardless if the contractor sold that amount of advertising space. In 2002, guarantees for small- to medium-size agencies in top 20 media markets ranged from $17,000 to $2.1 million.
- Revenue Share: 92% of agencies reported that their contracts included a revenue share, whereby the advertising sales contractor paid the transit agency a pre-defined percentage of their annual revenue. Revenue shares ranged from 25% to 65% for small- to medium-size agencies in top 20 media markets. However, it is also noted that in economically depressed times, the revenue guarantee is usually the greater number.
- Rates vary by media market, exterior vs. interior advertising, positioning and size of an advertisement on a vehicle, and duration of a campaign.
- Among large transit agencies in the top 20 media markets, exterior "king-sized" (the most common size, 30 inches by 144 inches) bus advertisements ranged from $520 to $735 per 4-week posting. For longer 52-week postings, rates were lower by $60 to $150.

Memorandum

- In-vehicle advertising draws much lower rates than exterior advertising, because the ridership is so much lower. Interior car cards were priced at $16 to $24 per month.
- In-vehicle electronic advertisements were too new to draw conclusions in the TCRP Synthesis.
- Bus wraps and "station dominance/station blitz" are more proven forms of "nontraditional" forms of advertising. They command substantially higher rates, but are more limited in use because of cost to advertisers. Vehicle wrapping has been successful for certain types of events, product roll-outs, vehicles, or advertisers. Issues identified with bus wraps include visibility and safety; aesthetic concerns (leading to a limitation on the number of vehicles wrapped in a fleet); dilution of the agency brand; coordination issues with operations; and costs of repainting after wraps are removed.
- Rates for full-bus wraps ranged from $5,300 to $7,700 per month; longer-term commitments of 12 weeks or more were expected.
- The value of a full-bus wrap was approximately 4 times the value of conventional advertising at large transit agencies. Larger conventional side advertisements ("super king") were $2,000 at San Francisco-area transit agencies, and full-back advertisements were priced between $1,200 and $2,500.
- Revenue potential is affected by the size of the transit agency in terms of number of vehicles, and ridership.
- At the time of writing in 2004, transit agencies realized much lower revenue levels after 2002 because of the economy.

Estimating Methods

- Percentage of total operating funds: 0.1% to 3.2%, average of 1.5%
- Percentage of fare revenues: 4.4% of revenues from fares, outliers include 10% and 20% of fares.
- Revenue per passenger trip/based on ridership: average 3.5 cents per trip for large transit agencies. See Figure 12 from TCRP correlating revenue to ridership, below.

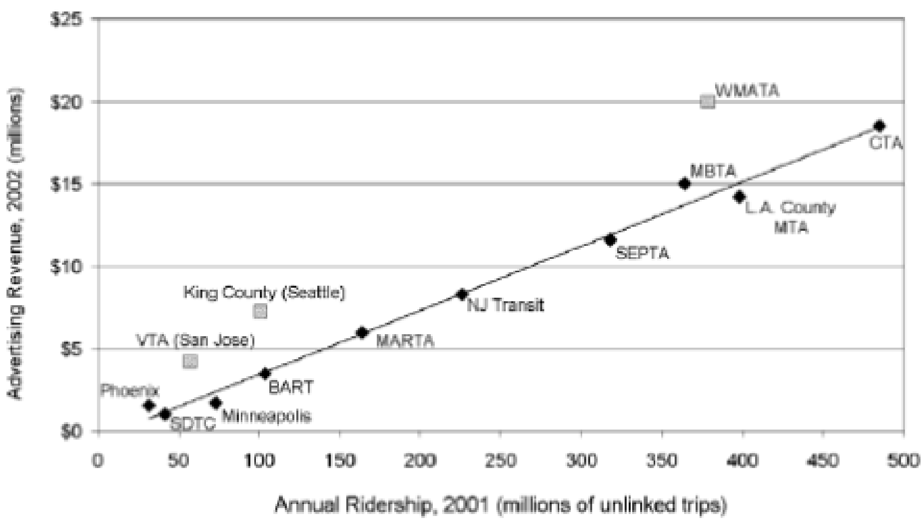


FIGURE 12 Advertising revenue and ridership, large agencies in top 20 media markets. Note: Line is drawn to best fit observations indicated as diamonds. *R*-squared is 0.99. Note that advertising revenues are gross revenues to the transit agency. In-house costs are not subtracted from the gross revenue figures.

- Revenue per vehicle/based on fleet size: strong correlation with fleet size for the 14 bus-only agencies surveyed; mostly between $1,100 and $1,800 per bus; average $1,472 per bus excluding highest and lowest values. See Figure 13 from TCRP correlating revenue to fleet size.

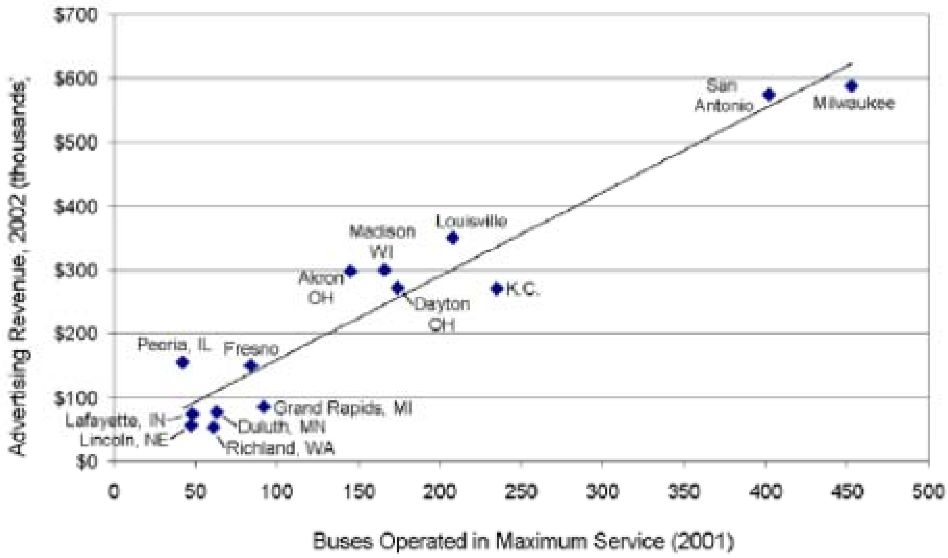


FIGURE 13 Advertising revenues and fleet size, transit agencies in medium and small media markets. Note: Line is drawn to best fit observations. *R*-squared is 0.92. Note that advertising revenues are gross revenues to the transit agency. In-house costs are not subtracted from the gross revenue figures.

- Revenue per vehicle for smaller transit agencies in large metropolitan areas: in 2002, average revenue of $4,900 per bus and 12.8 cents per passenger trip for agencies characterized by operating substantial commuter service into the central city or between suburbs, or both; benefit from attractive demographics of their own ridership and surrounding automobile drivers, which attract a higher-end mix of advertisers than central city bus systems.

At the end of this document, as an Appendix, is Table 6 from TCRP Synthesis 51, Summary of Advertising Revenue in 2002. Considering both ridership and fleet size, the ATN system would appear to fall into the category of “Other Transit Agencies in Top 20 Media Markets.”

San José Airport Rate Card

The Mineta San José International Airport contracts with advertisement sales company Clear Channel. The rate card for several standard media types is copied below.

CLEAR CHANNEL AIRPORTS
2012 MONTHLY NET RATES

STANDARD MEDIA	Unit Rate	Long Term Rate
Dioramas (8)	$6,060	$4,665
Mini-Spectaculars	$15,545	$11,960
Wall Spectaculars	$19,045	$14,650

Additional information about media types and rates was obtained during a conversation with Clear Channel. Dioramas and mini-spectaculars are backlit; they are located on concourse and in gate hold areas. Current digital network consists of 18 screens (provide more movement and are vibrant); located primarily in baggage claim, with highest queue times, and 4 in concourses. Rate for digital network is $10,000 per month. Most advertisers mix digital and dioramas. Another offering is a high-end, stretchy banner – outdoor equivalent to billboards. These are located at security checkpoints and are offered at $20,000 per month (Clear Channel, 2012).

Qualitative Comparisons Between ATN and Other Transit Modes

- ATN vehicles are smaller than buses, and thus will have less visible area than a bus. ATN vehicles range from 141 inches to 153 inches long and 57 to 83 inches tall. This places the effectiveness and revenue generation ability of an ATN vehicle wrap closer to a standard king-size bus exterior ad (30 inches by 144 inches) than a full-size bus wrap (6 feet tall by 40 feet long).
- ATN vehicles operate on exclusive, grade-separated guideways. ATN vehicles will be less visible to non-users than buses that operate in mixed traffic. The guideway design may also affect visibility if vertical surfaces partially obscure vehicles, for example if there are raised curbs, crash barriers, and passenger safety fences.
- The ATN guideway will be located in fairly prominent locations parallel to major Airport roads. Because the guideway is elevated, vehicles will be more visible when seen from afar rather than when they are directly overhead.
- The ATN represents a new technology, and it should attract more attention and more media coverage than conventional transit. As a consequence, it may attract higher-tier advertisers in Silicon Valley including national-level advertisers (which typically pay more). However, because it is a new technology, it may also need to demonstrate a reliable track record before major advertisers sign on to more lucrative and visible opportunities such as vehicle wraps.
- ATN has more vehicles per rider than conventional transit agencies. This affects estimates that are based on fleet size or ridership.
- Conventional-sized advertisements are easier to sell because advertisers do not need to reformat their pre-designed ads. It is unlikely that ATN would support standard-size advertisements both for branding reasons as well as physical reasons (door openings). Custom wraps would likely be necessary.

Revenue Benchmarks

- Currently, the Airport receives a minimum revenue guarantee of $4.2 million per year for 100 advertising sites, or an average of $42,000 per site. Occupancy rate is currently 30%. That contract is due to expire in 2014 and has one 3-year option to extend the contract to 2017 (Airport, 2012). Airport staff states that the option is at the Airport's discretion and if they exercise it, the amount of the minimum revenue guarantee will not change. (Airport, 2012).
- In 2002, VTA advertising revenue was $4.2 million with a ridership of 57.3 million and 493 buses and light rail vehicles, equating to 7.3 cents per passenger trip or $8,519 per vehicle (TCRP).
- In 2010, VTA advertising revenue was $1.67 million (VTA 2012) with a ridership of 41.9 million and 361 buses and 47 light rail vehicles (NTD 2012), equating to 4 cents per passenger trip and $4,100 per vehicle. Total operating expenses were $262.8 million (VTA 2012). Estimated operating expenses for 2012 are $295.3 million and advertising revenue of $1.65 million (VTA 2012).
- In 2002, SamTrans advertising revenue was $2.1 million with a ridership of 18.1 million trips and 278 buses, equating to 11.6 cents per passenger trip or $7,550 per bus (TCRP).
- In 2010, SamTrans advertising revenue was $1.54 million (SamTrans 2012) with a ridership of 14.4 million and 255 buses (NTD 2012), equating to 10.7 cents per passenger trip and $6,040 per bus. Motor bus operating expenses were $90.7 million (SamTrans 2012). Budgeted revenue in FY12 is $900,000; with the same ridership and service levels, revenue would be 6.3 cents per trip and $3,530 per bus. Budgeted operating expenses are $99.4 million (SamTrans 2012).
- In 2010, AC Transit advertising revenue was $1.15 million (AC Transit 2012) with a ridership of 61.4 million and 532 buses (NTD 2012), equating to 1.9 cents per passenger trip and $2,160 per bus. Operating expenses were $322.5 million (AC Transit 2012). Budgeted advertising revenue for FY2011 through 2013 is $1.25 million; with the same ridership and service levels revenue would be 2 cents per passenger trip and $2,350 per bus. Operating expenses are forecast at $309.1 million (AC Transit 2012).
- In FY2012, BART advertising revenue was budgeted at $7.1 million (BART 2012) with a ridership of 110.2 million (estimated) and 534 vehicles (BART 2012), equating to 6.4 cents per passenger trip and $13,300 per vehicle. Operating expenses are forecast at $506.9 million (BART 2012).
- Note that due to survey methodology, all vehicle quantities are based on vehicles in peak use.

Advertising Revenue Estimates

Assumptions for ATN System

- Number of vehicles at peak use: 300
- Passenger trips per year: 5,000,000
- Annual operating cost: $10,000,000
- Annual farebox revenue: $0
- Stations: 8 small/satellite stations, 2 large stations
- Based on ridership and fleet size, ATN would most likely be considered a small-medium agency within a top 20 media market.

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Estimate – Advertising Revenue as a Percentage of Total Operating Funds

This estimating method compares total annual advertising revenue to the annual operating cost. Using sample ratios, the potential advertising revenues for ATN are calculated below.

- Assuming operating funds of $10,000,000 per year, times:
  - 0.4%: $40,000 (AC Transit, 2010 and 2012)
  - 0.5%: $50,000 (VTA 2012)
  - 0.6%: $60,000 (VTA 2010)
  - 0.9%: $90,000 (SamTrans 2012)
  - 1.4%: $140,000 (BART 2012)
  - 1.5%: $150,000 (TCRP survey average in 2002)
  - 1.7%: $170,000 (SamTrans 2010)
  - 3.1%: $310,000 (Singapore MRT; Arup 2012)
  - 3.2%: $320,000 (TCRP survey max in 2002)
  - 5.0%: $500,000 (general rule of thumb for metros; observed in Brazil and elsewhere; Arup 2012)
  - 6.2%: $620,000 (Hong Kong; Arup 2012)
- Commentary: The percentage revenue in the Bay Area is generally low compared to some other data points, which may point toward a combination of high cost of providing transit service plus low advertising revenue.

Estimate – Percentage of Farebox Revenues

- N/A. No farebox revenues to compare to.

Estimate – Advertising Revenue per Passenger Trip

This estimating method compares annual advertising revenue to the total annual unlinked passenger trips to yield revenue per trip. Using sampled revenue rates, the potential advertising revenues for ATN are calculated below.

- Assuming 5,000,000 trips per year, times:
  - 2.0 cents per trip: $100,000 (AC Transit 2011)
  - 4.0 cents per trip: $200,000 (VTA 2010)
  - 6.3 cents per trip: $315,000 (SamTrans 2012)
  - 6.6 cents per trip: $330,000 (BART 2010)
  - 10.7 cents per trip: $535,000 (SamTrans 2010)
- Commentary: This metric is most applicable to large transit agencies; see TCRP Figure 12 where there is a strong correlation of large agencies to revenue per passenger trip. As a "small-medium agency within a top 20 media market," ATN could command a price premium compared to the larger transit agencies because of the air traveler / business traveler demographic rather than a more generalized urban/suburban transit setting.

However, ATN has minimal exterior advertising visibility (limited geographic area; small vehicles; small size of advertisements; exclusive elevated guideway); it is easier to imagine advertising focused on the user inside the vehicle. In-vehicle advertising would be expected to add value because a screen is dedicated to a small captive audience.

Estimate – Advertising Revenue by Fleet Size

This estimating method compares annual advertising revenue to the number of vehicles in service during peak hours. Using sampled revenue per vehicle, the potential advertising revenues for ATN are calculated below.

- Assuming 300 ATN vehicles, times:
  - $1,500 per vehicle: $450,000 (TCRP 2002, average of bus-only agencies in smaller media markets)
  - $2,350 per vehicle: $705,000 (AC Transit 2012)
  - $3,500 per vehicle: $1,050,000 (SamTrans 2012)
  - $4,100 per vehicle: $1,230,000 (VTA 2010)
  - $5,000 per vehicle: $1,500,000 (TCRP 2002, average of smaller agencies in top 20 media markets)
  - $6,040 per vehicle: $1,812,000 (SamTrans 2010)
- Commentary: The applicability to ATN of value per vehicle is questionable, considering the vehicle size and visibility issues discussed previously. As a potential lower bound, the $1,500 per vehicle corresponds with TCRP Figure 13, which is applicable to smaller media markets (generally lower rates than the top 20 media markets). It is doubtful that the $5,000 per vehicle representing the “smaller agencies in top 20 media markets” and that is most applicable to ATN is still at this level now. Separately, the downward shift for SamTrans from 2010 to 2012 is remarkable.
- Additionally, at this time, the assumption for number of ATN vehicles is still a major variable.

Illustration of Revenue by Advertisement Type

In contrast to the above estimating methods, this section illustrates a bottoms-up approach to building up a revenue estimate. It is based on number of vehicles, various media types that could be applied to vehicles and stations, an average occupancy rate, and an assumed revenue share; which frankly are all highly speculative at this time.

- 300 vehicles times 30% occupancy rate (SJC 2012) times 45% revenue share (median between 25% and 65% reported revenue share in TCRP):
  - 2 x vehicle exterior king size advertisements at $630 per 4-week posting, discounted by 50% from 2002 levels: $292,680 (TCRP 2002), or
  - 1 full-back size (equal to the size of the back of a bus) advertisement at $1,850 per 4-week posting, discounted by 50% from 2002 levels: $449,550 (TCRP 2002), and
  - 1 in-vehicle electronic advertising display (no information available).
- 8 small stations times 30% occupancy rate times 45% revenue share:
  - 2 Dioramas at $4,665 per month: $120,915 (SJC Clear Channel 2012)

- 2 large stations times 30% occupancy rate times 45% revenue share:
  - 8 Dioramas at $4,665 per month: $120,915 (SJC Clear Channel 2012), and
  - 2 Wall Spectaculars at $14,650 per month: $94,932 (SJC Clear Channel 2012)
- Commentary: Small changes in any of the vehicle-level assumptions (number of vehicles, occupancy rate, number of advertisements per vehicle, price per advertisement, length of posting) or station-level assumptions, and assumed revenue share, can result in large swings in the total revenues.

Preliminary Conclusions

- TCRP Synthesis 51 provides an excellent, though somewhat dated, reference to understand how advertising is managed in small and large transit agencies in small and big media markets throughout the United States. Given that only conventional transit agencies were surveyed, the applicability to ATN is questionable, particularly given the technological and systemic differences of ATN, plus the lack of information about more modern advertising technologies including in-vehicle electronic displays.
- When information from TCRP Synthesis 51 is combined with more recent budget and operating data gleaned from local Bay Area transit agencies and the National Transit Database, some benchmarks begin to seem more credible, though they are still based on conventional transit.
- We have attempted to identify and describe some of the differences between ATN and conventional transit as they relate to advertising. The various qualitative differences do not yet seem to point to a clear inclination upward or downward of expected advertising revenues compared to conventional transit.
- The method of estimating advertising revenue as a percentage of total operating funds seems to produce the most conservative estimate, especially when compared to other Bay Area transit agencies. On this basis, an annual percentage of less than 2% would be comparable to Bay Area transit operators; up to 5% would seem comparable with international practice; and beyond 5% would seem unlikely unless the ATN has an extraordinary marketing cachet.
- The method of estimating advertising revenue by passenger trip is also generally conservative when compared to other nearby Bay Area transit operators. The most favorable rate of 10.7 cents per trip could potentially be justified if recent data for in-vehicle electronic advertising revenues can be found.
- The method of estimating advertising revenue by fleet size seems to yield generous results due to old TCRP data, one outlier of recent SamTrans revenue, and the fact that the ATN fleet is assumed to be very large. The qualitative differences do not provide clear direction on this. A middle-of-the-road estimate of $3,500 per vehicle yields a number that is twice as high as the other two methods described above.
- The illustration by advertisement type lists different components that could be included in the ATN system, with rudimentary pricing based on the Airport rate card. This type of build-up is extremely speculative at this point and should only be considered credible when a number of assumptions can be relied upon and rates are developed specifically to reflect the unique characteristics of an ATN system.
- Based on the methods described above, with deference to percentage of total operating funds and revenue per passenger trip, an advertising revenue of $500,000 per year seems to be reasonably supported. This estimate should be refined to reflect more ATN-specific characteristics if available in the future.

Memorandum

References

- Transit Cooperative Research Program (TCRP) Synthesis 51: Transit Advertising Sales Agreements, 2004
- 2010 National Transit Database, for SamTrans, AC Transit, VTA
- SamTrans FY2012 Adopted Operating Budget
- VTA Adopted Biennial Budget, Fiscal Years 2012 and 2013
- AC Transit Adopted Biennial Budget, Fiscal Years 2011-12 and 2012-13
- Arup presentation on Singapore MRT, 2012
- Inputs from Arup global staff, 2012
- Inputs from Airport staff, 2012
- Inputs from Clear Channel (Airport advertising sales contractor), 2012

Appendix

Copied below is Table 6 from TCRP Synthesis 51, Summary of Advertising Revenue in 2002. It is interesting to compare the potential ATN system to other transit agencies in terms of trips and vehicles in peak-hour service, by advertising market.

TABLE 6
SUMMARY OF ADVERTISING REVENUE

Agency Name	City/State	Ad Sales Revenue, 2002 ($thousands)	Unlinked Passenger Trips, 2001 (millions)	Who Sells Advertising	Vehicles in Peak-Hour Service: Buses	Heavy Rail Cars	Light Rail Cars	Commuter Rail Cars
Top 20 Media Market, Large Agency								
Washington Metropolitan Area Transit Authority (WMATA)	Washington, DC	20,000.0	378.9	Viacom	1,212	628		
Chicago Transit Authority (CTA)	Chicago, IL	18,500.0	484.8	Viacom	1,627	988		
Massachusetts Bay Transportation Authority (MBTA)	Boston, MA	15,000.0	364.3	Viacom (some in-house)	884	320	155	376
Los Angeles County Metropolitan Transportation Authority (LACMTA)	Los Angeles, CA	14,200.0	398.1	Viacom	2,026	70	51	
Southeastern Pennsylvania Transportation Authority (SEPTA)	Philadelphia, PA	11,600.0	318.1	Viacom	1,106	308	108	291
New Jersey Transit Corporation (NJ Transit)	(Statewide), NJ	8,300.0	225.9	Viacom	1,838		31	733
King County Department of Transportation—Metro Transit Division	Seattle, WA	7,250.0	101.0	Viacom	976		3	
Metropolitan Atlanta Rapid Transit Authority (MARTA)	Atlanta, GA	6,000.0	164.1	Viacom	603	186		
Santa Clara Valley Transportation Authority (VTA)	San Jose, CA	4,241.5	57.3	Viacom	452		41	
San Francisco Bay Area Rapid Transit District (BART)	Oakland, CA	3,464.5	103.9	Viacom		507		
Metro Transit	Minneapolis, MN	1,700.0	73.3	Viacom	792			
City of Phoenix Public Transit Department	Phoenix, AZ	1,560.0	31.6	Transit Advertising Group	338			
San Diego Transit Corporation	San Diego, CA	1,006.3	41.8	Michael Allen Associates	258			
Maryland Transit Administration	(Statewide), MD	1,000.0	111.0	Gateway; Viacom (bus shelters)	773	66	49	110
Other Transit Agencies in Top 20 Media Markets								
San Mateo County Transit District (SamTrans)	San Carlos, CA	2,100.0	18.1	Viacom	278			
Golden Gate Bridge, Highway and Transportation District	San Francisco, CA	950.0	11.6	Viacom (some in-house)	233			
Snohomish County Transportation Benefit Area Corporation (Community Transit)	Everett, WA	750.0	9.1	Viacom	217			
Pierce County Public Benefit Authority	Tacoma, WA	700.0	14.5	Viacom	172			
Potomac and Rappahannock Transportation Commission	Woodbridge, VA	294.7	1.3	Viacom	65			
Livermore Amador Valley Transit Authority	Livermore, CA	150.0	2.2	Orion Outdoor	50			
Tri Delta Transit	Antioch, CA	42.5	2.2	Orion Outdoor	45			

Memorandum

TABLE 6 (*Continued*)

Agency Name	City/State	Ad Sales Revenue, 2002 ($thousands)	Unlinked Passenger Trips, 2001 (millions)	Who Sells Advertising	Vehicles in Peak-Hour Service: Buses	Heavy Rail Cars	Light Rail Cars	Commuter Rail Cars
Mid/Small Media Market								
Utah Transit Authority (UTA)	Salt Lake City, UT	2,140.1	25.9	Freeway Advertising	529		33	
Port Authority of Allegheny County	Pittsburgh, PA	1,800.0	74.8	Viacom	848		47	
Connecticut Transit	Hartford, New Haven, Stamford, CT	839.5	27.3	Obie Media	309			
Milwaukee County Transit System (MCTS)	Milwaukee, WI	587.9	71.2	Obie Media (buses), Clear Channel (shelters), Transit Television Network (transit TV)	453			
VIA Metropolitan Transit	San Antonio, TX	574.0	47.0	Gateway	402			
Transit Authority of River City (TARC)	Louisville, KY	350.0	16.6	Viacom	208			
Madison Metro Transit	Madison, WI	300.0	10.5	Obie Media	166			
Metro Regional Transit Authority	Akron, OH	298.0	6.4	In-house staff	145			
Greater Dayton RTA	Dayton, OH	271.8	14.9	In-house staff	174			
Kansas City Area Transportation Authority (KCATA)	Kansas City, MO	271.0	15.6	Obie Media	235			
Greater Peoria Mass Transit District	Peoria, IL	155.0	1.9	In-house staff	42			
Fresno Area Express	Fresno, CA	150.0	13.3	Vista Media Group	84			
Interurban Transit Partnership (The Rapid)	Grand Rapids, MI	85.2	5.2	Princeton Media	92			
Duluth Transit Authority	Duluth, MN	77.0	3.2	Houck Motor Coach Advertising	63			
CityBus of Greater Lafayette	Lafayette, IN	74.4	3.1	In-house staff	48			
StarTran	Lincoln, NE	56.0	1.6	Houck Motor Coach Advertising (some in-house)	47			
Sun Tran	Tucson, AZ	54.0	15.9	Attention Transit Advertising (bus wraps in-house)	159			
Ben Franklin Transit	Richland, WA	53.0	3.8	Obie Media	61			
Lake Erie Transit	Monroe, MI	3.1		In-house staff				
Muncie Indiana Transit System	Muncie, IN	1.9	1.4	Burkhart Advertising (some in-house)	25			
Worcester Regional Transit Authority	Worcester, MA	na	4.8	In-house staff				
Transportation District Commission of Hampton Roads	Hampton, VA	na	16.6	In-house staff	280			

Notes: na = not available. (*Sources*: Survey of transit agencies; National Transit Database.)

Appendix D

Environmental Issues and Strategy Memo

Memorandum

ARUP

To	Laura Stuchinsky, Henry Servin, Manuel Pineda	Date	June 1, 2012
Copies	William Baumgardner, Austin Smith	Reference number	214704-00
From	John Hesler (David J. Powers & Associates), Jim Jordan, Gary Hsueh	File reference	4-05
Subject	San José ATN Feasibility Study Environmental Issues and Strategy		

1 Introduction

The purpose of this memo is to identify and discuss potential environmental issues related to the recommended alignment for the San Jose Automated Transit Network (ATN) Feasibility Study, and then to discuss an approach for environmental clearance.

The City of San José (City) is evaluating the feasibility of developing an ATN in and around the Norman Y. Mineta San José International Airport (Airport). ATN, also referred to as Personal Rapid Transit or podcars, is an innovative, emerging transit system concept. The purpose of this study is to determine the feasibility of the ATN technology to perform the role of an Automated Transit Circulator (ATC). The project seeks to fulfill the 2000 Measure A ballot provision to provide an automated people mover to connect the Airport terminals to the east with VTA's Light Rail Transit (LRT) service, and towards the west the Joint Powers Board Peninsula Corridor commuter rail service (Caltrain) and a future extension of the Bay Area Rapid Transit (BART) system. This study does not compare the ATN technology to other modes of transportation.

The City selected two consultants to serve as its Project Team, Arup and the Aerospace Corporation (Aerospace), to initially assess the feasibility of building such a system and potentially to carry out the Design and Procurement of an ATN (Project). Arup, working with subconsultant David J Powers & Associates, is responsible for identifying and discussing environmental issues related to the ATN.

2 Background

Environmental clearance would be required for constructing and operating an ATN. The project is located in California, and therefore is subject to the requirements of the California Environmental Quality Act (CEQA). The project may also be subject to the National Environmental Policy Act (NEPA), if federal funding is used to support the project. Other environmental permits and approvals may also be required to implement an ATN, depending on the location of the alignment. The options for pursuing environmental clearance are discussed in Section 5 below.

The recommended ATN alignment that has been evaluated in this memo is described in the San José ATN Feasibility Study Recommended Alignment memo, dated April 30, 2012. In general, the ATN Recommended Alignment consists of a 6.4-mile, 10-station system connecting the Airport to the VTA Metro/Airport LRT station and the Santa Clara Caltrain/future BART station as well as interconnecting points within the Airport: Terminal A and its parking garage, Terminal B and ConRAC (Consolidated Rent-A-Car) garage, Economy Lot 1 (the surface parking lot north of Terminal A), and the surface lot south of Terminal B (Daily Lot 4).

As documented in the San José ATN Feasibility Study Existing Conditions Memo dated July 22, 2011 (see Section 5 of that document), a significant amount of planning has been completed for transit connections to the Airport. The Airport People Mover Planning Study dated June 2000 investigated linking the Airport to the VTA Metro/Airport LRT station via an Automated People Mover (APM). The subsequent Airport Connection to Silicon Valley Rapid Transit Corridor Study released in 2001 investigated options for adding another APM linkage from the Airport to the Santa Clara Caltrain station. A Final Supplemental Environmental Impact Report (EIR) for the Airport Master Plan Update was completed in January 2003 that evaluated the environmental impacts of the APM options.

3 Potential Environmental Issues

This section describes the likely environmental issues associated with construction and operation of the ATN as described in the San José ATN Feasibility Study Recommended Alignment memo. In general, the impacts will fall into two broad categories: the direct impacts from construction of the footprint of the ATN (i.e., the guideway, stations, maintenance facility, etc.) and indirect impacts such as traffic, noise, vibration, air quality, and visual.

3.1 Direct Impacts

Land Use

Much of the ATN will be constructed on Airport property, where the alignment, stations, and related improvements will be designed to be integrated into the facilities they will serve. For example, stations will be located and designed to facilitate access to/from the passenger terminals, rental car facility, and on-Airport parking areas. Similarly, the alignment will be constructed to comply with all applicable airport design, safety, and operations criteria such as setbacks, height restrictions near runway ends, etc. Therefore, the ATN is not expected to result in any land use impacts with regard to the Airport.

On the west side of the Airport, the off-Airport alignment is proposed to utilize the median of Brokaw Road. The alignment will be elevated and, therefore, will not sever access to the land uses located along Brokaw Road. At the west end of the alignment, the ATN will terminate near the east side of the Union Pacific Railroad tracks and will connect, possibly via pedestrian overcrossing, with the existing CalTrain/future BART Santa Clara Station.

On the east side of the Airport, the off-Airport alignment is proposed to utilize portions of Airport Parkway, Technology Drive, and Metro Drive. Just east of the Airport Boulevard/Airport Parkway intersection, the ATN will utilize the existing Airport Parkway bridge over the Guadalupe River and will be at-grade in order to pass under State Route 87 and the overhead electric transmission lines. East of State Route 87 and continuing to the Metro/Airport LRT Station on North First Street, the ATN will be elevated in the medians of Airport Parkway, Technology Drive, and Metro Drive. The elevated guideway will prevent the loss of access to land uses located along these roadways.

To summarize, land use impacts both on and off the Airport are not anticipated to be significant.

Biology

At all locations, excluding the two new crossings of the Guadalupe River to serve Economy Lot 1, the Airport's long-term parking facility (commonly referred to as the "Green Island"), the ATN will be constructed on developed areas of the Airport and within the rights-of-way of existing streets. At such urbanized locations, existing vegetation is limited to trees, shrubs, and grasses that have been planted as ornamental landscaping. Such vegetation is not considered ecologically-sensitive. Therefore, loss of various trees and/or shrubs to accommodate the ATN will not constitute a significant adverse biological impact. Tree removal could adversely affect nesting birds, but such impacts can be avoided through standard measures such as pre-construction surveys and, if necessary, limiting construction periods.

The ATN is proposed to cross the Guadalupe River at two locations between U.S. 101 and Airport Parkway. The vegetation along the riparian corridor formed by the Guadalupe River is considered ecologically-sensitive as it provides habitat for numerous species of wildlife. Two threatened and endangered species, steelhead rainbow trout and Chinook salmon, are present in the Guadalupe River. For this reason, any new crossing of the Guadalupe River has the potential to result in significant adverse biological impacts.

The new ATN crossings will be elevated structures, each with a width of approximately 10 feet. These crossings will require the removal of some vegetation within the banks of the river. Any loss of such vegetation will be considered significant and will require mitigation. Within the area where the crossings will be constructed, there are locations where gaps exist between large trees and, therefore, opportunities for adjustments to the alignments to be made, which will minimize impacts. In addition, the relatively narrow width of the proposed structures, as compared to many bridge crossings (e.g., the nearby Skyport Drive bridge is 150 feet in width), will result in reduced shading impacts.

The piers supporting the proposed bridge structures will result in adverse impacts to fisheries, if they are located within the low-flow channel of the river. The width of the low-flow channel in this area is less than 50 feet (maximum), and with an assumed typical span of 80 feet, it is likely that the structures can be designed to avoid any piers within the low-flow channel.

Depending on the type of structures, it may be necessary to temporarily realign the low-flow channel during construction. If this is necessary, special measures will be required by the National Marine Fisheries Service and the California Department of Fish & Game to avoid adverse effects to fisheries. For this reason, the City should consider whether precast structures will be feasible, as their use may avoid such construction impacts.

Another advantage of locating all piers outside of the low-flow channel and avoiding construction work within the low-flow channel is that a Section 404 Permit from the U.S. Army Corps of Engineers and a Section 401 Water Quality Certification from the Regional Water Quality Control Board would not be required.

As stated above, the loss of riparian habitat will require mitigation in the form of replacement habitat creation. There are a number of mitigation options potentially available to the City. The options, in order of regulatory agency preference, are:

- Use of excess mitigation planted upstream (near Skyport Drive) for the State Route 87 Freeway Project by the City and Caltrans (if available); or
- Mitigation through the planned Santa Clara Valley Habitat Conservation Plan/Natural Communities Conservation Plan (HCP/NCCP) of which the City is a partner agency (if approved); or
- Purchase of riparian credits from an approved mitigation bank (if available); or
- Creation of riparian habitat at a location to be determined.

To summarize, biological impacts will not be significant, except at the two new crossings of the Guadalupe River. Such impacts can, however, be minimized and mitigated to a less-than-significant level.

Flooding

According to the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA), portions of the ATN alignment are located within the 100-Year Floodplain of the Guadalupe River. The Guadalupe River itself is a major designated floodway in San Jose. As such, construction of facilities such as guideways and stations within the floodplain could affect flood flows, depth of flooding, etc.

Avoidance of flooding impacts will not be difficult. Design techniques are widely available to avoid the creation of obstructions within floodplains. The City's Floodplain Management Ordinance requires projects to be constructed to avoid significant floodplain impacts. The Santa Clara Valley Water District will require that any work within the banks of the Guadalupe River be designed so as to not diminish the hydraulic capacity of that waterway.

To summarize, although portions of the ATN will be located within a floodplain, the system will be designed to avoid flooding impacts.

Cultural Resources

The ATN alignment is not believed to impact known cultural resources. In addition, there are a variety of standard mitigation and avoidance measures that are required of projects that will generally reduce potential impacts to cultural resources to a less-than-significant level if they are discovered during construction. If the project moves forward, a cultural resources study is recommended as part of environmental clearance efforts.

Hazardous Materials

The ATN alignment traverses lands that have historically been used for commercial and industrial purposes, including the Airport and adjacent properties to the west of the Airport. It is possible that implementation of the ATN alignment and stations will impact land that has been contaminated in the past. An analysis of hazardous materials and waste near the ATN alignment has not been conducted and is suggested if the project moves forward.

The ATN system may use battery-powered vehicles that run on the guideway. Vehicle batteries could leak hazardous material onto the guideway and onto the ground below in case of accident. It is assumed that an ATN system will need regulatory approval to operate and this will require that a comprehensive plan will be in place to deal with the potential release of hazardous materials.

There are a variety of standard mitigation and avoidance measures that are required of projects that will generally reduce hazardous materials impacts to a less-than-significant level.

Temporary/Construction Impacts

Like all public works projects, construction of an ATN will result in short-term impacts including traffic, noise and vibration, air quality, and water quality. The location of the project away from sensitive land uses such as residences and schools will minimize such effects. In addition, there are a variety of standard mitigation and avoidance measures that are required of projects that will reduce short-term construction impacts to a less-than-significant level.

3.2 Indirect Impacts

Traffic

By definition, the ATN will provide a mode of travel between on-Airport destinations, as well as between the Airport and nearby existing and planned rail systems (i.e., Caltrain, LRT, and BART). Unlike a development such as a shopping center or residential subdivision, the ATN will not generate traffic, but instead will accommodate travel demand, providing an alternative to other modes (e.g., cars and buses). Trips taken on the ATN will directly translate to fewer vehicles on roadways serving the Airport and the surrounding area. The ATN, therefore, will not increase roadway traffic volumes and will not contribute to peak-period congestion.

As currently envisioned, the ATN will be elevated within the rights-of-way of portions of Brokaw Road, Airport Parkway, Technology Drive, and Metro Drive. This concept will allow for the retention of access to/from the land uses located along these streets. It will also generally allow for retention of existing traffic lanes and avoidance of operational impacts.

Three segments are anticipated to be at-grade: one is located along the north edge of the airfield; another is located along the existing Airport Parkway bridge and under State Route 87; and the third is along northbound Airport Boulevard at the intersection of Airport Parkway. It is anticipated that traffic lanes will be reduced in number along Airport Parkway, and possibly along Airport Boulevard in the northbound direction at the intersection. Conversations with Airport staff indicate that Airport Boulevard north of Airport Parkway is not heavily used, that Airport Parkway as an Airport access road has been overtaken in importance by Skyport Drive, and that reconfiguration of the intersection is possible if justified by more detailed traffic analysis. Preliminary investigation indicates there are opportunities in the vicinity of the intersection to allow for a design solution that, in combination with the observed decreases in traffic flow, would not be likely to significantly impact traffic.

To summarize, it is anticipated that the ATN will not result in significant adverse traffic impacts. To the extent that the ATN will reduce vehicle trips on area roadways, the traffic impacts could be beneficial.

Noise and Vibration

The proposed alignment of the ATN will not be adjacent to any residences or other noise-sensitive land uses. In addition to the Airport itself, the land uses adjacent to the proposed alignment are offices, commercial, and industrial, none of which are considered noise-sensitive.

An ATN system is expected to have similar noise and vibration characteristics to the APM system that was evaluated by the City in a 2002 EIR. The noise and vibration analysis undertaken for the APM concluded that such impacts would be substantially below the applicable thresholds of significance.

To summarize, the noise and vibration impacts from the operation of an ATN are not expected to be significant.

Air Quality

As noted above, the ATN is expected to reduce travel that would otherwise occur by automobiles or buses. A reduction in such travel will result in a corresponding reduction in vehicular emissions. In addition, the ATN will utilize zero-emission vehicles.

To summarize, the air quality effects from the operation of an ATN will be beneficial.

Visual and Aesthetic Considerations

Since the proposed ATN will be elevated along much of its alignment, it will be visible from many locations. The ATN guideway, which could be up to approximately 20 feet in width for a dual-guideway section (typical for off-Airport locations), will be visible from nearby office buildings, hotels, and highways. It will also be visible to persons walking/jogging/cycling along the existing levees of the Guadalupe River.

The ATN guideway would represent a visual intrusion into the existing setting. The ATN will not obstruct any existing views or panoramas that would be considered visually important, however, so this impact will not be significant. Further, the City plans to design the project to integrate it into the existing setting as much as possible. This will involve choosing colors and textures for the guideway that are compatible with nearby buildings and other structures. The Santa Clara and First Street stations will also be designed to fit in with the existing character of the area. Finally, landscaping will be integrated into the project wherever practical.

To summarize, the visual and aesthetic impacts from the ATN are not expected to be significant.

4 Environmental Clearance Options

There are a number of options that the City will need to consider when the environmental review process for the ATN is undertaken. These options fall into three categories:

- Entire Project versus Phased Project
- CEQA Only versus NEPA/CEQA
- Level of Environmental Review

4.1 Entire Project versus Phased Project

There are both advantages and disadvantages to preparing an environmental document on the entire ATN project versus preparing a separate environmental document for each phase of the project. The chief advantages of preparing one document on the entire project are as follows:

- The City won't have to go through multiple review and approval cycles for each phase.
- Even if funding is only available for an initial construction phase of the project, clearing the entire project environmentally allows future phases to proceed without delay, when additional funding becomes available.
- Clearing the entire project gives the public and various governmental agencies the "whole of the action" (which is preferred under CEQA) as to how the ATN will ultimately function when fully constructed.
- This allows for obtaining a master permit for construction and operations, rather than pursuing separate permits for individual phases.

The chief disadvantages of preparing one document on the entire project are as follows:

- If the initial phase has few impacts and is not controversial, but if subsequent phases have significant impacts and/or controversial aspects, the process could become protracted. This could result in delays for the first phase because the entire project would be held up pending resolution of the issues associated with the latter phases.
- Preparing an environmental document on the entire project may warrant a higher level of environmental document than what would otherwise be required on any one phase. The higher level document would likely be costlier and require more time.

In order to separate the ATN into phases that could each undergo their own separate environmental review, the City will have to demonstrate that each phase has "independent utility," meaning that each phase has merit on its own and does not require construction of subsequent phases.

The first phase identified in the Recommended Alignment Memo would have independent utility by connecting on-Airport destination to each other and to the VTA LRT station. The second phase, which would extend the ATN network to Santa Clara Caltrain, does not seem to introduce new or greater impacts or controversial aspects than the first phase.

4.2 CEQA Only versus NEPA/CEQA

As introduced, all projects in California require compliance with CEQA. In addition, projects that require federal approvals or projects that utilize federal funding require compliance with NEPA. If NEPA compliance is required, the NEPA Lead Agency is typically the funding or approval agency, which in this case would likely be the Federal Transit Administration (FTA).

The CEQA-only process has advantages over the NEPA/CEQA process because it is typically shorter in duration and it is less costly. The reasons for this are as follows:

- The CEQA Lead Agency is typically a local agency (likely the City in this case) and the NEPA Lead Agency is a federal agency. In general, the process is simpler and quicker when only a local agency is involved.
- The federal process not only requires NEPA compliance, but also compliance with a number of other federal environmental statutes, including the Endangered Species Act, the National Historic Preservation Act, the Clean Air Act, the Clean Water Act, and Section 4(f) of the Department of Transportation Act. Compliance with these processes can be both time-consuming and costly.

For projects where federal approvals are required and/or where federal funding is certain, compliance with NEPA is not an option; it is mandatory. However, if neither of these is applicable, NEPA compliance may still be desired by a local agency because it accelerates the approval process in the event that federal funding becomes available later. In fact, agencies sometimes go through the NEPA process before federal funds become available because it can make the project rank higher for funding as it is viewed as being closer to “shovel ready.” In such cases, local agencies must weigh these potential advantages against the fact that the federal process is both longer and more costly.

4.3 Level of Environmental Review

Under both CEQA and NEPA, there are three levels of environmental review. The terminology is different between NEPA and CEQA, but the three levels are roughly equivalent. Table 1 summarizes the terms used to differentiate the levels of environmental review.

Table 1. CEQA and NEPA Levels of Environmental Review

	CEQA Terminology	**NEPA Terminology**
Small projects that can be readily deemed as having no potential for resulting in significant environmental effects	Categorical Exemption (CE)	Categorical Exclusion (CE)
Projects that may/will result in significant environmental effects but mitigation for such effects is proposed	Initial Study → Negative Declaration (IS/ND)	Environmental Assessment → Finding of No Significant Impact (EA/FONSI)
Projects that will likely result in significant environmental effects and projects that are controversial on environmental grounds	Environmental Impact Report (EIR)	Environmental Impact Statement (EIS)

In some cases, the appropriate level of environmental review is not clear cut. For example, the CEQA Lead Agency may firmly believe that a project will not result in any unmitigated significant impacts but is aware that the project is controversial on environmental grounds. In that example, instead of preparing an IS/ND, the Lead Agency may decide to prepare an EIR because it is the highest level of review and because it is a conservative approach that may be beneficial in the event of a legal challenge.

5 Recommendations

The preliminary analysis above examined the ATN's potential direct impacts in terms of land use, biology, flooding, and temporary/construction impacts; and potential indirect impacts in terms of traffic, noise and vibration, air quality, and visual and aesthetic considerations.

5.1 Conclusions

Based on the preliminary analysis completed to date, it is highly probable that the ATN project will not result in any significant unmitigated environmental effects. Mitigation is potentially needed for biological impacts and temporary/construction-related impacts, but mitigations would be available to reduce impacts to a less-than-significant level. Further, the nature of the project is one that is unlikely to be controversial on environmental grounds. In fact, many community groups, residents, and businesses have long been advocating for improved transit access between the Airport and the nearby rail systems.

5.2 Alignment Design Recommendations

The preliminary analysis to date is based on the recommended alignment described in the San José ATN Feasibility Study Recommended Alignment memo, the purpose of which was to test feasibility. It is probable that the alignment will change, potentially significantly, as an alignment is designed to work with the particular characteristics of an operational ATN and as more detailed information about physical constraints is collected. The following environmental considerations are recommended for consideration in future alignment design:

- Minimize the number of new crossings of the Guadalupe River;
- Avoid disturbance or interference with the low-flow channel of the Guadalupe River;
- Retain existing roadway access to private property as much as possible;
- Maintain existing traffic lanes where needed (in consultation with the City and the Airport); and
- Consider guideway and station aesthetics to blend with the surroundings.

5.3 Suggested Approach for the ATN Project

Given the conclusions of the preliminary analysis completed to date, if the project moves forward, it is suggested that the City proceed with the preparation of an Initial Study (IS) leading to the adoption of a Negative Declaration (ND) to comply with CEQA. Similarly, if NEPA compliance is required or desired, an Environmental Assessment (EA) leading to a Finding of No Significant Impact (FONSI) is suggested. For simplicity, cost-effectiveness, and an expedited review process, a combined IS/EA, which is a common practice, is recommended.

Future issues for the City to decide include: the City's approach to phased environmental analysis versus analysis of the complete project; to what extent will the City influence the design of the final alignment to minimize and avoid impacts; and, consequently, whether it will be necessary to pursue additional permits for project implementation.

5.4 Further Studies

If and when it is appropriate to prepare an environmental clearance document for an ATN, the Arup Team recommends the following studies be conducted to investigate potential environmental impacts:

- Traffic – to verify adequate traffic operations in roadways that are altered to accommodate ATN guideway and stations (elevated and at-grade);
- Noise – to estimate changes to ambient noise based on a chosen technology and/or vendor, and changes in traffic patterns, and to analyze potential noise due to construction;
- Air Quality – to document the potential impacts of construction and changes in traffic patterns;
- Biological Resources – to investigate potential disturbance to habitat in the Guadalupe River channel;
- Floodplain – to investigate potential alteration of the floodplain near the Guadalupe River;
- Visual Resources – to analyze potential impacts of a guideway system and station design; and
- Cultural Resources – to determine the presence of any cultural resources potentially impacted by the ATN;
- Hazardous Materials – to determine the presence of any hazardous materials near the alignment and stations.

Appendix E

Preliminary Business Case Report

City of San José DOT

San José International Airport Automated Transit Network Feasibility Study

Preliminary Business Case Report

October 17, 2012

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 214-704

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ARUP

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Disclaimer

This preliminary set of draft findings are issued and produced by Arup for the benefit of the City of San José (City) under the terms of Arup's agreement with the City dated September 17, 2011 for transportation planning and design services relating to the San José Automated Transit Network.

The Arup consulting team has used information received from a range of sources, including information provided by the City and benchmarking data from similar projects. Any statements or findings contained within this report are all based upon this information. In the course of Arup's evaluation of the San José Automated Transit Network, Arup provides no assurance as to the accuracy of any such information, and bears no responsibility for the results of any actions taken on the basis of these initial findings.

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1 Executive Summary

1.1 Project Vision

1.2 Purpose

1.3 Background

1.4 Evaluation Criteria and Methodology

1.5 Evaluation Results

1.6 Conclusions

1.7 Project Development Options

1 Executive Summary

1.1 Project Vision

The City of San José (City) Department of Transportation is evaluating the feasibility of developing an Automated Transit Network (ATN or Project) in and around the Norman Y. Mineta San José International Airport (Airport). An ATN is an "on-demand" (i.e., no schedule, responsive to passenger travel requirements) system of small (2–6-passenger), computer-controlled (driverless) vehicles operated on or suspended below an elevated guideway.

This Project aligns with the City's "Green Vision" and environmental, transportation, and economic development goals. In addition, the Project would improve the convenience and capacity of public access to and from the Airport. The City would also like to reinforce its reputation as a center of innovation and capitalize on the strength of the local high-tech industry, by leading the adoption of new technology and identifying creative strategies to finance the delivery of those improvements.

The Project consists of a 6.4 linear-mile alignment with a combination of at-grade and elevated concrete structures. The system includes 10 stations connecting the Airport terminals, the car-rental facility, and two parking lots with Santa Clara Valley Transportation Authority (VTA) Light Rail line towards the east and Caltrain commuter rail and planned Bay Area Rapid Transit District (BART) station toward the west. It is expected that by 2030 the Project would accommodate an overall passenger-carrying capacity of approximately 14,000 users per day.

1.2 Purpose

The purpose of this Preliminary Business Case is to support the City's decision-making process on whether to move forward to the next stage of the Project (i.e., detailed planning, engineering, technology assessment, and procurement, etc.) and, if so, to determine the range of viable project development options. This study presents a high-level cost comparison of the ATN to other modes of transportation.

1.3 Background

This Project is being completed in partnership with the Airport and the VTA. An ATN, also referred to as Personal Rapid Transit (PRT), is an innovative, emerging transit-system concept.

There are several ATNs in operation worldwide. In 2011, three systems commenced operations at London Heathrow Airport, in Masdar City (Abu Dhabi) and at Rovisco Pais Hospital (Portugal) and another one is under construction in Suncheon, South Korea. As per Aerospace's report titled "Automated Transit network Feasibility Evaluation – San José Mineta International Airport" and dated

August 7, 2012, the ATN technology has not been fully deployed on the scale required for the San José application. Current ATN systems serve several low-volume stations in a linear or “WYE” configuration. The San José application would consist of 10 stations, two of which with high-volume and all of which would be connected via a network that allows passengers to travel nonstop to any point within the network. Therefore, the technology requires further development to demonstrate its ability to deliver the passenger-carrying capacity required for the network of stations contemplated for this Project.

The purpose of the study commissioned by the City (Feasibility Study) is to determine the feasibility of the ATN to perform the role of an Airport Transit Connector (ATC). The Project seeks to fulfill the 2000 Measure A ballot provision to study the feasibility of an automated transit system to connect the Airport terminals with the VTA light rail, Caltrain and BART and potentially points in between.

For the Feasibility Study, the City selected two consultants, Arup North America Ltd (Arup) and The Aerospace Corporation (Aerospace), to initially assess the feasibility of using an ATN as the ATC. The planning, design, technology, regulatory, approvals, and environment assessment are outside the scope of this Preliminary Business Case, but these aspects are considered in the Arup Feasibility Study Final Report or elsewhere. The Preliminary Business Case will reference these other reports when necessary.

1.4 Evaluation Methodology

This Preliminary Business Case uses quantitative and qualitative methods to evaluate the Project’s feasibility from a funding perspective. The quantitative assessment was undertaken as a “funding gap” analysis recognizing that a more complete financial analysis will be undertaken during the next stage of the Project’s development.

In the context of this report, the funding gap is the difference between project costs and the revenues currently available to fund the construction and operations of the Project. A risk-adjusted cash flow model was built to estimate a range of the funding gap. The funding gap range was developed using three scenarios considering different risk confidence levels and sensitivities.

The qualitative assessment evaluated five characteristics of the Project that were considered key to deliver the Project but were not quantitatively measurable. These included (1) the compliance with Measure A funding requirements, (2) the affordability compared to alternative systems, (3) the minimization of overall uncertainty, (4) the maximization of “equity of use” and (5) maximization of revenue potential without compromising the “equity of use”.

Finally, Arup evaluated potential strategies to develop the Project from initial feasibility to commencement of operations and identified the areas to focus on at the next stage of the Project’s development.

1.4.1 Quantitative Evaluation Methodology

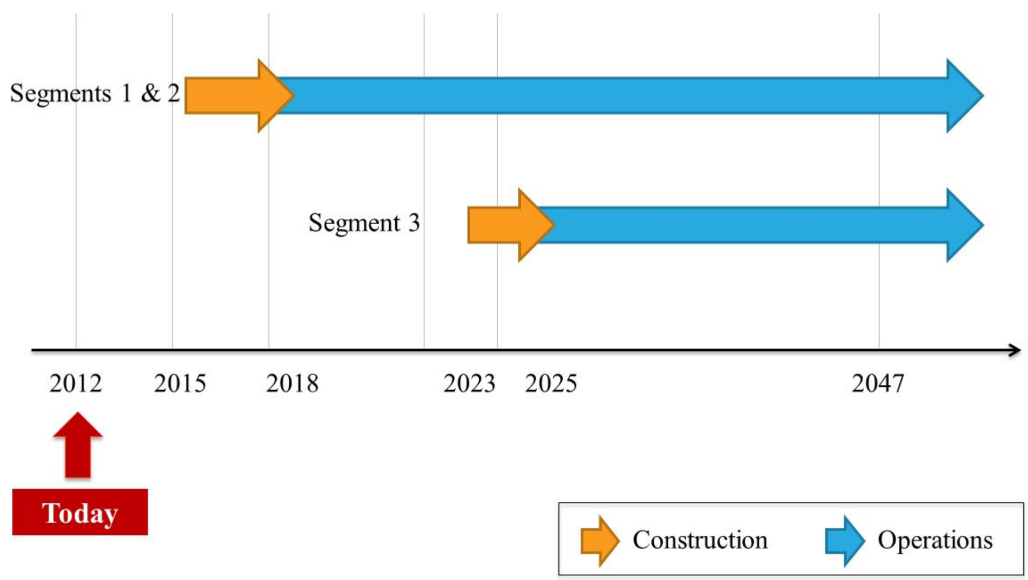
For the purpose of this analysis, the following Project timeline was assumed:

- The Project would start construction in 2015, after a 3-year development and procurement period starting in 2012.
- The overall Project forecast would then last 33 years, which accounts for a 3-year initial construction period and a 30-year operation period.
- Segments 1 (2.7 miles) and 2 (1.3 miles) would be built together between 2015 and 2018. They would begin operations in 2018 and continue operations through the end of 2047.
- Construction of Segment 3 (2.4 miles long) would begin in 2023. Despite longer guideways, it would only take 2 years to complete (i.e., 1 year less than Segments 1 and 2) due to the simpler layout. Operations would begin in 2025 to coincide with the commencement of BART service to Santa Clara station.

For the purpose of this analysis, the operating costs and revenues have been considered through the end of 2047. However, the system's operations would continue beyond that date.

Figure 1 illustrates the timeline assumptions for the purpose of this analysis.

Figure 1: Project Timeline [1]



Source: Arup

[1] An operating period of 30 years has been assumed for this analysis (i.e., 2018–2047) to account for at least one full cycle of vehicle replacement for all three segments.

The Project consists of a 6.4 linear-mile alignment with a combination of at-grade and elevated concrete structures and 10 stations. Arup developed baseline cost estimates for the construction and operation of the Project. These estimates are based on benchmark data and project-specific bottom-up analysis.

In line with industry best practices, Arup assessed Project risks for the likelihood of occurrence and potential cost or schedule impact. Three scenarios were simulated, each defined by different confidence levels: the Optimistic Case, the Most Likely Case, and the Pessimistic Case.

In collaboration with the City, Arup identified potential revenues from the following sources to support the operations and maintenance of the Project:

- Annual Airport operations budget savings from the discontinuation of the current Airport shuttle bus services that would be completely replaced by the ATN services ("Bus Savings")
- Incremental parking revenue associated with the increased demand for the ATN system
- Advertisement on the ATN system

At this time, the City has not identified funding sources to support the construction of the Project.

For the revenue estimates it was considered appropriate to use sensitivities applied on the Bus Savings component of the potential revenue sources listed above.

Table 1 below provides a summary of the assumptions used in the three scenarios. Discussions with the City indicated that the Most Likely Case was the scenario that best aligned with the City's cost and risk preferences and therefore would be the basis for Arup's conclusions and recommendations.

Table 1: Scenario Definition

Scenario	Description	Assumptions
Optimistic Case	Reflects the view generally taken by construction builders and implies a 70% chance that the costs will be higher than the value presented	▪ Risk-adjusted construction costs @ 30th percentile ▪ Risk-adjusted operating costs @ 30th percentile ▪ Bus Savings sensitivity @ +25%
Most Likely Case	Reflects the view generally taken by the Federal Transit Administration (FTA) and implies a 20% chance that the costs will be higher than the value presented	▪ Risk-adjusted construction costs @ 80th percentile ▪ Risk-adjusted operating costs @ 80th percentile ▪ No Bus Savings sensitivity
Pessimistic Case	Reflects the view generally taken by lenders and implies a 5% chance that the costs will be higher than the value presented	▪ Risk-adjusted construction costs @ 95th percentile ▪ Risk-adjusted operating costs @ 95th percentile ▪ Bus Savings sensitivity @ -25%

Source: Arup

Finally, in order to estimate a funding gap range, a cash flow model was created for each scenario, comparing the Year-Of-Expenditure (YOE) (i.e., indexed) risk-adjusted construction, operations and maintenance costs with forecasted revenues over the assumed 33-year life of the Project.

1.4.2 Qualitative Evaluation Methodology

In collaboration with the City, Arup identified a number of overarching delivery objectives for the Project grouped into four main areas: technology, procurement, transportation, and funding/financing.

Working with the City five Project Delivery Objectives were prioritized and evaluation criteria were defined for each of these in order to assess the Project. Table 2 summarizes the Project Delivery Objectives and related evaluation criteria.

Table 2: Project Delivery Objectives and Evaluation Criteria

Project Delivery Objectives	Evaluation Criteria
1. Be compliant with VTA and Measure A funding requirements	▪ The Project should fulfill the Measure A requirement to build an automated rail connection between the Airport and the VTA, Caltrain, and BART systems.
2. Be affordable when compared to alternative systems	▪ Ongoing operations and maintenance costs should be comparable to or less than the costs of operating existing shuttle bus services. ▪ Construction costs should be comparable to or less than the APM option previously considered.
3. Minimize overall Project uncertainty (e.g., technology, regulatory approvals)	▪ The Project risk profile should be at a level acceptable to the City and there should be no apparent “fatal flaws.” (1)
4. Maximize access and “equity of use” (e.g., for economically disadvantaged groups and Airport staff)	▪ The Project should not collect fares from the general public or Airport staff.
5. Maximize revenue potential without compromising access and “equity of use”	▪ All viable commercial revenue sources, other than fares, should be considered.

Source: Arup
(1) A “fatal flaw” is a technical or financial factor that would rule out proceeding with the Project to the next level of evaluation. A technical fatal flaw may involve the ATN technology, the Project’s physical context, alignment or ridership. A financial fatal flaw may involve the City’s affordability limit with regards to operations and maintenance costs and construction costs. An absence of apparent fatal flaw at this stage is not a recommendation to proceed but rather an absence of evidence that would bar the Project from proceeding to the next level of evaluation.

1.5 Evaluation Results

1.5.1 Quantitative Results

1.5.1.1 Funding Gap Analysis

The results of the funding gap analysis are summarized in Table 3 and include the effect of inflation from 2012 to 2047 (i.e., YOE dollars).

The funding gap assessment has been conducted to differentiate between the construction and operation period of the Project. This is because potential restrictions exist for different sources of funds. Federal grants may only be used for construction projects while saving generated from discontinued shuttle bus services may only be used for operating the Project.

Based on the Most Likely Case, which best reflects the City's cost and risk preferences, the results indicate that:

- The funding identified for the Project's operations (i.e., bus savings) is greater than the estimated operations and maintenance costs (i.e., there is no funding shortfall during operations).[1]
- A significant construction funding gap would need to be overcome to build the project given that no capital funding has been committed yet.

Table 3: Quantitative Assessment Summary (YOE Dollars) (1)

	Optimistic Case (YOE $, Million)	Most Likely Case (YOE $, Million)	Pessimistic Case (YOE $, Million)
Average Annual Operations Funding Surplus / (Gap)	9	1	(6)
Construction Funding Surplus / (Gap) (2)	(747)	(1,019)	(1,205)

Source: Arup
(1) The assumed base date is January 1, 2012 for indexation purposes.
(2) This analysis does not include possible private financing costs as it assumes that construction will be funded by public sources (local, state and federal). As noted elsewhere in the report, the option to use private financing as part of a possible project development and procurement strategy will be considered in the next phase of the studies.

1.5.1.2 Transportation Mode Comparison

As shown in Table 4, Arup has also conducted a high-level cost comparison of the ATN system was made with shuttle buses and Automated People Mover (APM) modes of transportation. The APM option was previously considered by the City, under a separate study by another consultant team. The APM comparison in this study represents the route that was the most analogous to the ATN route. Please see Arup's memorandum titled "San José ATN Feasibility Study Cost Comparison Methodology", which provides further details on how the APM risk-adjusted costs were derived.

The comparison shows that there is no apparent financial fatal flaw with the Project since the ATN system, based on the Most Likely Case, meets Project Delivery Objective 2 of affordability by offering:

- Operations and maintenance costs that are comparable to the cost of operating existing shuttle bus services
- Construction costs that are lower than the APM option.

In addition, the ATN system offers improved passenger experience and level of service.

[1] Subsequent to the preliminary business case analysis, the Airport reduced its shuttle bus budget for FY 2012-2013. If the City were to move forward with this project at some time in the future, all potential revenue sources would be reevaluated at that time.

Table 4: ATN, Shuttles Buses, and APM Cost Comparison in 2012 Dollars

Mode	Risk-Adjusted Construction Costs (2012 $, Million)	Annual Operations and Maintenance Base Costs (2012 $, Million)	Comments
ATN system	758 [2]	10	▪ Waiting time generally less than 1 minute ▪ On-demand point-to-point travel ▪ Reduced walking distance due to 10 passenger stations ▪ Passenger experience: Excellent e.g., improved wait time, travel time, comfort, point-to-point service
Shuttle Buses	N/A	10	▪ Longer travel times for Airport shuttle buses and VTA Flyer Line 10 ▪ Longer headways [5] for VTA Flyer Line 10 (15-20 minutes) ▪ Stops at all stations
Airport People Mover [3]	967 [4]	Estimates not available for comparison purposes [1]	▪ Passenger experience: Good, but service limited to half the locations of the ATN or shuttle bus services ▪ Headway [5] 2 minutes on routes between the terminal stations and 4 minutes on routes to Caltrain and VTA ▪ Stops at 5 passenger stations and would not serve Lot 4 Daily Parking

Source: Arup, Airport FY 2011–12 budget, and San Jose International Airport APM Projects Conceptual Cost Estimate (September 2001)

(1) Operations and maintenance cost comparison were not available from previous studies.

(2) Most Likely Case, expressed in 2012 dollars (note that Table 3 costs are expressed in YOE dollars)

(3) An underground option was explored in 2001, which assumed free transfer of tunnel boring machines from the BART extension project. The route used for comparison here is based on the alignment around the Northern end of the airfield and does not use tunnel boring machines.

(4) Includes 40% categorical risk contingency, which is significantly less than the ATN categorical risk contingency (based on the Most Likely Case, 134%). This is due to the fact that the APM is a proven technology with a track record and regulatory approval in the United States.

(5) Headway is defined as the interval time between vehicles.

1.5.2 Qualitative Results

Based on the evaluation of the City's Project Delivery Objectives, summarized in Table 5, in order to proceed with the next stage of the Project as it is currently planned, the priority should be to reduce the Project uncertainty to an acceptable level for the City and prepare an adequate funding plan to address the funding gap identified. At that point a financing and procurement method assessment can be made.

Table 5: Qualitative Assessment Summary

Project Delivery Objectives	Evaluation Criteria	Evaluation Results
1. Be compliant with VTA and Measure A funding requirements	▪ The Project should fulfill the Measure A requirement to build an automated rail connection between the Airport and the VTA, Caltrain, and BART systems.	Objective met: ▪ The Project achieves VTA criteria to date.
2. Be affordable when compared to alternative systems	▪ Ongoing operations and maintenance costs should be comparable to or less than the costs of operating existing shuttle bus services. ▪ Construction costs should be comparable to or less than the APM option previously considered.	Objective met: ▪ The Project achieves both criteria within reasonable range. (See section 1.5.1 Quantitative Results above).
3. Minimize overall Project uncertainty (e.g., technology, regulatory approvals)	▪ The Project risk profile should be at a level acceptable to the City and there should be no apparent fatal flaws.	Objective not met: ▪ There are no apparent fatal flaws. ▪ The ATN technology requires further development (1) ▪ The cost and risk analysis conducted in this study conservatively estimates the technology and Project-specific risks at this point of development of the ATN technology.
4. Maximize access and "equity of use" (e.g., for economically disadvantaged groups and Airport staff)	▪ The Project should not collect fares from the general public or Airport staff.	Objective met: ▪ The Network provides direct connection to public transit; no fares assumed for users.
5. Maximize revenue potential without compromising access and "equity of use"	▪ All viable commercial revenue sources, other than fares, should be considered.	Objective met: ▪ No fares assumed, but all viable alternative revenue sources have been considered (e.g., advertising).

Source: Arup

(1) As per Aerospace's report titled "Automated Transit network Feasibility Evaluation – San José Mineta International Airport" and dated August 7, 2012.

1.6 Conclusions and Recommendations

As explained in section 1.2.1, the conclusions and recommendations of the Preliminary Business Case are based on the Most Likely Case, which best reflects the City's cost and risk preferences.

1.6.1 Conclusions

The quantitative and qualitative assessments have demonstrated that there is no apparent fatal flaw with the Project. In this context, it is important to consider that the quantitative cost and risk analysis conducted in this study have conservatively estimated the technology and Project-specific risks at this point of development of the ATN technology. In particular, the following conclusions can be drawn:

- The Project is self-sustaining during the operations phase and generates an average annual operating surplus of $1 million (YOE dollars) relative to the potential revenue sources considered in this study. However, with no capital funding committed or identified for the Project to date, a $1 billion (YOE dollars) construction funding gap would have to be overcome to build it. The City should prepare a robust Project funding plan to address this gap in construction funding.

- When compared to alternative modes of transportation systems, there is merit to explore the Project as a viable alternative because the estimates are that it has lower construction costs than the previously considered APM project, in addition to offering improved connectivity (i.e. twice as many passenger stations), passenger experience, and level of service.

- As shown in Table 5 above, the Project meets four of the City's five Project Delivery Objectives (Project Delivery Objectives 1, 2, 4, 5) and there are no apparent technical (i.e., technology, physical context, alignment, ridership) or financial (i.e., breach of the City's affordability limit) fatal flaws. An absence of apparent fatal flaw at this stage is not a recommendation to proceed but rather an absence of evidence that would bar the Project from proceeding to the next level of evaluation.

- As per Aerospace's report titled "Automated Transit network Feasibility Evaluation – San José Mineta International Airport" and dated August 7, 2012, the ATN technology requires further development to demonstrate its ability to deliver the passenger-carrying capacity required for the network of stations contemplated for this Project.

- The uncertainty levels are within the expected benchmark range for a project of this complexity, technology track record, and level of design development; but inherent in any project are unrecognized risks, which may change the expected results. As the Project is further developed these uncertainties can be further identified and mitigated and the contingency levels reduced.

During the next stage of the Project Arup recommends that the City focus its effort to address the following key Project development tasks that are considered critical for its success:

1. Demonstrate readiness of the ATN technology to meet the Project's specific requirements.
2. Engage the ATN technology industry's availability and ability to deliver.
3. As the technology is further developed, identify strategies to optimize the Project costs and mitigate risks and uncertainties.
4. Prepare a robust capital funding plan.
5. Develop a plan to resolve regulatory, environmental, and stakeholder approvals.

Arup has identified possible development options in Section 4 to address these key Project development tasks.

1.6.2 Recommendations

1.6.2.1 Project Development Options

In order to develop the Project further, Arup has considered four possible development options. These options are strategies to address the first four key Project development tasks identified above. The last Project development task (i.e., regulatory, environmental, and stakeholder approvals) is outside the scope of this report, but Arup recognizes this should be addressed in parallel. It will have a critical impact on the schedule for delivering the Project and gaining the appropriate level of political/public support.

For analysis purposes, each of the following development options has been considered independently, but in practice, they may have shared components:

- Option 1: The ATN industry leads the market with its own research and development, plus the experience gained from delivering other projects around the world (i.e., the City waits for the market to mature).
- Option 2: The City and any other collaborating agencies, leads a research and development program.
- Option 3: The City and any other collaborating agencies, and the ATN industry collaborate with shared costs and benefits. Note that this option has two sub-options, namely, Option 3A – "Preferred Supplier" and Option 3B – "Industry Collaboration".
- Option 4: The City prepares an RFP for a "starter project" that can be delivered with the current technology and industry delivery capabilities.

1.6.2.2 Project Development Recommendation

Following several Project team workshops with the City, Arup evaluated the relative merits of each development option. Arup recommends Option 3A – "Preferred Supplier" in order to address the Project development tasks identified.

The Project is a transportation project with significant innovation of technology and type of service it provides. There are no standard approaches for development and procurement for delivering the Project. As identified above, this Project will involve a significant amount of development, requiring a creative approach in order to deliver it successfully.

The key aspect of the recommended approach is to engage industry effectively in order to advance the Project's feasibility. This approach would allow a "client" and "supplier" to focus on a particular project in order to advance the understanding of technology readiness and the industry's delivery capabilities.

In addition, this approach would demonstrate commitment and willingness to succeed on both sides. Based on Arup's discussions with industry suppliers during the 2011 Request for Information process, the ATN industry is willing to engage in collaborative efforts, within commercially feasible limits, in order to advance the technology.

The primary benefits of this option are the ability to maintain a constructive and collaborative engagement with the Preferred Supplier, while respecting intellectual property rights and / or commercially sensitive information. The Preferred Supplier approach should lead to more efficient progress and incorporate innovation early in the process.

The recommended next steps are summarized in Section 5.

2 Introduction and Methodology

2 Introduction and Methodology

2.1 Introduction

2.1.1 Purpose

The purpose of the study commissioned by the City of San José (Feasibility Study) is to determine the feasibility of the ATN to perform the role of an Airport Transit Connector (ATC). The Project seeks to fulfill the 2000 Measure A ballot provision to study the feasibility of an automated transit system to connect the Airport terminals with VTA's light rail service towards the east with Caltrain commuter rail service (Caltrain) and BART toward the west, and potentially points in between. This study is focused specifically on the ATN mode of transportation, and generally does not compare the ATN technology to other modes.

For the Feasibility Study, in 2010 the City selected two consultants, Arup North America Ltd (Arup) and The Aerospace Corporation (Aerospace), to initially assess the feasibility of using an ATN as the ATC.

The purpose of this Preliminary Business Case is to support the City's decision-making process on whether to move forward to the next stage of the Project (i.e., detailed planning, engineering, technology assessment, and procurement, etc.) and, if so, to determine the range of viable project development options. This study presents a high-level cost comparison of the ATN to other modes of transportation.

The planning, design, technology, regulatory, approvals, and environment assessment are outside the scope of this report, but these aspects are considered in the Arup Feasibility Study report or elsewhere. The Preliminary Business Case will reference these other reports, where necessary.

2.1.2 Report Structure

The approach to the analysis for this report is reflected in the diagram structured as follows:

Figure 2: Report Structure

Source: Arup

2.2 Background

2.2.1 Project History

The City and VTA had originally considered building an APM. The preferred alignment considered was a 1.5-mile tunnel under the Airport runways to connect the Airport to VTA light rail and Caltrain stations. This option was eventually discarded in 2008 because of its cost.

After completing an industry Request for Information (RFI) process in 2008, the City decided to explore the ATN as an alternative option to achieve the Measure A requirements.

2.2.2 Automated Transit Network Technology

An ATN is an “on-demand” (i.e., no schedule, responsive to passenger travel requirements) system of small (2–6-passenger), computer-controlled (driverless) vehicles operated on or suspended below an elevated guideway.

An ATN does not have a scheduled or fixed route. Vehicles wait at stations for passengers to arrive. Passengers decide when and where to go in the fixed guideway network and depart within seconds of arriving at a station. Stations are off the main line, so vehicles do not need to stop at intermediate stations. Computers identify the optimum route to a given destination and avoid collisions by ensuring a safe distance between vehicles.

There are several ATNs in operation worldwide. In 2011, three systems commenced operations at London Heathrow Airport, in Masdar City (Abu Dhabi) and at Rovisco Pais Hospital (Portugal) and another was under construction in Suncheon, South Korea. As per Aerospace’s report titled “Automated Transit network Feasibility Evaluation – San José Mineta International Airport” and dated August 7, 2012, the ATN technology has not been fully deployed on the scale required for the San José application. Current ATN systems serve several low-volume stations in a linear or “WYE” configuration. The San José application would consist of 10 stations, two of which with high-volume and all of which would be connected via a network that allows passengers to travel nonstop to any point within the network. Therefore, the technology requires further development to demonstrate its ability to deliver the passenger-carrying capacity required for the network of stations contemplated for this Project.

2.3 Project Description

2.3.1 Location

The Project is located in and around the Norman Y. Mineta San José International Airport (Airport). The Airport is located in the heart of Silicon Valley, the center of global technology innovation, two miles from downtown San José. The Airport is a completely self-supporting enterprise owned and operated by the City of San José. San José is Northern California’s largest city, and the tenth largest city in the United States. The Airport serves approximately 30,000 passengers per day and approximately 8 million passengers per year.

Figure 3: Project Location

Source: http://www.airports-guides.com/

2.3.2 Project Scope

The Project consists of a 6.4 linear-mile alignment with a combination of at-grade and elevated concrete structures. The system includes 10-station system connecting the following:

- Airport's Terminal A and its parking garage (Terminal A)
- Airport's Terminal B and Consolidated Rent-A-Car (ConRAC) garage (Terminal B)
- Surface parking lot north of Terminal A (Economy Lot 1)
- Surface parking lot south of Terminal B (Daily Lot 4)
- VTA Metro/Airport light rail station
- Santa Clara future BART station

The Project has been split into three Segments that correspond to distinct portions of the ATN alignment. These Segments may be concurrently or consecutively built. The phasing assumptions used for the quantitative analysis are detailed in Section 2.4.3.2.

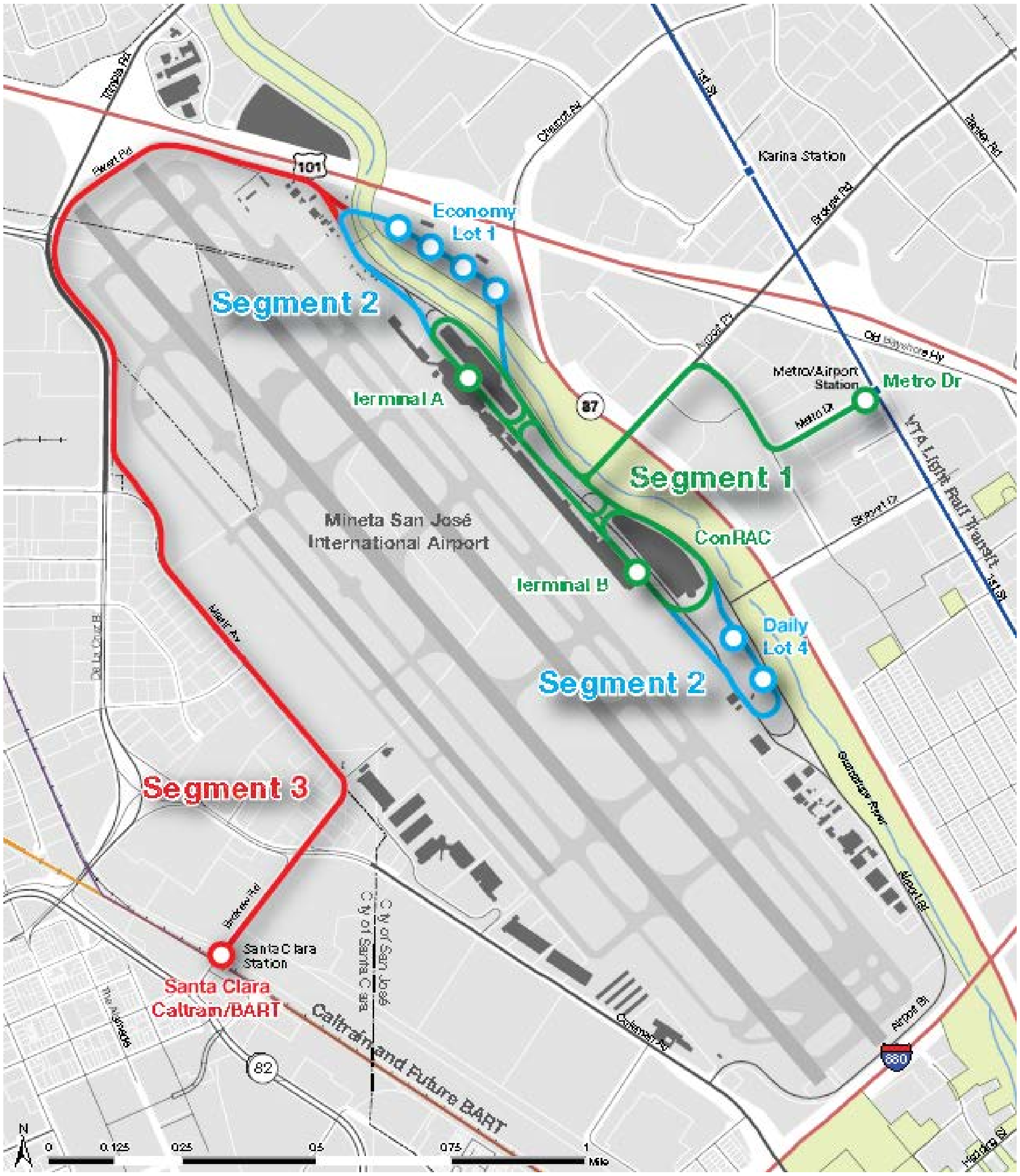
Table 6 below describes how the ATN alignment and stations have been split between each Project Segment. Figure 4 provides an illustration of the ATN alignment per Segment.

Table 6: ATN Alignment per Segment

Segment	ATN Alignment and Stations	ATN approximate length
Segment 1	▪ Metro/Airport VTA Station ▪ Terminal A ▪ Terminal B	2.7 miles
Segment 2	▪ Economy Lot 1 ▪ Daily Lot 4	1.3 miles
Segment 3	▪ Santa Clara Caltrain Station	2.4 miles

Source: Arup

Figure 4: ATN Alignment per Segment at the Airport



Source: Arup

2.3.3 Passenger Demand

It is expected that by 2030, the 10-station ATN system will accommodate a passenger-carrying capacity of approximately 14,000 users per day. Table 7 below provides a split per Segment of the expected daily passenger demand in 2030.

Table 7: Daily Passenger Demand per Segment in 2030

Segment	Daily ATN Trips in 2030
Segment 1	8,850
Segment 2	3,730 additional trips
Segment 3	1,580 additional trips
TOTAL	**14,160**

Source: Arup

2.4 Evaluation Methodology

2.4.1 Evaluation Criteria

In collaboration with the City, Arup identified a number of overarching delivery objectives for the Project grouped into four main areas: technology, procurement, transportation, and funding/financing.

Table 8: Overarching Project Delivery Objectives

Technical	Procurement
▪ Maximize asset life ▪ Maximize cost and schedule certainty	▪ Maximize stakeholder and political support (e.g., compelling Project) ▪ Minimize overall Project uncertainty (e.g., cost, schedule, technology and regulatory approvals) ▪ Maximize industry competition ▪ Maximize use of industry experience, market precedence, and innovation ▪ Use a fair and transparent procurement process ▪ Maximize support from the local community ▪ Achieve timeliness (e.g., capitalize on first mover advantage)
Transportation	**Funding and Financing**
▪ Maximize access and "equity of use" (e.g., economically disadvantaged groups and Airport staff) ▪ Lead technology development and innovation for solving long-term transportation needs ▪ Maximize value and service quality to end users	▪ Be compliant with VTA and the Measure A funding requirements ▪ Be affordable when compared to alternative systems ▪ Maximize efficient use of available public funds ▪ Maximize use of alternative funding and financing sources (e.g., private finance, land value capture) ▪ Maximize revenue potential without compromising access and "equity of use"

Source: Arup

Working with the City five delivery objectives (Project Delivery Objectives) were prioritized and evaluation criteria were defined for each of these in order to assess the Project. Table 9 summarizes the Project Delivery Objectives and related evaluation criteria.

Table 9: Evaluation Criteria

Project Delivery Objectives	Evaluation Criteria
1. Be compliant with VTA and Measure A funding requirements	▪ The Project should fulfill the Measure A requirement to build an automated rail connection between the Airport and the VTA, Caltrain, and BART systems.
2. Be affordable when compared to alternative systems	▪ Ongoing operations and maintenance costs should be comparable to or less than the costs of operating existing shuttle bus services. ▪ Construction costs should be comparable to or less than the APM option previously considered.
3. Minimize overall Project uncertainty (e.g., technology, regulatory approvals)	▪ The Project risk profile should be at a level acceptable to the City and there should be no apparent "fatal flaws." (1)
4. Maximize access and "equity of use" (e.g., for economically disadvantaged groups and Airport staff)	▪ The Project should not collect fares from the general public or Airport staff.
5. Maximize revenue potential without compromising access and "equity of use"	▪ All viable commercial revenue sources, other than fares, should be considered.

Source: Arup
(1) A "fatal flaw" is a technical or financial factor that would rule out proceeding with the Project to the next level of evaluation. A technical fatal flaw may involve the ATN technology, the Project's physical context, alignment or ridership. A financial fatal flaw may involve the City's affordability limit with regards to operations and maintenance costs and construction costs. An absence of apparent fatal flaw at this stage is not a recommendation to proceed but rather an absence of evidence that would bar the Project from proceeding to the next level of evaluation.

2.4.2 Factors to Consider

The Project evaluation and decision-making process should reflect the City's Project Delivery Objectives, as described above.

The key factors considered during the evaluation of the City's Project Delivery Objectives are summarized in Table 10 below:

Table 10: Factors to Consider

Category	Factors to Consider
Technology	▪ Readiness and reliability ▪ Capacity ▪ Intellectual property ▪ Testing and commissioning
Market	▪ Technical and delivery capacity/ability and track record ▪ Financial strength ▪ Competition ▪ Conflict of interest
Performance Requirements	▪ Design development ▪ Operating performance ▪ Project complexity
Legal/Regulatory Framework	▪ Applicable standards and codes ▪ Impact on cost and schedule
Funding and Financing	▪ Affordability ▪ Funding plan ▪ Marketing ▪ Market's ability to raise finance
Political/Public Support	▪ Political support and need ▪ Project management ▪ Public acceptance

Source: Arup

2.4.3 Quantitative Evaluation

2.4.3.1 Funding Gap Analysis

This Preliminary Business Case uses quantitative and qualitative methods to evaluate the Project's feasibility from a funding perspective. The quantitative assessment was undertaken as a "funding gap" analysis recognizing that a more complete financial analysis will be undertaken during the next stage of the Project's development.

In the context of this report, the funding gap is the difference between Project costs and the revenues currently available to fund the construction and operations of the Project. A risk-adjusted cash flow model was built to estimate a range of the funding gap. A funding gap range was developed using three scenarios considering different risk confidence levels and sensitivities.

The funding gap assessment differentiates between the construction and operation period of the Project. This is because potential restrictions exist for different sources of funds. Federal grants may only be used for construction projects whilst savings generated from discontinued shuttle bus services may only be used for operating the Project.

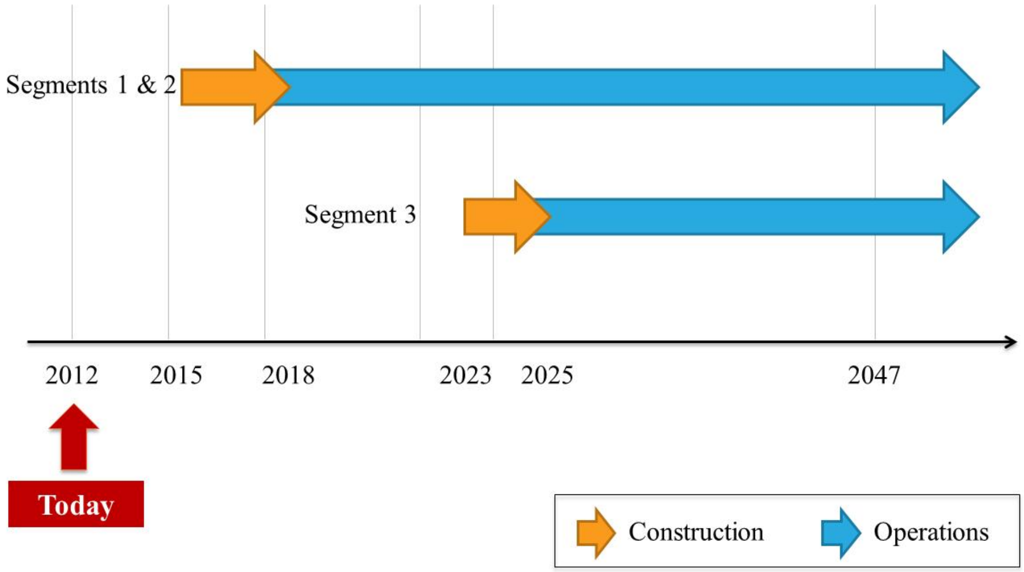
2.4.3.2 Scenario Definition

For the purpose of this analysis, the following Project timeline was assumed:

- The Project would start construction in 2015, after a 3-year development and procurement period starting in 2012.
- The overall Project forecast would then last 33 years, which accounts for a 3-year initial construction period and a 30-year operation period.
- Segments 1 (2.7 miles) and 2 (1.3 miles) would be built together between 2015 and 2018. They would begin operations in 2018 and continue operations through the end of 2047.
- Construction of Segment 3 (2.4 miles) would begin in 2023. Despite longer guideways, it would only take 2 years to complete (i.e., 1 year less than Segments 1 and 2) due to the simpler layout. Operations would begin in 2025 to coincide with the commencement of BART service to Santa Clara station.
- Operating costs and revenues would continue up until the end of 2047. However, it is probable that the system's operations would continue beyond that date.

Figure 5 illustrates the timeline assumptions for the purpose of this analysis.

Figure 5: Project Timeline (1)



Source: Arup
(1) An operating period of 30 years has been assumed for this analysis (i.e., 2018–2047) to account for at least one full cycle of vehicle replacement for all three segments.

The Project consists of a 6.4 linear-mile alignment with elevated concrete structures and 10 stations. Arup developed baseline cost estimates for the construction and operation of the Project. These estimates are based on benchmark data and project-specific bottom-up analysis.

In line with industry best practices, Arup assessed Project risks for the likelihood of occurrence and potential cost or schedule impact. Three scenarios were simulated, each defined by different confidence levels: the Optimistic Case, the Most Likely Case, and the Pessimistic Case.

In collaboration with the City, Arup identified potential revenues from the following sources to support the operations and maintenance of the Project:

- Annual Airport operations budget savings from the discontinuation of the current Airport shuttle bus services that would be completely replaced by the ATN services ("Bus Savings")
- Incremental parking revenue associated with the increased demand for the ATN system
- Advertisement on the ATN system

At this time, the City has not identified funding sources to support the construction of the Project.

For the revenue estimates it was considered appropriate to use sensitivities applied on the Bus Savings component of the potential revenue sources listed above.

Table 11 below provides a summary of the assumptions used in the three scenarios. Discussions with the City indicated that the Most Likely Case was the scenario that best aligned with the City's cost and risk preferences and therefore would be the basis for Arup's conclusions and recommendations.

Table 11: Scenario Definition

Scenario	Description	Assumptions
Optimistic Case	Reflects the view generally taken by construction builders and implies a 70% chance that the costs will be higher than the value presented	▪ Risk-adjusted construction costs @ 30th percentile ▪ Risk-adjusted operating costs @ 30th percentile ▪ Bus Savings sensitivity @ +25%
Most Likely Case	Reflects the view generally taken by the Federal Transit Administration (FTA) and implies a 20% chance that the costs will be higher than the value presented	▪ Risk-adjusted construction costs @ 80th percentile ▪ Risk-adjusted operating costs @ 80th percentile ▪ No Bus Savings sensitivity
Pessimistic Case	Reflects the view generally taken by lenders and implies a 5% chance that the costs will be higher than the value presented	▪ Risk-adjusted construction costs @ 95th percentile ▪ Risk-adjusted operating costs @ 95th percentile ▪ Bus Savings sensitivity @ -25%

Source: Arup

Finally, in order to estimate a funding gap range, a cash flow model was created for each scenario, comparing the Year-Of-Expenditure (YOE) (i.e., indexed) risk-adjusted construction, operations and maintenance costs with forecasted revenues over the assumed 33-year life of the Project.

2.4.4 Qualitative Evaluation

The qualitative assessment evaluated the five Project Delivery Objectives identified in Section 2.4, because these are considered key to deliver the Project but are not quantitatively measurable.

In addition, Arup evaluated potential strategies to develop the Project from initial feasibility to commencement of operations and identified the areas to focus on at the next stage of the Project's development.

Finally, Arup conducted a market sounding process with the industry. This was done by interviewing the ATN technology providers on the key issues relating to the key risks. The results of these discussions have been considered throughout this report.

3 Evaluation

3.1 Base Costs Analysis

3.2 Revenue Analysis

3.3 Risk Analysis

3.4 Risk-Adjusted Costs

3.5 Quantitative Evaluation

3.6 Qualitative Evaluation

3.7 Conclusions

3 Evaluation

3.1 Base Costs Analysis

Arup used benchmark data and project-specific bottom-up analysis to develop preliminary life-cycle costs, consisting of construction, operation, maintenance, and renewal costs.

The base costs for the Project Segments have been estimated in 2012 dollars prior to the risk adjustments. Note that the base costs should not be used for budgetary or planning purposes. Only the total risk-adjusted figures, presented in Section 3.3.4.3 below, should be used for that intent. Table 12 below provides a summary of the base costs.

Table 12: Base Costs Summary – Not for Budgetary or Planning Purposes

Base Costs	2012 $, Million
Construction Base Costs (Total – All Segments)	280
Development Base Costs (Total – All Segments)	70
Operations and Maintenance Base Costs (Annual – All Segments)	10

Source: Arup

3.1.1 Construction Base Costs

The construction base costs are based on Arup's memorandum titled "Rough Order of Magnitude Cost Estimate" (Appendix C1 of the San José International Airport Automated Transit Network Feasibility Study Final Report – July 2012). The construction base costs include the direct costs of building the Project, as well as the indirect costs associated with construction. The direct construction costs include the following components:

- Guideway (single-track, double-track, and triple-track)
- Minor stations (Economy Parking Lot 1, Daily Parking Lot 4, VTA Metro/Airport and Santa Clara Caltrain/future BART stations)
- Major stations (Terminals A and B)
- A maintenance facility
- General allowances for utility relocations and small subcontracted work
- Control system (as a proportion of construction costs)
- Vehicles (based on assumed unit cost and fleet size of 300)

Indirect costs and other additions include the following components:

- Contractor's indirect costs

- Contractor's overhead and profit
- Design engineering
- Project insurance
- Performance and payment bond

The primary construction cost differences between the Segments are in proportion to the vehicle and station numbers, and the length of reinforced concrete elevated guideways.

- In Segment 1 approximately 80% of the vehicles (245 of 300) would be procured to meet passenger demand forecasts. This compares to 13% and 7% for Segment 2 and Segment 3 respectively. Segment 1 has two "major stations", a maintenance facility, and one "minor station". In addition, Segment 1 has 2.7 miles (i.e., 42% of the total network length) of elevated guideways. These guideways have a mixture of single, double and triple track alignments.
- Segment 2 has the shortest alignment length with 1.3 miles (i.e., 20% of the total network length). Segment 2 also has six "minor stations".
- Segment 3 has the longest elevated double track guideway and a small length of single track guideway, representing 2.4 miles (i.e., 38% of the total network length).

Table 13 below provides a summary of the construction base costs per Project Segment:

Table 13: Construction Base Costs per Project Segment

Construction Base Costs	2012 $, Million
Segment 1	141
Segment 2	54
Segment 3	85
TOTAL	**280**

Source: Arup

3.1.2 Development Base Costs

At this stage of the design development detail (i.e., < 2%), an allowance for the Project development base costs has been assumed to be equal to 25% of construction base costs. This is in line with industry benchmarks and the cost accounts for the following pre-construction activities:

- Preliminary design engineering
- Right-of-way engineering
- Environmental documentation

- Procurement costs, such as bid documentation and award of contract
- Permit approvals

Table 14 provides a breakdown of development base costs per Project Segment:

Table 14: Development Base Costs per Project Segment

Development Base Costs	2012 $, Million
Segment 1	35
Segment 2	14
Segment 3	21
TOTAL	**70**

Source: Arup

3.1.3 Operating and Maintenance Base Costs

The operations, maintenance, and renewal base costs are based on Arup's memorandum titled "Rough Order of Magnitude Cost Estimate" (Appendix C1 of the San José International Airport Automated Transit Network Feasibility Study Final Report – July 2012). The operations, maintenance, and renewal base costs have been benchmarked and estimated on an annual basis. These costs include the following components:

- Staffing
- Maintenance
- Periodic renewals
- Energy use

Arup used the following basis to estimate each cost category:

- Staffing costs are based on a "bottom-up" approach that applies California labor rates for an ATN specific Project organization structure.
- Maintenance needs are based on length of track, number of berths, and number of vehicles.
- Periodic renewals include vehicle replacement over the assumed 30-year operating period, as well as periodic information system replacements and guideway inspections.
- Energy usage is calculated using benchmark data from similar projects.

The primary operations, maintenance and renewal cost differences between the Segments are in proportion to the vehicle and station numbers, energy demand and network length. The majority of the management, operations and labor staff costs have been allocated Segment 1, with an incremental increase in proportion to the vehicle and station numbers, and network length for Segments 2 and 3.

Table 15 provides a summary of these annual base costs per Project Segment:

Table 15: Annual Operations and Maintenance Base Costs per Project Segment

Annual Operations and Maintenance Base Costs	2012 $, Million
Segment 1	8
Segment 2	1
Segment 3	1
TOTAL	**10**

Source: Arup

3.2 Revenue Analysis

In order to fulfill the two Project Delivery Objectives of (1) maximizing access to the Airport and (2) providing "equity of use," the City recommended that the Project not collect fares from the general public or Airport staff. This approach is in line with other international benchmarks.

The primary source of Project revenues considered at this time are the Bus Savings defined as the savings from the Airport's operating budget as a result of discontinuing the shuttle bus services at the Airport and the VTA Flyer Line 10 since those services would be replaced by the ATN service. This budget includes all vehicle, fuel, staff and overhead costs. The shuttle bus budget was assumed to increase annually by 1.50% per annum between 2012 and 2027 to account for the forecasted growth in Airport passengers. However, the City Council would need to take action to dedicate the Bus Savings to the Airport ATN Project. If it chose otherwise, the ATN Project revenues assumptions would need to be altered.

Empirical evidence obtained at other airports around the world show that an improved passenger experience to travel from remote parking lots to airport terminals results in high utilization of the parking lots (i.e., increased demand). Arup has assumed that all of the incremental revenue from the car-parking lots connected to the ATN will be dedicated to fund the ongoing operations of the ATN system. In addition, Arup has estimated that the increase in parking revenue will be approximately equal to 10% of the current annual revenue at the car-parking lots served by the ATN.

This source of revenue is assumed to commence in the second year of operation. This ramp-up period is in line with Airport expectations and benchmarking data. Thereafter, this revenue is index-linked to the Airport passenger growth forecast (i.e., 1.50% per annum).

In line with the benchmarking analysis performed, advertisement revenue has been assumed to commence in the third year of operations (i.e., 2020). This would allow sufficient time for the Project to establish market confidence with the system's reliability and ensure increased passenger-service quality and brand recognition.

This revenue has been assumed to increase year-on-year from 2020 by approximately $70,000 (2012 dollars) per annum up to a maximum amount of $0.5 million (2012 dollars) in the second year of operation of Segment 3 (i.e., 2026). Thereafter, this revenue is capped at $0.5 million (2012 dollars) per annum.

As discussed in Arup's memorandum titled "San José ATN Feasibility Study Alternative Revenue Sources", other revenue sources (e.g., revenue from adjacent developments) were considered, but these sources were not deemed to be commercially viable at this stage of the analysis.

Table 16 below provides a summary of the estimated revenues, primarily considered to support the operations and maintenance of the Project.

Table 16: Revenue Summary to Support the Project's Operations and Maintenance

Revenue Source	Annual Revenue Estimate (2012 $)
Bus Savings	▪ Total for all Project segments: $9 million o Segments 1 and 2: $8 million o Segment 3: $1 million ▪ 2018–2027: 1.50% increase per annum[(1)]
Other Revenues – Incremental Parking Revenue dedicated to the ATN system	▪ 2019: $1.2 million ▪ 2020–2027: 1.50% increase per annum
Other Revenues – Advertisement Revenue on the ATN system	▪ 2020–2025: $70,000 increase per annum up to a cap of $0.5 million per annum ▪ 2026–thereafter: capped at $0.5 million per annum

Source: Arup
[(1)] The Airport expects a 1.50% annual increase in budget for shuttle buses between 2012 and 2027. To account for this, bus savings have also been increased by 1.50% per annum between 2012 and 2018, commencement year of operations.

3.2.1 Bus Savings Assumptions

In collaboration with the City, Arup identified that the savings realized from discontinuing the various shuttle bus services to and at the Airport as a result of the Project would be allocated to the Project as a source of revenue. This budget includes all vehicle, fuel, staff, and overhead costs. The City's commitments for this source of funding for the Project, was dependent on the following conditions:

- The Project provides equal or better services than the shuttle buses
- The Project boosts the visibility and image of the Airport
- The Project does not impede the Airport's expansion plans

- The Airport's financial position improves.

Based on the 2011–12 Airport budget, Arup has identified these savings would come from the following sources:

- On-Airport shuttle buses
- VTA Flyer

These sources are explained further in the following sections.

3.2.1.1 On-Airport Shuttle Buses

Arup has assumed the following:

- Segments 1 and 2 will bring about savings from the complete discontinuation of the inter-terminal "Terminal A–Terminal B" route and the surface parking "Economy Lot 1–Daily Lot 4" route.
- The surface parking lot route servicing lots 5 and 6 will be discontinued in 2027 due to the building of a new Airport terminal. The demand for Hourly Lot 5 will transfer to Hourly Lot 3, which does not require an ATN station because of its proximity to Terminal B station. The demand for Daily Lot 6 will transfer to Daily Lot 4, which is served by an ATN station. The savings realized from discontinuing this route will therefore not be allocated to the Project.
- The Airport will maintain a small contingency contract for back-up and special events, which, due to its immateriality, has not been modeled in the funding gap analysis.

3.2.1.2 VTA Flyer

The VTA Flyer is the shuttle bus operated by the VTA and currently linking Metro/Airport VTA station, the Airport terminals, and Santa Clara station (Line 10). For savings related to the VTA Flyer, Arup has assumed the following:

- Segments 1 and 2 will bring about savings from the discontinuation of the route connecting the VTA Metro/Airport light rail station to the Airport terminals (15% of the total route serviced by the VTA Flyer).
- Segment 3 will bring about savings from the discontinuation of the route connecting the Airport terminals to Santa Clara Caltrain/future BART station (85% of the total route serviced by the VTA Flyer).
- In 2018, the Airport will resume contributions to the VTA Flyer's costs ($1.25 million per annum in 2012) due to the expected growth in passengers (see further details below).

3.2.1.3 Insurance Costs

In addition, Arup has assumed that the discontinuation of on-Airport shuttle buses would eliminate the need for insurance on these vehicles. The savings relating to insurance costs were split equally between all Segments.

3.2.1.4 Staff Costs and Overheads

While on-Airport shuttle bus services will be discontinued, Arup has assumed that Airport staff costs and overhead (less than $0.1 million per annum as per Airport 2011–12 budget) will not be reduced, since Airport staff will administer the Project operations.

3.2.1.5 Shuttle Bus Budget Increase

The Airport has forecasted a growth in passengers from 8.2 million in 2010 to 17.6 million in 2027. As a result, the Airport expects a 25% linear increase in the demand, and hence overall budget, for shuttle buses between 2012 and 2027 (or 1.50% per annum). Table 17 below provides a summary of bus savings assumptions, based on the 2011–12 Airport budget:

Table 17: Bus Savings Summary

Segment	Category	Assumptions (2012 $)
Segments 1 and 2	On-Airport shuttle buses: Inter-terminal “Terminal A–Terminal B” route and surface parking “Economy Lot 1–Daily Lot 4” route	$7,837,061
	VTA Flyer: Airport contribution	$187,500
	Insurance	$9,600
	Total Segments 1 and 2	**$8,034,161**
Segment 3	VTA Flyer: Airport contribution	$1,062,500
	Insurance	$4,800
	Total Segment 3	**$1,067,300**
	TOTAL	**$9,101,461**
All Segments	Shuttle buses budget increase	1.50% per annum 2018–2027 (1)

Source: 2011–12 Airport budget
(1) The Airport expects a 1.50% annual increase in budget for shuttle buses between 2012 and 2027. To account for this, bus savings have also been increased by 1.50% per annum between 2012 and 2018, commencement year of operations.

3.3 Risk Analysis

The objective of the risk analysis was to determine the total expected costs based on Project-specific knowledge. The Project-specific risk analysis was conducted using a number of industry best-practice methods, such as Monte Carlo simulation of key risks, risk workshops with the Project team, discussions with industry/supplier experts and construction practitioners, and incorporation of experience from precedent projects.

For the purposes of this risk analysis, the construction method assumed was a Design–Build approach. This was assumed given the technical complexity and specialist expertise required to build the Project, and market precedents of comparable projects.

The risk contingencies, summarized in Table 18 along with risk-adjusted costs, are within the expected benchmark range for a project of this complexity, technology track record, and level of design development detail.

Table 18: Risk-Adjusted Costs – All Segments

Scenario	Optimistic Case (2012 $, Million)	Most Likely Case (2012 $, Million)	Pessimistic Case (2012 $, Million)
Confidence Range [(1)]	*30th Percentile*	*80th Percentile*	*95th Percentile*
Total Risk-Adjusted Construction Costs	537	758	909
Total Risk-Adjusted Annual Operations and Maintenance Base Costs	11	13	14
Construction Risk [(2)]	66%	134%	181%
Operations and Maintenance Risk [(3)]	8%	24%	35%

Source: Arup
[(1)] "80^{th} percentile confidence range" means an 80% probability the values in Table 18 will not be exceeded
[(2)] This is calculated as Categorical Risk / (Total Base Cost + Elemental Risk ($318 million))
[(3)] This is calculated as (Elemental Risk + Categorical Risk) / Annual Base Costs ($10 million)

Based on the Most Likely Case, the results include a significant risk contingency (134%) when compared to other fixed guideway transportation systems which have a longer track record of commercial operations and longer track record of obtaining regulatory approvals in the United States. For example, the APM project identified in Table 25 includes a 40% risk contingency. The cost and risk analysis conducted in this study conservatively estimates the technology and Project-specific risks at this point of development of the ATN technology.

It is critical for the City to setup a process to manage all of the identified Project risks and communicate these expectations to the appropriate stakeholders. Proactively addressing these risks and implementing mitigation strategies will reduce uncertainty and total expected Project costs. To achieve this objective, the City should implement a detailed risk-management process with the objective of reducing or mitigating the potential outcomes of the risks.

Engaging effectively with the industry will also be critical to understand better the key Project risks and the market's ability to manage these. As the Project proceeds the risk analysis performed to date can become the basis for the evaluation and development of a preferred procurement method and the commercial agreements with the private sector appropriate for that method.

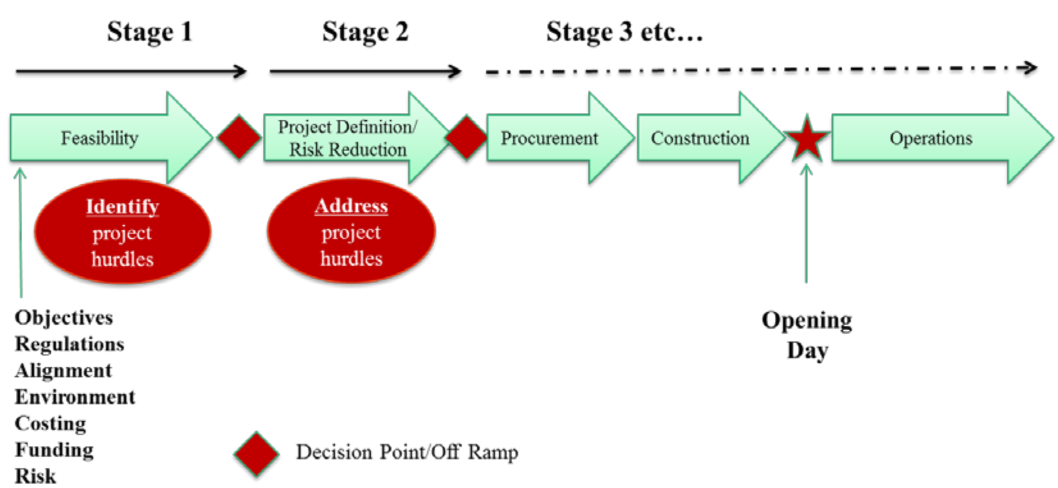
3.3.1 Risk and Decision-Making Background

Project cost escalation is a significant problem facing public agencies. The failure to deliver individual projects and programs within established budgets can have a significant impact on later programs. In particular, large-scale infrastructure projects greater than $100 million can be extremely complex and are often fraught with uncertainty, especially if the project incorporates new technologies with limited track records.

A comprehensive risk management approach can help project teams control project risks and has a direct impact on the success or failure of projects. It is critical to recognize uncertainties in order to identify, manage and mitigate risks at interim stages throughout a project's lifecycle. It is also essential to communicate these uncertainties and their impact to stakeholders and decision-makers to allow appropriate decisions to be taken on whether to proceed with a project or not.

As illustrated in Figure 6 below, key decisions should be taken throughout the Project development process in order to maintain control over Project risks, establish the most appropriate path forward, and identify any potential technical or financial fatal flaws:

Figure 6: Project's Key Decision Points

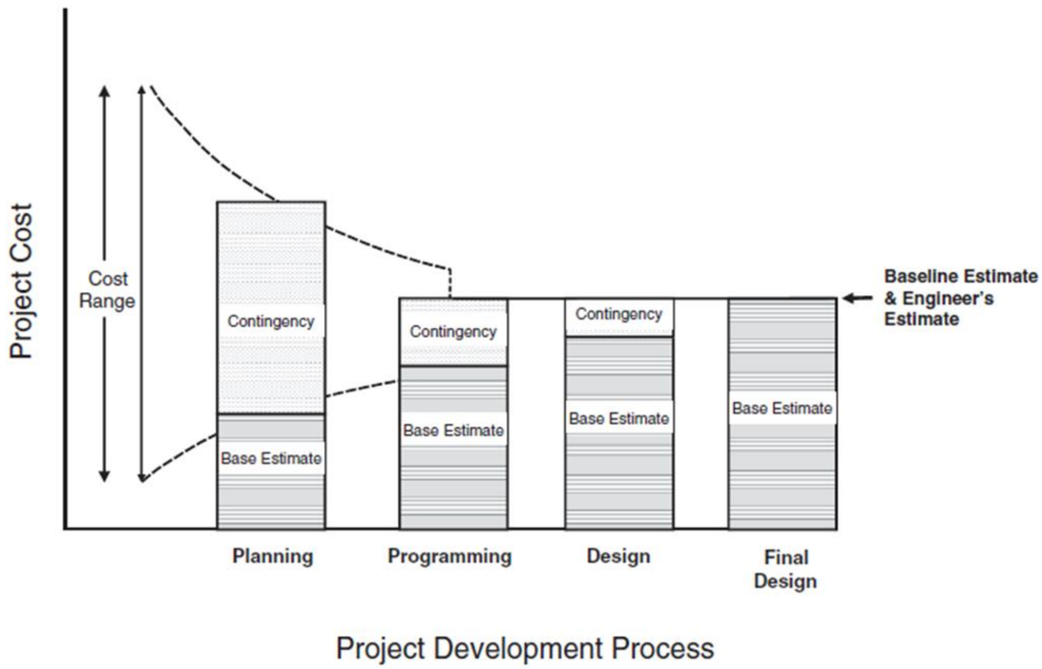


Source: Arup

3.3.2 Risk Analysis Objective

The objective of the risk analysis undertaken in this section is to determine the total expected cost of the Project today based on Project-specific knowledge. The total expected cost is defined as the risk-adjusted Project costs, which include contingencies for potential costs in excess of anticipated levels. As shown in Figure 7 below, Project risks will change throughout the Project development process, but they should be managed and mitigated in order to control Project costs. Quantifying Project risks encourages stakeholders and decision-makers to monitor these risks and reduce them through risk-management techniques, project development, and improved information.

Figure 7: Project Development Process and Risk Quantification



Source: *Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs*, National Cooperative Highway Research Program

3.3.3 Risk Contingency Types

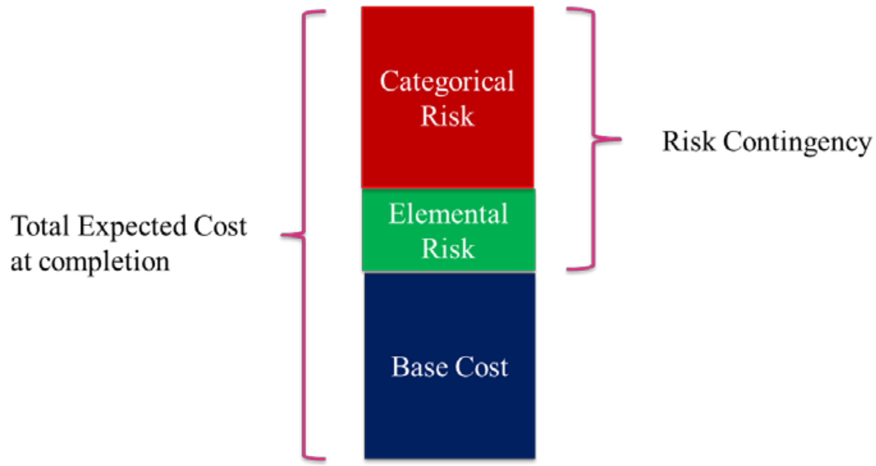
The base costs represent an estimate of the quantity and unit cost rates for each cost category and do not include any risk contingencies.

Risk contingencies can be classified into two categories:

- The elemental risk contingency accounts for the uncertainty underlying the quantification of base costs due to the early stage of project definition. It relates to the variation of costs due to the estimators assumptions for labor, equipment, and materials
- The categorical risk contingency accounts for the events that could cause the total expected cost to increase. Such events may include delays due to uncertain geotechnical ground conditions or change of Project scope by the City.

Figure 8 below illustrates how these risk contingencies build up on top of the base costs:

Figure 8: Risk Contingency Types



Source: Arup

3.3.4 Risk Management

The risk management methodology adopted for the Project at this stage is as follows:

1. Risk identification: Determine the risks that might affect the project and document their characteristics by brainstorming with the Project team through workshops, discussing with industry experts and construction practitioners, and reviewing checklists.
2. Risk assessment: Analyze through quantitative and qualitative risk analysis procedures the likelihood and impact of the risks identified. This assessment assists in deriving risk contingency estimates.
3. Risk mitigation and planning: Prepare potential risk response options (e.g., improved information, acceptance, avoidance, mitigation, or transference) and decide how to approach and plan risk-management activities.

The following steps have not been considered in this report, but should be adopted in subsequent stages of the Project development process:

4. Risk allocation: Allocate responsibility for each Project risk to a particular party, typically through a contract. The fundamental rationale of risk allocation is to allocate each risk to the party best able to manage it in alignment with Project goals.
5. Risk monitoring and control: Capture, analyze, and report Project performance, usually as compared to the risk management plan. Risk monitoring and control also assists in contingency tracking and resolution.

6. Update risk assessment: Continuously revise the risk assessment throughout the Project life as events occur and improved information is obtained.

3.3.4.1 Risk Identification

Risks identified at outreach workshops are grouped into the following risk categories:

- Design and Construction
- Operation and Maintenance
- Market and Political
- Procurement and Legal
- Funding and Financing

A full Project risk register is shown in Appendix A1.

3.3.4.2 Risk Assessment

Using the information developed in the Project risk register, Arup has performed a quantitative risk analysis. This exercise aims to assess Project risks for likelihood of occurrence and potential cost or schedule impact.

Using the construction and operations and maintenance base costs described in Section 3.1, as well as Project schedule estimates, Arup has applied the Monte Carlo simulation to quantify the probability that the Project will finish within objectives.

As described previously, Arup has simulated three possible scenarios, defined by confidence levels, in terms of total expected costs: the Optimistic Case, the Most Likely Case, and the Pessimistic Case. Savings and revenues have not been risk-adjusted, but sensitivities have been run on bus savings.

Risk Assessment Approach

Arup's approach to conduct the quantitative risk assessment is as follows:

1. The ten key Project risks with the highest cost impact on the Project have been simulated. Arup has not attempted to quantify an exhaustive list of risks since their cost impacts overlap at this early stage of Project development. The goal was to assess the risks that had a sufficient degree of accuracy and reasonable risk-measurement quantity and to ensure Project estimates were not unrealistically high.
2. The objective of the quantitative risk assessment has been to evaluate, for each key Project risk, the probability of potential cost and schedule overrun. For each risk, a description has been provided with examples of potential risk triggers (see below for the list of key Project risks).

3. These risks have been assessed in the @RISK software (Monte Carlo simulation) using Optimistic, Most Likely, and Pessimistic scenarios with the corresponding confidence levels: 30th, 80th, and 95th percentile ranges.

4. At this early stage of Project development, Arup has assumed the project delivery option to be a design–build approach, given the technical complexity, specialist expertise, and market precedent for comparable projects.

5. Only the total risk-adjusted costs for the Project have been determined at this stage. Arup has not considered the possible risk allocation between the various parties.

Key Project Risks

Table 19 below summarizes the key Project risks identified. These risks have been assessed for their potential impact during the construction or operations phase of the Project.

A summary of potential impact for these risks is also provided in Appendix A2.

Table 19: Key Project Risks

Risk	Risk Description and Example Triggers
Construction Costs	Risk that the actual capital costs are higher than anticipated (e.g., increased scope, quantities, or poor quality)
Construction Schedule	Risk that the construction schedule is longer than anticipated (e.g., adverse weather conditions, labor disputes, lack of experience of supplier to deliver Project, or unknown ground conditions such as geotechnical/archeological issues)
Operation, Maintenance, and Renewal Costs	Risk that operation, maintenance, and renewal costs are higher than anticipated (e.g., lack of historical data, increased O&M activities/quantities, lower useful life, and increased energy costs)
Bus savings (“Revenue”) (1)	Risk that the revenue source changes (e.g., no guaranteed commitments to support Project payments)
Technology	Risk that the chosen technology is not adequate to accommodate the Project requirements/performance, becomes obsolete, or fails
Market Capability	Risk that suppliers do not have sufficient experience or partners to deliver the Project (e.g., primarily R&D experience and lack of experience delivering commercially viable systems)
Market Competition	Risk of insufficient number of suppliers in the market for a competitive procurement process and selection of the most suitable partner/bidder (e.g., premium on price due to lack of industry competition)
Funding and Financing	Risk that the City does not establish an adequate funding and financing plan (e.g., the Project attracts insufficient interest and poor creditworthiness among potential investors, lenders, and public authorities (federal, state and local) to support the funding and financing plan)
Regulatory Codes and Standards	Risk that existing regulatory codes and standards, requirements, and approval process have to be amended to suit the ATN system, causing procurement delays and increased requirements
Stakeholder Approval	Risk that stakeholder approval is not obtained, delayed, or changes the Project requirements
Permits and Approvals	Risk that necessary approvals are not obtained, or are obtained but are subject to unanticipated conditions which have adverse cost consequences or cause prolonged delays (e.g., environmental approval process)

Source: Arup

(1) This risk has not been quantified. The Bus Savings estimates used for the Funding Gap Analysis do not include any risk contingency. However, sensitivities of +25% and -25% have been run on these.

3.3.4.3 Risk Mitigation and Planning

Each Project risk is unique, but is often linked to other risks. A tailored risk mitigation strategy is therefore required to address risks proactively, which will in turn reduce uncertainty and total expected Project costs. This process should be repeated continuously as the Project develops.

Arup has drawn on precedents and lessons learned from other relevant projects in order to determine the potential risk mitigation strategies for each Project risk. Ultimately risk mitigation will involve procurement contracting and Project delivery options that include some risk transfer. Efficient risk transfer should allocate the responsibility of each risk to the party best able to manage it.

Potential risk mitigation strategies for the Project are presented in Appendix A3.

3.4 Risk-Adjusted Costs

3.4.1 Risk-Adjusted Construction Costs

The risk-adjusted construction costs produced by Arup's risk assessment approach are presented in Table 20 below.

The risk contingencies are within the expected benchmark range for a project of this complexity, technology track record, and level of design development (i.e., less than 2% of the design is complete). For planning purposes, the Washington State Department of Transportation (WS DOT) relies a benchmark of -50% – +200% for the estimated range of cost variance for capital projects at a 2% design development stage.

WS DOT's practice is derived from an extensive review of the literature and an industry survey representing responses from 48 state highway authorities and the Federal Highway Administration. Leading public agencies from outside the highway sector have also been considered in WS DOT's results, including the FTA, the New York Metropolitan Transit Authority, and the Department of Energy.

The elemental risk contingency is constant throughout the three scenarios because it relates to the "estimators contingency" (i.e., variations in the estimators assumptions used at the current level of design development). It relates to the variation of costs due to the estimators assumptions for labor, equipment, and materials.

The categorical risk contingency accounts for the events that could cause the total expected cost to increase. Such events may include delays due to uncertain geotechnical ground conditions or change of Project scope by the City.

Table 20: Risk-Adjusted Construction Costs – All Segments

Scenario	Optimistic Case (2012 $, Million)	Most Likely Case (2012 $, Million)	Pessimistic Case (2012 $, Million)
Confidence Range	*30th Percentile*	*80th Percentile*	*95th Percentile*
Construction Base Costs	280	280	280
Elemental Risk	44	44	44
Categorical Risk	213	434	585
Total Risk-Adjusted Construction Costs	**537**	**758**	**909**
Construction Risk(1)	66%	134%	181%

Source: Arup
(1) This is calculated as Categorical Risk / (Total Base Costs + Elemental Risk ($318 million))

3.4.2 Risk-Adjusted Operations and Maintenance Costs

The risk-adjusted operations, maintenance, and renewal costs produced by Arup's risk assessment approach are presented in Table 21 below and are detailed in Arup's memorandum titled "Rough Order of Magnitude Cost Estimate" (Appendix C1 of the San José International Airport Automated Transit Network Feasibility Study Final Report – July 2012). The elemental and categorical risk contingencies were combined for operations and maintenance costs due to lack of operating track record and available and reliable sources of data. The goal was to assess the risks that had a sufficient degree of accuracy and reasonable risk-measurement quantity and to ensure Project estimates were not unrealistically high.

The risk contingencies are within the expected benchmark range for a project of this complexity, technology track record, and level of design development detail. For example, the risk contingency for operations and maintenance costs on California High-Speed Rail amounts to 10%.

Table 21: Risk-Adjusted Annual Operations and Maintenance Costs – All Segments

Scenario	Optimistic Case (2012 $, Million)	Most Likely Case (2012 $, Million)	Pessimistic Case (2012 $, Million)
Confidence Range	*30th Percentile*	*80th Percentile*	*95th Percentile*
Annual Operations and Maintenance Base Costs	10	10	10
Elemental and Categorical Risk	1	3	4
Total Risk-Adjusted Annual Operations and Maintenance Base Costs	**11**	**13**	**14**
Operations and Maintenance Risk(1)	8%	24%	35%

Source: Arup
(1) This is calculated as (Elemental Risk + Categorical Risk) / Annual Base Costs ($10 million)

3.4.3 Risk-Adjusted Costs per Segment

The risk-adjusted costs per Project segment for construction and operations and maintenance are presented in Table 22 and Table 23. These numbers, and not the base costs presented in Section 3.1, should be used for budgetary and planning purposes.

Table 22: Risk-Adjusted Construction Costs per Segment

Scenario	Optimistic Case (2012 $, Million)	Most Likely Case (2012 $, Million)	Pessimistic Case (2012 $, Million)
Segment 1	226	318	382
Segment 2	145	205	245
Segment 3	166	235	282
TOTAL	**537**	**758**	**909**
Construction Risk(1)	66%	134%	181%

Source: Arup
(1) This is calculated as Categorical Risk / (Total Base Cost + Elemental Risk ($318 million))

Table 23: Risk-Adjusted Annual Operations and Maintenance Costs per Segment

Scenario	Optimistic Case (2012 $, Million)	Most Likely Case (2012 $, Million)	Pessimistic Case (2012 $, Million)
Segment 1	9	10	11
Segment 2	1	2	2
Segment 3	1	1	1
TOTAL	**11**	**13**	**14**
Operations and Maintenance Risk(1)	9%	24%	35%

Source: Arup
(1) This is calculated as (Elemental Risk + Categorical Risk) / Annual Base Costs ($10 million)

3.5 Quantitative Evaluation

3.5.1 Funding Gap Analysis

The results of the funding gap analysis are summarized in Table 24 and include the effect of inflation from 2012 to 2047 (i.e., YOE dollars).

The funding gap assessment differentiates between the construction and operation period of the Project. This is because potential restrictions exist for different sources of funds. Federal grants may only be used for construction projects whilst savings generated from discontinued shuttle bus services may only be used for operating the Project.

Based on the Most Likely Case, which best reflects the City’s cost and risk preferences, the results indicate that:

- The funding identified for the Project’s operations (i.e., bus savings) is greater than the estimated operations and maintenance costs (i.e., there is no funding shortfall during operations).
- A significant construction funding gap would need to be overcome to build the project given that no capital funding has been committed yet.

Table 24: Quantitative Evaluation Summary (YOE Dollars) [1]

	Optimistic Case (YOE $, Million)	Most Likely Case (YOE $, Million)	Pessimistic Case (YOE $, Million)
Average Annual Operations Funding Surplus / (Gap)	9	1	(6)
Construction Funding Surplus / (Gap) [2]	(747)	(1,019)	(1,205)

Source: Arup
[1] The assumed base date is January 1, 2012 for indexation purposes.
[2] This analysis does not include possible private financing costs as it assumes that construction will be funded by public sources (local, state and federal). As noted elsewhere in the report, the option to use private financing as part of a possible project development and procurement strategy will be considered in the next phase of the studies.

3.5.2 Transportation Mode Comparison

As shown in Table 25, Arup has also conducted a high-level cost comparison of the ATN system with shuttle buses and Automated People Mover (APM) modes of transportation. The APM option was previously considered by the City, under a separate study by another consultant team. The APM comparison in this study represents the route that was the most analogous to the ATN route. Please see Arup's memorandum titled "San José ATN Feasibility Study Cost Comparison Methodology", which provides further details on how the APM risk-adjusted costs were derived.

This comparison shows that there is no apparent financial fatal flaw with the Project since the ATN system, based on the Most Likely Case, meets Project Delivery Objective 2 of affordability by offering:

- Operations and maintenance costs that are comparable to the cost of operating existing shuttle bus services
- Construction costs that are lower than the APM option.

In addition, the ATN system offers improved passenger experience and level of service.

Table 25: ATN, Shuttles Buses, and APM Cost Comparison in 2012 Dollars

Mode	Risk-Adjusted Construction Costs (2012 $, Million)	Annual Operations and Maintenance Base Costs (2012 $, Million)	Comments
ATN system	758 [2]	10	▪ Waiting time generally less than 1 minute ▪ On-demand point-to-point travel ▪ Reduced walking distance due to 10 passenger stations ▪ Passenger experience: Excellent e.g. improved wait time, travel time, comfort, point-to-point service
Shuttle Buses	N/A	10	▪ Longer travel times for Airport shuttle buses and VTA Flyer Line 10 ▪ Longer headways [5] for VTA Flyer Line 10 (15-20 minutes) ▪ Stops at all stations
Airport People Mover [3]	967 [4]	Estimates not available for comparison purposes [1]	▪ Passenger experience: Good, but service limited to half the locations of the ATN or shuttle bus services ▪ Headway [5] 2 minutes on routes between the terminal stations and 4 minutes on routes to Caltrain and VTA ▪ Stops at 5 passenger stations and would not serve Lot 4 Daily Parking

Source: Arup, Airport FY 2011–12 budget, and San Jose International Airport APM Projects Conceptual Cost Estimate (September 2001)

(1) Operations and maintenance cost comparison were not available from previous studies.

(2) Most Likely Case, expressed in 2012 dollars (note that Table 24 costs are expressed in YOE dollars)

(3) An underground option was explored in 2001, which assumed free transfer of tunnel boring machines from the BART extension project. The route used for comparison here is based on the alignment around the Northern end of the airfield and does not use tunnel boring machines.

(4) Includes 40% categorical risk contingency, which is significantly less than the ATN categorical risk contingency (based on the Most Likely Case, 134%). This is due to the fact that the APM is a proven technology with a track record and regulatory approval in the United States.

(5) Headway is defined as the interval time between vehicles.

3.5.3 Assumptions and Analysis

3.5.3.1 Indexation Assumptions

The assumed base date for indexation purposes is January 1, 2012. Table 26 provides a list of the indices used in the analysis to escalate the costs and revenues over the Project timeline:

Table 26: Indices

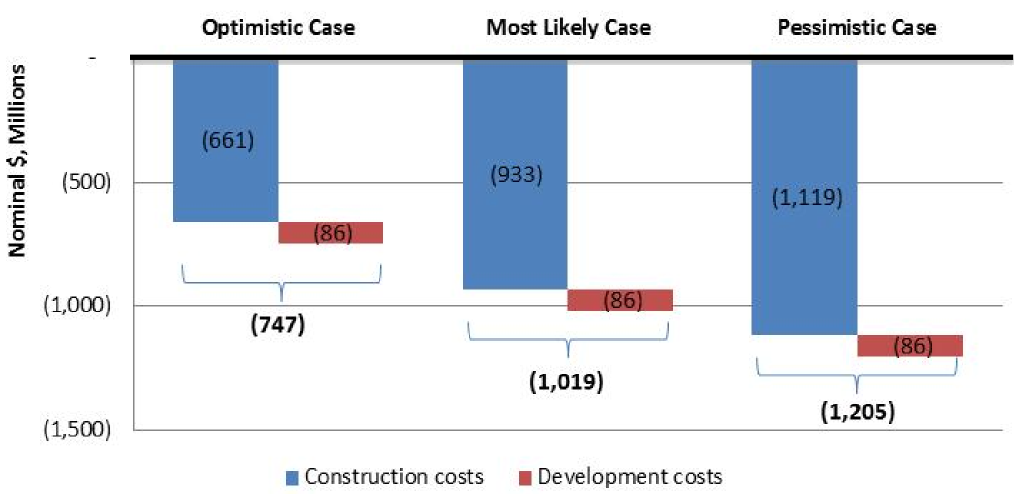
Category	Rate	Description
Construction Costs/ Development Costs (2012–2022)	3.12%	10-year average for Construction Cost Indices (CCI) Source: *Engineering News Record*
Construction Costs (after 2023)	4.50%	30-year average for CCI Source: *Engineering News Record*
Operations and Maintenance Costs	3.23%	30-year average Consumer Price Index (CPI) (All Urban Consumers) for the area "San Francisco–Oakland–San Jose" Source: Bureau of Labor Statistics
Savings and Revenues	3.23%	30-year average CPI (All Urban Consumers) for the area "San Francisco–Oakland–San Jose" Source: Bureau of Labor Statistics

Source: Arup

3.5.3.2 Cumulative Construction Funding Gap

Figure 9 summarizes the funding gap that the City faces to construct the Project in each scenario. Based on the Most Likely Case, the total funding gap of $1,019 million (YOE dollars) to build the Project consists of $933 million of construction costs and $86 million of development costs.

Figure 9: Cumulative Construction Funding Gap

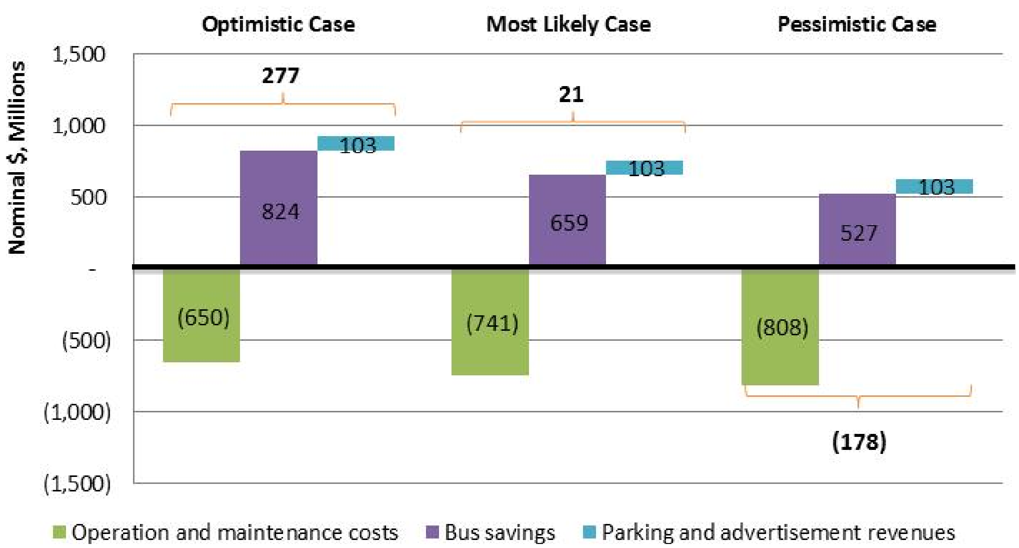


Source: Arup

3.5.3.3 Cumulative Operations Funding Gap

Figure 10 summarizes the cumulative funding gap or surplus identified to operate and maintain the Project over the 30-year operating period. Based on the Most Likely Case, the total operating surplus is $21 million (YOE dollars).

Figure 10: Cumulative Operations Funding Surplus/Gap



Source: Arup

3.6 Qualitative Evaluation

Based on the evaluation of the City's Project Delivery Objectives, summarized in Table 27, in order to proceed with the next stage of the Project as it is currently planned, the priority should be to reduce the Project uncertainty to an acceptable level for the City and prepare an adequate funding plan to address the funding gap identified. At that point a financing and procurement method assessment can be made.

Table 27: Qualitative Assessment Summary

Project Delivery Objectives	Evaluation Criteria	Evaluation Results
1. Be compliant with VTA and Measure A funding requirements	▪ The Project should fulfill the Measure A requirement to build an automated rail connection between the Airport and the VTA, Caltrain, and BART systems.	<u>Objective met</u>: ▪ The Project achieves VTA criteria to date.
2. Be affordable when compared to alternative systems	▪ Ongoing operations and maintenance costs should be comparable to or less than the costs of operating existing shuttle bus services. ▪ Construction costs should be comparable to or less than the APM option previously considered.	<u>Objective met</u>: ▪ The Project achieves both criteria within reasonable range. (See section 1.5.1 Quantitative Results above).
3. Minimize overall Project uncertainty (e.g., technology, regulatory approvals)	▪ The Project risk profile should be at a level acceptable to the City and there should be no apparent fatal flaws.	<u>Objective not met:</u> ▪ There are no apparent fatal flaws. ▪ The ATN technology requires further development (1) ▪ The cost and risk analysis conducted in this study conservatively estimates the technology and Project-specific risks at this point of development of the ATN technology.
4. Maximize access and "equity of use" (e.g., for economically disadvantaged groups and Airport staff)	▪ The Project should not collect fares from the general public or Airport staff.	<u>Objective met:</u> ▪ The Network provides direct connection to public transit; no fares assumed for users.
5. Maximize revenue potential without compromising access and "equity of use"	▪ All viable commercial revenue sources, other than fares, should be considered.	<u>Objective met</u>: ▪ No fares assumed, but all viable alternative revenue sources have been considered (e.g., advertising).

Source: Arup

(1) As per Aerospace's report titled "Automated Transit network Feasibility Evaluation – San José Mineta International Airport" and dated August 7, 2012.

3.7 Conclusions

The quantitative and qualitative assessments have demonstrated that there is no apparent fatal flaw with the Project. In this context, it is important to consider that the quantitative cost and risk analysis conducted in this study have conservatively estimated the technology and Project-specific risks at this point of development of the ATN technology. In particular, the following conclusions can be drawn:

- The Project is self-sustaining during operations and generates an average annual operating surplus of $1 million (YOE dollars) relative to the potential revenue sources considered in this study. However, with no capital funding committed or identified for the Project to date, a $1 billion (YOE dollars) construction funding gap would have to be overcome to build it. The City should prepare a robust Project funding plan to address this gap in construction funding.
- When compared to alternative modes of transportation systems, there is merit to explore the Project as a viable alternative because the estimates are that it has lower construction costs than the previously considered APM project, in addition to offering improved connectivity (i.e., twice as many passenger stations), passenger experience, and level of service.
- As shown in Table 27 above, the Project meets four of the City's five Project Delivery Objectives (Project Delivery Objectives 1, 2, 4, 5) and there are no apparent technical (i.e., technology, physical context, alignment, ridership) or financial (i.e., breach of the City's affordability limit) fatal flaws. An absence of apparent fatal flaw at this stage is not a recommendation to proceed but rather an absence of evidence that would bar the Project from proceeding to the next level of evaluation.
- As per Aerospace's report titled "Automated Transit network Feasibility Evaluation – San José Mineta International Airport" and dated August 7, 2012, the ATN technology requires further development to demonstrate its ability to deliver the passenger-carrying capacity required for the network of stations contemplated for this Project.
- The uncertainty levels are within the expected benchmark range for a project of this complexity, technology track record, and level of design development; but inherent in any project are unrecognized risks, which may change the expected results. As the Project is further developed these uncertainties can be further identified and mitigated and the contingency levels reduced.

During the next stage of the Project Arup recommends that the City focus its effort to address the following key Project development tasks that are considered critical for its success:

1. Demonstrate readiness of the ATN technology to meet the Project's specific requirements.
2. Engage the ATN technology industry's availability and ability to deliver.

3. As the technology is further developed, identify strategies to optimize the Project costs and mitigate risks and uncertainties.
4. Prepare a robust capital funding plan.
5. Develop a plan to resolve regulatory, environmental, and stakeholder approvals.

Arup has identified possible development options in Section 4 to address these key Project development tasks.

4 Development Options

4.1 Introduction
4.2 Option Evaluation
4.3 Recommendations
4.4 Co-development Process

4 Project Development Options

4.1 Introduction

In order to develop the Project further, Arup has considered four possible development options. These options are strategies to address the first four key Project development tasks identified above. The last Project development task (i.e., regulatory, environmental, and stakeholder approvals) is outside the scope of this report, but Arup recognizes this should be addressed in parallel. It will have a critical impact on the schedule for delivering the Project and gaining the appropriate level of political/public support.

For analysis purposes, each of the following development option has been considered independently but in practice, they may have shared components:

- Option 1: The ATN industry leads the market with research and development, plus the experience gained from delivering other projects around the world (i.e., the City waits for the market to mature).
- Option 2: The City and any other collaborating agencies, leads a research and development program.
- Option 3: The City and any other collaborating agencies, and the ATN industry collaborate with shared costs and benefits. Note that this option has two sub-options, namely, Option 3A – "Preferred Supplier" and Option 3B – "Industry Collaboration".
- Option 4: The City prepares an RFP for a "starter project" that can be delivered with the current technology and industry delivery capabilities.

4.2 Options Evaluation

Following several Project team workshops with the City, Arup evaluated the relative merits of each development option and cross-checked its assessment against the 'factors to consider' in Section 2.4.2. This allowed Arup to sift through the options in order to provide a clear recommendation.

A summary of the pros and cons of each option is provided in Table 28.

Table 28: Project Development Options Assessment

Options	Pros	Cons
Option 1: "Do nothing"	▪ Minimum City resource effort required. ▪ Minimum public funds required. ▪ Low political risk. ▪ Significant time for regulatory approval (i.e., no lead agency to support the Project).	▪ No control over Project outcome (i.e., may never get built). ▪ Lose "path finder" position in the United States. ▪ No control over development process/timing. ▪ Weak Project pipeline.
Option 2: Research Program	▪ High profile as an industry leader. ▪ Medium control over Project outcome. ▪ Lower failure risk for City. ▪ High industry and local support. ▪ Higher cost certainty. ▪ Reasonable time for regulatory approval. ▪ Reasonable time to obtain funding. ▪ Higher supplier experience. ▪ Reasonable time for due diligence. ▪ Reasonable time for stakeholder education and consensus.	▪ Medium upfront and longer term public funds required to develop / promote research program (source unknown). ▪ Need to develop Project pipeline to attract industry. ▪ Longer timeframe before "live" Project. ▪ Not core business of the City. ▪ Lose "path finder" opportunities for political support. ▪ Difficult to maintain control and manage potential conflict of interest of lead suppliers within the industry.

Options	Pros	Cons
Option 3: Public/Private Collaboration	▪ Medium profile as industry leader. ▪ Medium failure risk for City. ▪ Reasonable risk transfer. ▪ Share development costs. ▪ Medium timeframe before "live" Project. ▪ Strong control over Project outcome. ▪ High engagement with industry. ▪ Reasonable time for due diligence. ▪ Reasonable time for stakeholder education and consensus. ▪ Medium industry and local support. ▪ Incentivize industry innovation. ▪ Medium cost certainty. ▪ Higher supplier experience.	▪ Low upfront and longer term public funds required. ▪ Medium City resource effort required. ▪ Medium political risk. ▪ Difficult to maintain control and manage potential conflict of interest of lead suppliers within the industry.
Option 4: "Starter Project"	▪ Higher certainty of successful delivery. ▪ Reasonable risk transfer. ▪ Gain "path finder" opportunities with political support. ▪ Reduced Project cost and funding. ▪ Operational Project to prove performance. ▪ Shorter timescale – first to market.	▪ Low consensus i.e., not a compelling Project. ▪ Reduced service quality and ridership relative to larger project. ▪ Stakeholder buy-in is challenging at this time.

Source: Arup

4.2.1 Public/Private Collaboration Assessment

Arup recommended Option 3 (Public/Private Collaboration) to the City to develop the Project. This option was further considered by evaluating two sub-options, Option 3A “Preferred Supplier” and Option 3B “Industry Collaboration:

- Option 3A involves the City selecting a supplier to develop the Project from initial feasibility to commencement of operations
- Option 3B involves the City working collaboratively with the industry to develop the Project from initial feasibility to commencement of operations.

Figure 11 illustrates how both options would function in practice.

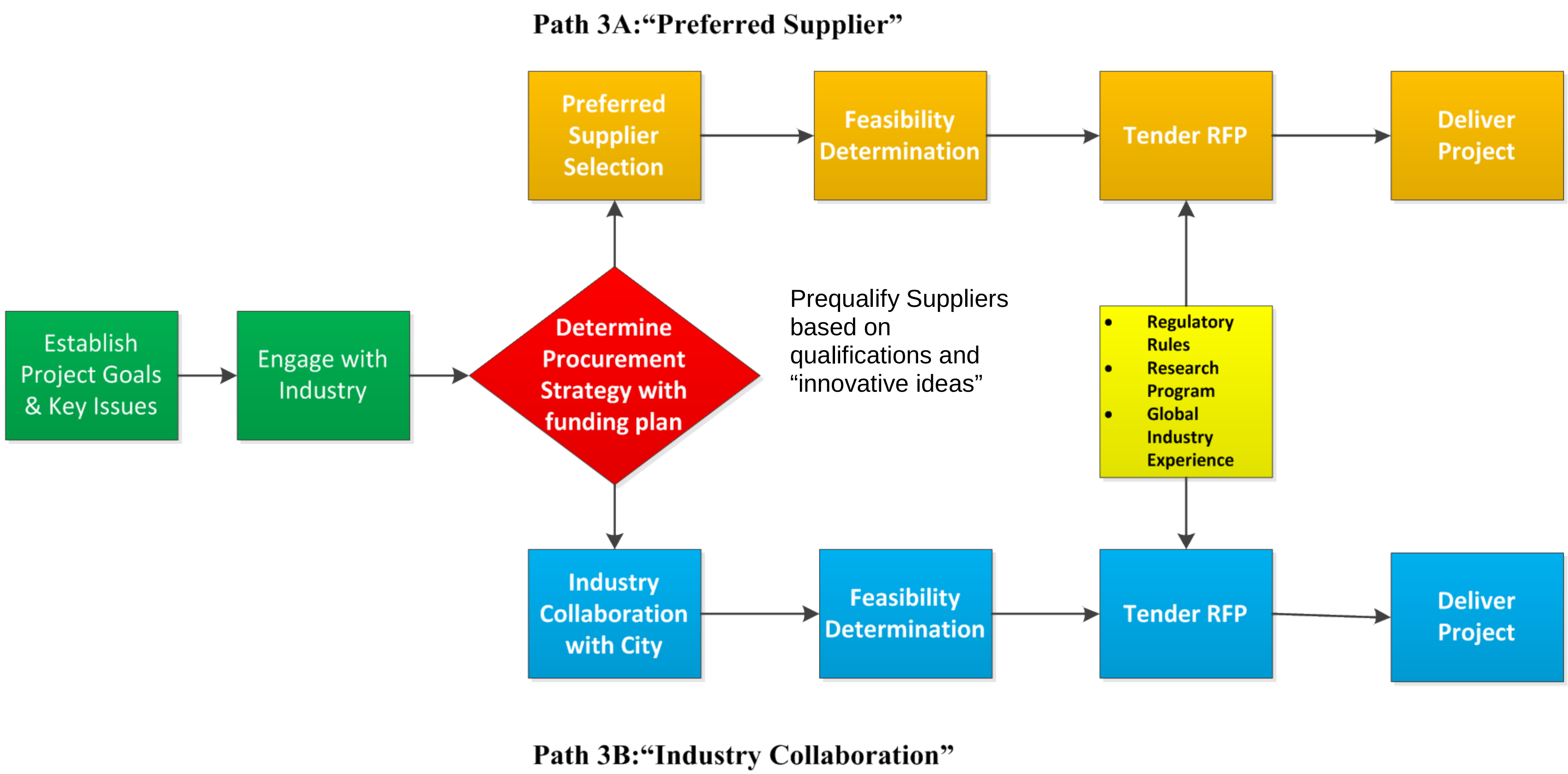
The qualitative evaluation of both development options is summarized in Table 29.

Table 29: Options 3A and 3B Assessment

Option	Pros	Cons
Option 3A: “Preferred Supplier”	▪ Lower development cost ▪ Obtain developed “winning ideas” on innovation earlier ▪ Simpler process (e.g. engagement with single supplier) ▪ Potentially develop Project earlier (e.g., focused with one supplier) ▪ Selection based on qualification and price	▪ Potential or perceived conflict of interest during development stage with preferred supplier. ▪ Maintain fair and transparent procurement process. ▪ Solution may be tailored towards one supplier only (i.e., no easy alternative)
Option 3B: “Industry Collaboration”	▪ Wider collection of industry experience ▪ Higher confidence with larger number of supplier engagement ▪ Opportunity to compare different technologies ▪ Alternative suppliers available to deliver Project (e.g., company failure)	▪ Higher development cost ▪ Higher level of effort required for supplier management ▪ Longer development phase may be required ▪ Difficulty achieving consensus between suppliers ▪ Lack of willingness to share information (e.g., innovation, IP and commercially sensitive information)

Source: Arup

Figure 11: Options 3A "Preferred Supplier" and 3B "Industry Collaboration"



Source: Arup

4.3 Recommendations

Following several Project team workshops with the City, Arup recommends Option 3A – "Preferred Supplier" in order to address the Project development tasks identified in Section 3.7.

The Project is a transportation project with significant innovation of technology and type of service it provides; therefore, there are no standard approaches for development and procurement for delivering the Project. As identified above, this Project will require a significant amount of development which will need creative approaches in order to deliver it successfully.

The key aspect of the recommended approach is to engage industry effectively in order to advance the Project's feasibility. This approach would allow a "client" and "supplier" to focus on a particular project in order to advance the understanding of technology readiness and the industry's delivery capabilities.

In addition, this approach would demonstrate commitment and willingness to succeed on both sides. Based on Arup's discussions with industry suppliers during the 2011 Request for Information process, the ATN industry is willing to engage in collaborative efforts, within commercially feasible limits, in order to advance the technology.

The primary benefits of this option are the ability to maintain a constructive and collaborative engagement with the Preferred Supplier, while respecting intellectual property rights and / or commercially sensitive information. The Preferred Supplier approach should lead to more efficient progress and incorporate innovation early in the process.

The benefits of pursuing the recommended Option 3A – "Preferred Supplier" development option are summarized follows:

- Leadership
- Project goals
- Industry understanding
- Right partnership
- Mutual goals
- Maintain competition

These "success factors" are described in more detail in the following sections.

4.3.1 Leadership

The City should show strong leadership by engaging with industry early to attract and incentivize progress, and advance the schedule to achieve "first mover" advantage. This could allow the City to capitalize on the current momentum for this Project. This could help maintain the political and stakeholder support, attract potential funding commitments, and promote the City as an innovative leader among peers.

4.3.2 Project Goals

The City should establish clear expectations by defining the outline Project requirements and identifying clear Project goals. This is critical in order to advance the Project.

4.3.3 Industry Understanding

The City should establish a comprehensive industry understanding by sharing the key findings to solicit constructive feedback, innovative ideas, identify any fatal flaws, and better understand and validate the industry expertise and capability. This will allow the City to determine and develop the most appropriate procurement and funding strategy for the Project.

4.3.4 Right Partnership

The City should identify the right partnership and relationships by openly communicating and engaging with prequalified suppliers (e.g., selection based on capabilities, experience, financial standing/capability, key personnel, approach, and Project understanding).

With an independent peer review, this should give the City better understanding of the depth of the supplier pool available and an increased understanding of their ability to stay in business over the long-term. This will increase confidence that the City would select the most appropriate partner to further develop the Project.

4.3.5 Mutual Goals

Define mutual goals by creating the appropriate attitudes and incentives in order to engage industry innovation and reduce the Project uncertainty. The City should create a "win-win" scenario. This could involve a shared cost "co-development" agreement with clear decision-making/acceptance criteria.

4.3.6 Maintain Competition

Maintain competition: Maintain control of a fair, competitive, and transparent procurement process. The City should seek objective results with sufficient flexibility to maintain control of a competitive procurement process. With a "co-development" agreement cost sharing provisions could be adopted on an "open book" basis. In addition, the City could establish an "option to re-bid" the final delivery contract, once the feasibility determination stage has been reached. This will allow alternative suppliers to bring wider industry experience and knowledge to the bid of the Project, if necessary. In addition the City would include appropriate "off- ramps" in the co-development agreement to ensure competitive tension is maintained with the Preferred Supplier. At the end of the development process (i.e., the point at which the Project has been determined feasible for procurement), the City would start a new procurement process to complete the design, construction and operation of the Project.

4.4 Co-development process

In order to deliver the "success factors" highlighted in the previous section, Arup created a "Co-development" process that could help the City to deliver a successful Project.

A successful project is ultimately dependent on the final negotiated agreement to deliver the project, which is subject to negotiation of efficient risk transfer between both parties and funding availability. In the following section, Arup describes the key attributes for this "Co-development" process:

- Shortlist a number of prospective bidders for a contract to help co-develop the Project. The winning bidder would enter into an exclusive interim agreement to act as a "co-developer" with the City. This first step would be to define a suitable Project to meet the City objectives and requirements. The City would need to have its own independent advisors to protect its interests.
- With a stipend offered by the City, it could utilize developers outline concepts/ideas. This could demonstrate the industry's ability to achieve the City's objectives, and allow the City to incorporate industry innovation early in the development process.
- During this "co-development" stage, the developer could be reimbursed using an "open book" or transparent basis up to a defined point with which the City is comfortable with the Project risk profile (e.g., feasibility determination stage). The co-developer could be reimbursed for achieving interim milestone(s) or receive a "success fee" based on independent verification of achieving the appropriate acceptance criteria.
- To ensure effective commitment on the private side, it is important to demonstrate their willingness to pursue and/or deliver a particular project (i.e., put "skin in the game"). This could be achieved in a number of ways, for example, cost sharing of project development costs, "sweat equity" for obtaining regulatory approval, "proving" technology capabilities at their own expense, or investing equity into the Project / development costs. During a "co-development" stage of the Project the cost sharing provisions could be adopted (e.g., 50/50) on an "open book" of actual time/material basis up to a cap, which would include reasonable allowance for profit.
- At the final delivery stage, among the other commercial incentives, the City could create meaningful commitments on the bid side with the appropriate level of performance bonds and security requirements etc.
- In order to allow the City flexibility and maintain control of a competitive procurement process, the City should maintain an "option to re-bid" the final delivery contract, once the feasibility determination stage has been

reached. In parallel, during the co-development stage or during the negotiation stage, industry experience and knowledge from global research programs, regulatory approvals, or completed projects, could be incorporated into the final bid documents.

- In return for achieving the feasibility determination stage, the City could offer, under a re-bid scenario, the original co-developer a 5% or 10% discount on the final bid price. This would be recognition for their contribution during the "co-development" stage. Again, at final bid stage, the City could offer stipends for conforming bids.
- Alternatively at the final bid stage, the City could conduct a sole source negotiation with the co-developer for a final agreement to deliver the Project, following acceptance at the feasibility determination stage. The City would need to have its own independent advisors to protect its interests.

The recommended next steps are summarized in 5.

5 Next Steps

The following is an outline of recommended next steps in order to further develop the Project as necessary to decide on the most appropriate implementation strategy:

Project Delivery/Leadership

- Set up a dedicated City Project-delivery team with appropriate leadership, management and governance resources
- Determine the decision-making protocol
- Establish and maintain political leadership and support at local, state and federal levels

Partnerships/Stakeholders

- Leverage valuable partner relationships to develop the Project (e.g., ATN vendors, local industry, state, and federal agencies)
- Consider engaging stakeholders with Memorandums of Understanding, etc.
- Determine the public outreach/communication protocol

Technology

- Engage with industry and adopt a suitable path forward to test/prove the technology
- Prepare a “bankable” risk profile (e.g., identified development options)

Approvals/Regulatory

- Solicit input from regulators on applicable codes/standards
- Define environmental approval process
- Define the Project approval process (e.g., approval agencies, legislative approval, etc.)

Costs/Risks

- Define the minimum Project performance requirements
- Advance the level of design detail and refine costs/risk estimates
- Define the acceptable level of overall affordability (i.e., construction costs and operations, and maintenance costs)
- Implement Project risk-management strategies
- Define the acceptable risk-tolerance level

Funding

- Identify a stable, predictable funding plan for short, medium and long-term goals with levels of commitments and timing of availability

Financing/Tax/Insurance

- Consider alternative procurement strategies and evaluate which one is best suited for the City using a VfM analysis (e.g., Design–Build, Design–Build–Finance, and Design–Build–Finance–Operate–Maintain, etc.)
- Explore private sector appetite for procurement methods that rely on transfer of risks to the private sector and the use of private financing

Appendix A

Risk Analysis

A1 Risk Identification

A summary of the risk identification and ranking (high, medium, and low) is shown below.

No.	Risk	Risk Description	Current Priority
Design and Construction			
1	Construction Costs	Risk that the actual capital costs are higher than anticipated (e.g., scope change, quantities or poor quality).	High
2	Design Specification	Risk that the design of the facility is incapable of delivering the services at the anticipated cost or that there are errors or omissions.	Medium
3	Site Condition	Risk that the geotechnical conditions vary from those assumed (e.g., unknown utilities, archaeological artifacts are discovered or unknown ground contamination) which causes construction costs to increase and/or causes construction delays.	Medium
4	Right-of-Way	Risk that the appropriate Project Right-of-Way is not addressed so as to enable the Project to be delivered as planned.	Low
5	Construction Schedule	Risk that the construction schedule is longer than anticipated (e.g., adverse weather conditions, labor disputes, lack of experience of supplier to deliver Project, or unknown ground conditions such as geotechnical / archaeological issues).	High
6	Testing and Commissioning	Risk that the commissioning and testing period is longer than anticipated and thus delays the start of operations/substantial completion.	High

No.	Risk	Risk Description	Current Priority
Operations and Maintenance			
7	Operation, Maintenance and Renewal costs	Risk that operations, maintenance and renewal costs are higher than anticipated (e.g., lack of historical data, increased O&M activities/quantities, reduced useful life, and increased energy costs).	High
8	Technology	Risk that the chosen technology is not adequate to accommodate the Project requirements/performance (e.g., becomes obsolete or fails).	High
Market and Political			
9	Market Capability	Risk that the ATN vendors do not have sufficient experience or partners to deliver the Project (e.g., primarily R&D experience and lack of experience delivering commercially viable systems).	High
10	Political Change	Risk that a change in political leadership could stop or change the Project as a result of different political priorities.	Medium
11	Project Management/Delivery	Risk that the appropriate level of City oversight and guidance is not achieved and critical project decisions are not made in a timely manner.	Medium
12	City Reputation	Risk that the Project fails as a result of poor decision-making or the failed Project damages the public confidence in the City's leadership and political support.	Medium
13	Ridership	Risk that the system does not serve the targeted population or reduce airport traffic, resulting in lower than expected ridership and an under-utilized/oversized facility.	Medium
14	Termination/ Default	Risk the vendors or City defaults, resulting in the Project being terminated.	Low
15	Force Majeure	Risk that the service in not delivered (pre- or post-completion) due to a force majeure.	Low
16	Option finder Opportunity	Risk the "first mover" opportunities will be lost if the project is not delivered first.	Medium

No.	Risk	Risk Description	Current Priority
Procurement and Legal			
17	Market Competition	Risk that there are not sufficient numbers of vendors in the market for a competitive procurement process and selection of the most suitable partner/bidder.	High
18	Regulatory Codes and Standards	Risk that existing regulatory codes, standards requirements, and approval process has to be amended to suit the ATN system, causing procurement delays and increased requirements.	High
19	Procurement Law	Risk that the City's procurement authority does not permit the Project to be procured as a Public-Private-Partnership (P3) or alternative delivery method.	Low
20	Stakeholder Approval	Risk that stakeholder approval is not obtained, is delayed, or is contingent on changes in the Project requirements.	High
21	Legal Challenge	Risk that a legal challenge is taken against the Project from opposition interest groups or local residents.	High
22	Permits and Approvals	Risk that necessary approvals are not obtained or are obtained but are subject to unanticipated conditions that have adverse cost consequences or cause prolonged delays (e.g., environmental approval process).	High
23	Procurement Strategy/Interface	Risk that the procurement strategy results in interface challenges that cause cost increases and poor performance (e.g., interface between Design/Construction and Operations/Maintenance).	Medium
24	Change in Law	Risk that a change in law or policy, which could not be anticipated, has adverse consequences on capital and/or operating costs.	Low
25	Award Protest	Risk that a legal challenge is taken against the project award.	Low

No.	Risk	Risk Description	Current Priority
Funding and Financing			
26	Bus savings ("Revenue")	Risk that the "Revenue" source changes i.e., no guaranteed commitments to support project payments.	High
27	Funding and Financing	Risk that the City does not establish an adequate funding and financing plan (e.g., the Project does not generate enough interest and creditworthiness among potential investors, lenders, and public authorities (federal, state and local) to support the funding and financing plan).	High
28	Additional Revenue	Risk that the revenue from additional sources are lower than anticipated (e.g., advertisement, parking user-charges etc.).	Low

A2 Potential Risk Impacts

A summary of the potential impact for the quantified key Project risks listed in Section 3.3.4 is presented below:

Construction Costs Risks

	Risks	Risk Description	Potential Impacts
1	Construction Costs	Risk that the actual capital costs are higher than anticipated (e.g. scope change, quantities, or poor quality).	▪ Increase in construction costs ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Increase in the public funding required
2	Construction Schedule	Risk that the construction schedule is longer than anticipated (e.g., adverse weather conditions, labor disputes, lack of experience of supplier to deliver Project, or unknown ground conditions such as geotechnical/archeological issues).	▪ Delay or inability to complete the Project ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Delay could lead to termination of contract, and replacement required

	Risks	Risk Description	Potential Impacts
3	Commissioning, Change in Law/Regulations, Permits and Approvals	Risk that the commissioning, testing, and Project approvals/permit period is longer than anticipated and thus delays the start of operations or achievement of substantial completion	▪ Delay or inability to complete the Project ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Suppliers do not maintain capacity to deliver project (e.g., insufficient financial standing) ▪ Increase in construction costs due to delay or legal pursuit ▪ Inability to secure necessary clearances and approvals (e.g., environmental)

	Risks	Risk Description	Potential Impacts
4	Technology Readiness, Funding Plan, Project Commencement	Risk of delay of Project commencement by regulatory approval of technology or technology readiness to achieve Project performance requirements, adequate funding plan or legal challenge (e.g., Project implementation could occur as early as 2015 or as late as 2025).	▪ Delay or inability to complete the Project ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Suppliers do not maintain capacity to deliver project (e.g., insufficient financial standing) ▪ Increase in construction costs due to delay or legal pursuit ▪ Inability to secure necessary regulatory approvals ▪ Increase in public funding required ▪ Re-scoping of Project or contract approaches ▪ Loss of private investment support
5	Market Capacity	Risk of insufficient number of vendors for a competitive procurement process and selection of the most suitable partner/bidder (e.g., premium on price due to lack of industry competition).	▪ Loss of stakeholder/political support ▪ Increase in Project costs ▪ Suppliers do not maintain capacity to deliver Project (e.g., insufficient financial standing)

Source: Arup

Operation & Maintenance Expenditure Risks

	Risks	Risk Description	Potential Impacts
1	Staff Cost	Risk that the actual staff costs are higher than anticipated (e.g., increased staff numbers, increased responsibilities, and specific expertise required, resulting in increased remuneration).	▪ Increase in operation costs ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Increase in public funding required
2	Maintenance Cost	Risk that the actual maintenance costs are higher than anticipated (e.g., increased frequency of parts replacement, higher "wear and tear," technology redundancy, lack of spare-parts supply).	▪ Increase in operations costs ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Increase in public funding required
3	Periodic Renewal Cost	Risk that the actual periodic renewal costs are higher than anticipated (e.g., lower useful asset life period than planned, unplanned replacement due to defects, technology obsolescence).	▪ Increase in operations costs ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Increase in public funding required
4	Energy Cost	Risk that the actual energy costs are higher than anticipated (e.g., uncertain weather conditions require increased vehicle cooling/ventilation, change in energy supply or market prices, energy demand is higher than expected for normal operations).	▪ Increase in operations costs ▪ Loss of stakeholder/political support ▪ Delay or inability to receive or keep funding ▪ Increase in public funding required

Source: Arup

A3 Potential Risk Mitigation Strategies

The table below highlights potential risk mitigation strategies for the key risks identified at this stage.

Construction Costs Risks

	Risks	Risk Description	Potential Mitigation Strategies
1	Construction Costs	Risk that the actual capital costs are higher than anticipated (e.g. scope change, quantities, or poor quality).	▪ Improve definition of Project scope of work, level of design, and requirements ▪ Conduct appropriate level of site testing and inspection ▪ Provide adequate Project team and organization with relevant experience to deliver Project and make timely decisions ▪ Allow sufficient risk and inflation contingencies in budget estimates ▪ Communicate uncertainty to stakeholder/political decision makers ▪ Allow a sufficient schedule extension in the planning ▪ Secure and maintain funding commitments ▪ Adopt appropriate procurement and contract strategy to manage and transfer risk efficiently ▪ Update, review, and validate cost projections ▪ Engage with industry for innovation and expertise ▪ Ensure adequate quality records and independent

	Risks	Risk Description	Potential Mitigation Strategies
			inspections are maintained ▪ Continue to incorporate value engineering to reduce overall Project cost without compromising quality or safety ▪ Maintain competitive procurement process with flexibility to incorporate innovation and change ▪ Select most appropriate partner to deliver the Project with relevant experience and financial standing
2	Construction Schedule	Risk that the construction schedule is longer than anticipated (e.g., adverse weather conditions, labor disputes, lack of experience of supplier to deliver Project, or unknown ground conditions such as geotechnical/archaeological issues).	▪ Develop a schedule for the entire Project based on highly dependent critical path items (e.g., regulatory and environmental approval, funding, etc.) ▪ Provide adequate Project team with relevant experience to deliver Project and make timely decisions ▪ Select most appropriate partner with relevant experience to deliver the Project ▪ Allow a sufficient schedule extension in the planning ▪ Allow sufficient site investigation and analysis to be undertaken ▪ Engage with labor unions and include adequate labor agreements in contract terms ▪ Engage with and commit stakeholders (e.g., environmental testing/inspection, Right-of-Way,

	Risks	Risk Description	Potential Mitigation Strategies
			access, etc.)
3	Commissioning, Change in Law/Regulations, Permits and Approvals	Risk that the commissioning, testing, and Project approvals/permit period is longer than anticipated and thus delays the start of operations or achievement of substantial completion.	▪ Engage with and commit stakeholders early in the process (e.g., regulatory bodies, legal/legislative and safety compliance, etc.) ▪ Maintain an independent peer review and test technology off site, based on acceptable standards ▪ Leverage global industry experience and expertise ▪ Engage, educate, and continue communication with approval bodies ▪ Outline approval process for suppliers Maintain legal review of pending changes
4	Technology Readiness, Funding Plan, Project Commencement	Risk of delay of Project commencement by regulatory approval of technology or technology readiness to achieve Project performance requirements, adequate funding plan or legal challenge (e.g., Project implementation could occur as early as 2015 or as late as 2025).	▪ Provide project requirements aligned with proven technologies and operational knowledge/results ▪ Maintain commercial incentives to achieve results (e.g., performance guarantees, letters of credit, etc.) ▪ Maintain an independent peer review and test technology off site, based on acceptable standards ▪ Provide innovative and efficient ways to transfer risk related to technology to the private sector ▪ Provide backup funding plan ▪ Maintain stakeholder support for the Project ▪ Maintain effective communication with all

	Risks	Risk Description	Potential Mitigation Strategies
			stakeholders, including public outreach ▪ Maintain an understanding of the Project risks ▪ Consider and monitor the interest of alternative sources of funds (e.g., private finance) to help deliver the project ▪ Maintain an investment grade project and procurement agency ▪ Maintain third-party agreements/interface and cooperation agreements with stakeholders
5	Market Capacity	Risk of insufficient number of vendors for a competitive procurement process and selection of the most suitable partner/bidder e.g., premium on price due to lack of industry competition	▪ Engage and continue communication with alternative supplier sources ▪ Provide incentives to engage and maintain interest of the supplier/private investors ▪ Provide a fair and transparent procurement process (i.e., not specified or tailored to one supplier). ▪ Define and articulate the Project "need" and political support ▪ Provide a pipeline of comparable projects ▪ Manage and monitor conflicts of interest

Source: Arup

Operation & Maintenance Expenditure Risks

	Risks	Risk Description	Potential Impacts
1	Staff Cost	Risk that the actual staff costs are higher than anticipated (e.g., increased staff numbers, increased responsibilities, and specific expertise required, resulting in increased remuneration).	▪ Develop a range of cost projections, including Low, Medium, and High scenarios, to understand the impact on the operational and long-term viability ▪ Allow sufficient risk and inflation contingencies in budget estimates ▪ Leverage global industry experience and expertise ▪ Conduct local market soundings ▪ Concur with fair and reasonable labor agreements
2	Maintenance Cost	Risk that the actual maintenance costs are higher than anticipated (e.g., increased frequency of parts replacement, higher "wear and tear," technology redundancy, lack of spare-parts supply).	▪ Develop operation model using an actual system and compare with tests/known results ▪ Allow sufficient risk and inflation contingencies in budget estimates ▪ Leverage global industry experience and expertise ▪ Maintain good practice procedures and adhere to recommended codes/standards
3	Periodic Renewal Cost	Risk that the actual periodic renewal costs are higher than anticipated (e.g., lower useful asset life period than planned, unplanned replacement due to defects, technology obsolescence).	▪ Develop operation model using an actual system and compare with tests/known results ▪ Allow sufficient risk and inflation contingencies in budget estimates ▪ Leverage global industry experience and expertise ▪ Maintain good practice procedures and adhere to recommended codes/standards
4	Energy Cost	Risk that the actual energy costs are higher than anticipated (e.g., uncertain weather conditions require increased vehicle	▪ Allow sufficient risk and inflation contingencies in

	Risks	Risk Description	Potential Impacts
		cooling/ventilation, change in energy supply or market prices, energy demand is higher than expected for normal operations).	budget estimates ▪ Leverage global industry experience and expertise in energy efficient technology ▪ Maintain good practice procedures and adhere to recommended codes/standards for energy efficiency ▪ Consider options/strategies to reduce energy demand or increase savings ▪ Consider commercial strategies to hedge against energy price fluctuations

Source: Arup

Appendix B

Possible Federal Grant Programs

Funding Source	Overview	Eligible Activities Relevant to the Project	Match Requirement
Section 5307 – Urbanized Area Formula Program	The program provides assistance for transit capital and operating expenditure in urbanized areas and for transportation-related planning.	- Planning, engineering design, and evaluation of transit projects and other technical transportation-related studies - Capital investments in new and existing fixed guideway systems including rolling stock, overhaul and rebuilding of vehicles, track, signals, communications, and computer hardware and software	Yes
Section 5309 – New Starts Program	The program supports the construction of new or extensions to fixed guideway systems.	- Light rail, rapid rail (heavy rail), commuter rail, monorail, automated fixed guideway system (such as a "people mover"), or a busway/high occupancy vehicle (HOV) facility, or an extension of any of these	Yes
Flexible Funding for Highway and Transit – Congestion Mitigation and Air Quality Improvement Program (CMAQ)	The program funds transportation projects or programs that contribute to improving air quality and relieving congestion.	- New or expanded transportation projects that reduce emissions, including capital investment in transportation infrastructure, congestion relief efforts, or other capital projects	Yes
Flexible Funding for Highway and Transit – Surface Transportation Program (STP)	The program supports a broad range of surface transportation capital needs, including many roads, transit, sea and airport access, vanpool, bike, and pedestrian facilities.	- Planning activities such as surface transportation planning activities, transit research and development, and environmental analysis	Yes
FTA National Research and Technology Program	The program seeks to improve public transportation by funding research, development, demonstration, and deployment projects.	- Research, development, demonstration, and deployment projects, and evaluation of technology of national significance to public transportation	No