Orange County Transportation Authority

Central Harbor Boulevard Transit Corridor Study

OCTA

FINAL REPORT – DRAFT

FULLERTON

ANAHEIM

GARDEN GROVE

SANTA ANA

FINAL REPORT

DRAFT

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ABBREVIATIONS/ACRONYMS

ACS .....American Community Survey
ART .....Anaheim Resort Transportation
ARTIC.....Anaheim Regional Transportation Intermodal Center
BRT .....Bus Rapid Transit
CEQA .....California Environmental Quality Act
EB .....Eastbound
FAST Act .....Fixing America's Surface Transportation Act
FTA .....Federal Transit Administration
FTC.....Fullerton Transportation Center
GHG .....Greenhouse Gases
GIS .....Geographic Information Systems
KSW .....Key Stakeholder Workshop
LOS .....Level of service
LOSSAN.....Los Angeles-San Diego-San Luis Obispo Rail Corridor
mph .....Miles per hour
NEPA.....National Environmental Policy Act
NB.....Northbound
OCTA .....Orange County Transportation Authority
OCTAM .....OCTA Travel Demand Model
O&M.....Operations & Maintenance
ROW .....Right-of-way
SARTC .....Santa Ana Regional Transportation Center
SB.....Southbound
SCAG.....Southern California Association of Governments
SR.....State Route
STOPS .....Simplified Trips-on-Project Software
TDM.....Travel Demand Model
V/C.....Volume to capacity
VHT.....Vehicle Hours Traveled
VMT.....Vehicle Miles Traveled
WB.....Westbound

1. INTRODUCTION/EXECUTIVE SUMMARY

1.1. STUDY BACKGROUND

Harbor Boulevard is Orange County's busiest north-south transit corridor. The corridor extends over 20 miles between the cities of La Habra and Costa Mesa, and intersects nearly 30 major east-west corridors. Its value as a north-south transit spine with connections to east-west arterials, including Katella Avenue, is evident on a daily basis. In 2015, average weekday boardings on buses from the Orange County Transportation Authority (OCTA) totaled more than 12,800 on this corridor. OCTA buses on nearby on Anaheim Boulevard/Lemon Street collected an additional 9,200 average weekday boardings between the cities of Fullerton and Newport Beach. Additionally, OCTA buses operating along Katella Avenue between the cities of Long Beach and Orange collected over 4,200 boardings on an average weekday. The three routes combined account for a significant share of OCTA's total average daily boardings.

This study focuses on an eight-mile segment of Harbor Boulevard from the Fullerton Transportation Center (FTC) in Downtown Fullerton, south through the cities of Anaheim and Garden Grove, ending at Westminster Avenue—on the border of Garden Grove and the City of Santa Ana. This segment accounts for approximately 60 percent of total route boardings. Additionally, this study also considers connections along a parallel five-mile segment of Lemon Street and Anaheim Boulevard from Downtown Fullerton to Katella Avenue in Anaheim. An additional 2.2-mile segment of Katella Avenue, from Harbor Boulevard to the Anaheim Regional Transportation Intermodal Center (ARTIC) in Anaheim's Platinum Triangle district has also been identified for consideration in this study. The complete study area is shown on Figure 1.1.

Each corridor includes a connection to future fixed-guideway improvements and regional rail centers in the study area (see Figure 1.1). These include:

The OC Streetcar Project

A 4.2-mile streetcar system will operate between the Santa Ana Regional Transportation Center (SARTC)—a hub for local and regional rail, bus, and airport taxi/shuttle service—and the intersection of Harbor Boulevard/Westminster Avenue. The project is currently in design and is expected to begin operations in 2020.

Anaheim Regional Transportation Intermodal Center

Opened in December 2014, ARTIC station provides rail, bus, taxi, and other services for commuters and travelers throughout Orange County. The first phase of ARTIC serves Metrolink, Amtrak, and connections to other local and regional transit providers, including OCTA and Anaheim Resort Transportation (ART). Phase two will provide additional passenger facilities and support services to accommodate future potential California High-Speed Rail service.

Fullerton Transportation Center

The Fullerton Transportation Center is the busiest train station in Orange County. The station is served by Amtrak, Metrolink, and OCTA. The station was featured in the *Fullerton College Connector Study* (2015), which the City of Fullerton developed to evaluate strategies for enhancing transit connections between local college campuses (Fullerton College and California State University, Fullerton [CSUF]) and the FTC.

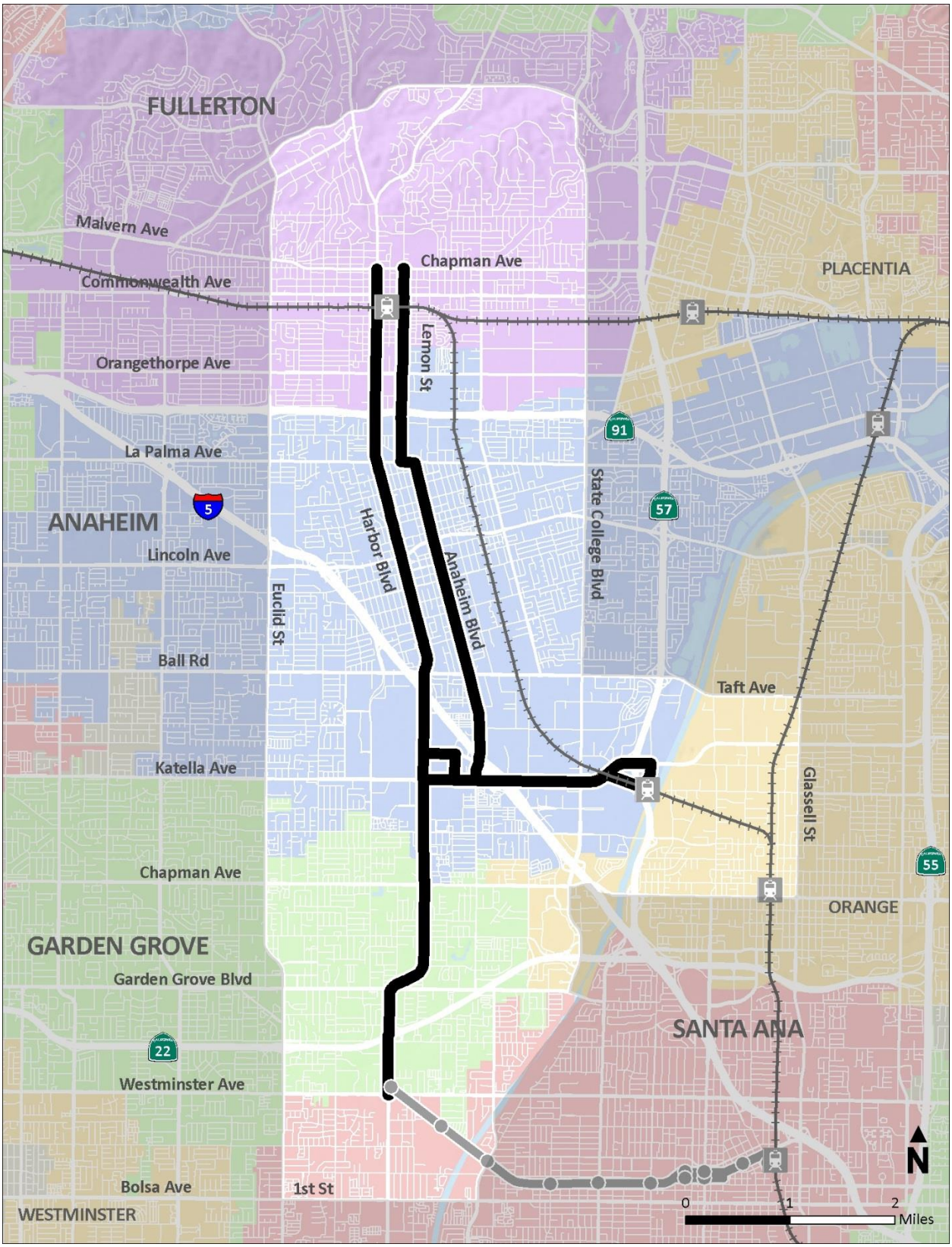
1.2. ABOUT THE STUDY

OCTA initiated this study in fall 2015 and has worked in close coordination with the cities of Anaheim, Fullerton, Garden Grove, and Santa Ana to achieve the following:

1. To analyze and develop strategies for improving transit along these important corridors.
2. To establish goals, objectives and evaluation criteria for evaluating various transit improvements.
3. To develop up to 12 conceptual transit alternatives and evaluate each alternative against the evaluation criteria.

This report presents alternatives, the results of the evaluation of alternatives, and recommendations for a path forward and advancement into a subsequent study phase which would likely include additional refinement, detailed environmental impact analysis, and additional public engagement.

Figure 1.1. The Central Harbor Boulevard Transit Corridor Study Area and Corridors



Source: STV, 2017

1.3. REPORT PURPOSE AND STRUCTURE

This report serves as a detailed companion to the *Central Harbor Boulevard Transit Corridor Study – Final Report Executive Summary*. Accordingly, this report is organized into six sections:

1) *Introduction*
   This section introduces the study, provides general information, and lays out the purpose and structure of the report.
2) *Purpose and Need*
   This section introduces the Purpose and Need of the project. The Purpose and Need determines the Mobility Problems which, in turn, determine the Goals and Objectives by which each alternative is evaluated against under Section 4 of this report.
3) *Conceptual Alternatives*
   This section introduces the four different mode and corridor options, and the twelve alternatives resulting from a unique combination of mode and corridor. These alternatives were introduced initially in the *Preliminary Definition of Alternatives Report* (April 2017). This section also describes potential stop locations and conceptual designs.
4) *Results*
   This section describes findings from the evaluation of each alternative across six criteria categories. This section also provides a ranking of all twelve alternatives, lists all capital costs, operating costs, travel time projections, and potential ridership implications.
5) *Outreach*
   This section provides an overview of outreach activities that have taken place since the study began in fall 2015.
6) *Preliminary Findings and Proposed Next Steps*
   This final section outlines OCTA's path forward upon completion of the study over the next 12 months.

2. PURPOSE AND NEED

This section defines the key mobility issues in the study area and confirms the project's purpose and need. The mobility problems defined at the end of this section also determine the goals and objectives by which each alternative was evaluated in Section 4 of this report.

2.1. STUDY CORRIDOR TRANSIT THEMES

There are several important themes that have arisen from previous analysis which must be considered in the development of conceptual transit alternatives:

a) *Important North-South Transit Spine*
Approximately 12 percent of OCTA's daily bus boardings occur along the two north-south corridors included in this study, helping riders connect to jobs, schools, and east-west connections on other OCTA routes.

b) *High Frequency Service*
Harbor Boulevard provides the highest frequency bus service in the OCTA system, operating Route 43, Bravo! Route 543, and other routes every 7.5 minutes during peak service hours at major bus stops.

c) *Resorts, Tourism, and Jobs*
The Harbor corridor contains high job density. The Anaheim Resort anchors a regional jobs center and is an international tourist destination. Moreover, The Disneyland Resort is the county's largest employer with an estimated 28,000 employees.

d) *Residential and Employment Densities*
The study area averages more than twice as many jobs and residents than the rest of Orange County.

e) *Future Planned Projects*
Each corridor city has plans to increase development and expand activity along Harbor Boulevard, Anaheim Boulevard/Lemon Street, or Katella Avenue. Anaheim and Garden Grove, in particular, are planning for a significant increase in hotel rooms. Anaheim, Santa Ana, and Fullerton also anticipate a large to moderate increase in housing units. Frequent and convenient transit service will be essential to meet the demands of this future development and offsetting higher traffic volumes. Table 2.1 below lists the number of housing units and planned hotel rooms per city within the study area.

Table 2.1. Planned/Under Review Projects in Study Area

City	Planned Housing Units	Planned Hotel Rooms
Anaheim	3,333	3,285
Fullerton	474	-
Garden Grove	26	2,093
Santa Ana	718	-
Total	4,551	5,378

Source: City of Anaheim, 2017; City of Fullerton, 2017; City of Garden Grove, 2017; City of Santa Ana, 2017

f) *Measure M1/M2*
Measure M is a half-cent sales tax first approved by Orange County voters in 1990 ("M1") and later renewed in 2006 ("M2"). The measure set aside nearly $1 billion for transit projects which focus on extending the influence of regional rail stations.

g) *Transit Rider Demographics and Needs*
Survey data indicates that home-to-work commute trips represent the greatest share of trips taken (78 percent), followed by school commutes (9 percent). The most desired improvements among existing riders are greater frequency of service and extended operating hours.

h) *Current Trends and the Challenge of Growing Transit Ridership*
Declining transit ridership is a key challenge for transit agencies nationwide. OCTA has experienced declining transit ridership in recent years and is focusing planning efforts around allocating service to its highest demand corridors. OCTA is also evaluating ways to increase the competitiveness and quality of transit service across all routes while minimizing the impact to first/last mile connections.

i) *OC Bus 360*
OCTA has recently implemented frequency improvements to many of its east-west routes in the study area. These include Route 26 (Commonwealth Avenue), Route 30 (Orangethorpe Avenue), Route 50 (Katella Avenue), and Route 54 (Chapman Avenue). The frequency improvements are expected to increase transit ridership in the area.

j) *Connections to Regional Rail*
Enhancing connections to local and regional transit services at the FTC, ARTIC, and SARTC is a major theme of this study. Enhanced service at each station has the potential to support future development in Downtown Fullerton, Downtown Anaheim, the Anaheim Platinum Triangle development district, and Downtown Santa Ana. Establishing these connections requires enhancements to north-south and east-west feeder service. Moreover, connections to these stations enhances the potential for a project to receive local funding.

Each theme listed above provides important information about the spatial distribution of current travel demand, operations on current transit lines, changing commuter behaviors, service attributes valued by existing riders, and where future residential and employment densities requiring enhanced transit service will likely be located. Given current and planned transit service in the corridor, the OCTA *Central Harbor Boulevard Transit Corridor Study* seeks to develop options to leverage these investments and facilitate connections to the OC Streetcar, The Anaheim Resort, and ARTIC.

2.2. TRANSIT AND ROADWAY PERFORMANCE

This section examines existing/future traffic conditions, how they impact transit performance, and how future traffic conditions may affect transit performance.

2.2.1. Existing Traffic Conditions

A major constraint for transit service along the Harbor Boulevard, Anaheim Boulevard/Lemon Street, and Katella Avenue study corridors is traffic congestion. Roadway congestion is reported using level of service (LOS) which assigns a letter grade based on the amount of delay and comfort a driver experiences during a particular time of day. Table 2.2 provides the criteria used to assign a LOS letter grade and describes the conditions a driver is likely to experience under each LOS grade.

Table 2.2. Level of Service Classifications

LOS	Definition
A	LOS A represents free-flow travel with an excellent level of comfort and convenience and the freedom to maneuver.
B	LOS B has stable operating conditions, but the presence of other road users causes a noticeable, though slight, reduction in comfort, convenience, and maneuvering freedom.
C	LOS C has stable operating conditions, but the operation of individual users is substantially affected by the interaction with others in the traffic stream.
D	LOS D represents high-density, but stable flow. Users experience severe restriction in speed and freedom to maneuver, with poor levels of comfort and convenience.
E	LOS E represents operating conditions at or near capacity. Speeds are reduced to a low but relatively uniform value. Freedom to maneuver is difficult with users experiencing frustration and poor comfort and convenience. Unstable operation is frequent, and minor disturbances in traffic flow can cause breakdown conditions.
F	LOS F is used to define forced or breakdown conditions. This condition exists wherever the volume of traffic exceeds the capacity of the roadway. Long queues can form behind these bottleneck points with queued traffic traveling in a stop-and-go fashion.

Source: Highway Capacity Manual, 2000

According to the *Highway Capacity Manual*, "Free-Flow Speed" on an urban street is the speed that a vehicle travels under low volume conditions when all the signals on the urban street are green for the entire trip. Thus, all delay at signalized intersections, even under low flow conditions, is excluded from the computation of urban street free-flow speed.

Table 2.3 and Table 2.4 on the following pages show peak hour traffic volumes, vehicle volume to capacity (V/C) ratios (i.e., number of vehicles on a roadway divided by the roadway's carrying capacity), and LOS for segments along the study corridors during peak morning travel hours.

None of the segments shown in Table 2.3 and Table 2.4 operate at free-flowing condition, which is to be expected in an urbanized area. There are numerous sections where "D" and "E" conditions are present, with V/C ratios close to 1.0, indicating the roadway is nearly at capacity.

Additionally, southbound traffic during the morning hour is slower compared to northbound traffic, especially within Anaheim near The Anaheim Resort. Projected employment/population increases throughout the study area indicate that LOS on Harbor Boulevard, Anaheim Boulevard/Lemon Street, and Katella Avenue could continue to worsen in the future.

To mitigate this pressure without a substantial shift in travel modes, corridor cities would need to acquire additional private right-of-way (ROW) to add additional capacity to streets. The high cost and impacts to adjacent land owners, however, make this a difficult proposition in a highly urbanized area like the study area. Existing demand and future growth thus require looking for ways to increase person throughput within existing constraints.

Table 2.3. Katella Avenue Study Corridor LOS (AM Peak)

	From	To	Class	Lanes	Volume	Capacity	V/C	LOS
Westbound								
Katella Avenue	West St	Harbor Blvd	2	3	761	2,670	0.29	**C**
	Harbor Blvd	Anaheim Blvd	2	3	838	2,670	0.31	**C**
	Anaheim Blvd	State College Blvd	2	4	785	3,560	0.22	**C**
	State College Blvd	SR-57	2	3	1,178	2,670	0.44	**C**
	SR-57	Main St	2	3	920	2,670	0.34	**C**
Eastbound								
Katella Avenue	West St	Harbor Blvd	2	3	1,501	2,670	0.56	**C**
	Harbor Blvd	Anaheim Blvd	2	3	1,509	2,670	0.57	**C**
	Anaheim Blvd	State College Blvd	2	4	1,410	3,560	0.40	**C**
	State College Blvd	SR-57	2	3	1,234	2,670	0.46	**C**
	SR-57	Main St	2	3	1,300	2,670	0.49	**C**

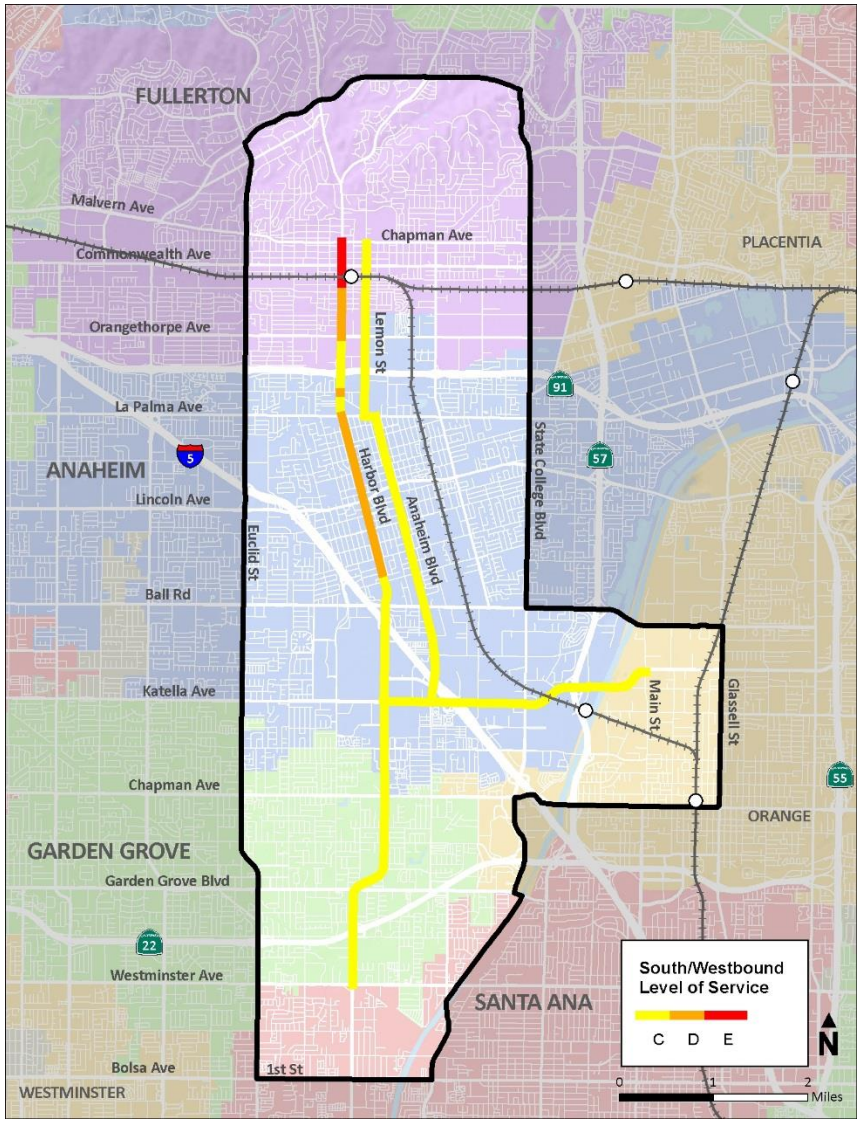
Source: Kittelson & Associates, 2016

Table 2.4. Harbor and Lemon/Anaheim Boulevard Study Corridors LOS (AM Peak Hours)

	From	To	Class	Lanes	Volume	Capacity	V/C	LOS
Southbound								
Harbor Boulevard	Chapman Avenue	Valencia Avenue	3	2	1,625	1,690	0.96	E
	Valencia Avenue	Orangethorpe Avenue	3	2	1,073	1,690	0.63	D
	Orangethorpe Avenue	Romneya Drive	2	3	1,522	2,670	0.57	C
	Romneya Drive	Victor Avenue	3	2	1,035	1,690	0.61	D
	Victor Avenue	La Palma Avenue	3	3	1,021	2,540	0.40	C
	La Palma Avenue	Sycamore Street	3	2	1,418	1,690	0.84	D
	Sycamore Street	Cypress Street	3	2	1,030	1,690	0.61	D
	Cypress Street	Vermont Avenue	3	2	1,329	1,690	0.79	D
	Vermont Avenue	Ball Road	3	3	1,202	2,540	0.47	C
	Ball Road	Manchester Avenue	2	4	1,861	3,560	0.52	C
	Manchester Avenue	Katella Avenue	2	3	1,046	2,670	0.39	C
	Katella Avenue	Orangewood Avenue	2	3	1,113	2,670	0.42	C
	Orangewood Avenue	Chapman Avenue	2	3	1,013	2,670	0.38	C
	Chapman Avenue	MacArthur Boulevard	2	3	1,056	2,670	0.40	C
Anaheim Boulevard / Lemon Street	Chapman Avenue	Orangethorpe Avenue	2	2	776	1,780	0.44	C
	Orangethorpe Avenue	SR-91	2	3	1,026	1,780	0.58	C
	SR-91 EB Ramps	La Palma Avenue	3	3	546	1,690	0.32	C
	Lemon Street	Anaheim Boulevard	2	2	1,036	1,780	0.58	C
	La Palma Avenue	Sycamore Street	3	2	649	1,690	0.38	C
	Sycamore Street	Broadway	3	2	733	1,690	0.43	C
	Broadway	Ball Rd	3	2	883	1,690	0.52	C
	Ball Rd	Cerritos Avenue	2	3	1,218	2,670	0.46	C
	Cerritos Avenue	Katella Avenue	2	3	615	2,670	0.23	C
Northbound								
Harbor Boulevard	MacArthur Boulevard	Chapman Avenue	2	3	1,194	2,670	0.45	C
	Chapman Avenue	Orangewood Avenue	2	3	1,090	2,670	0.41	C
	Orangewood Avenue	Katella Avenue	2	3	959	2,670	0.36	C
	Katella Avenue	Manchester Avenue	2	3	965	2,670	0.36	C
	Manchester Avenue	Ball Road	2	4	1,539	3,560	0.43	C
	Ball Road	Vermont Avenue	3	3	735	2,540	0.29	C
	Vermont Avenue	Cypress Street	3	2	754	1,690	0.45	C
	Cypress Street	Sycamore Street	3	2	601	1,690	0.36	C
	Sycamore Street	La Palma Avenue	3	2	846	1,690	0.50	C
	La Palma Avenue	Victor Avenue	3	3	1,475	2,540	0.58	C
	Victor Avenue	Romneya Drive	3	2	890	1,690	0.53	C
	Romneya Drive	Orangethorpe Avenue	2	3	954	2,670	0.36	C
	Orangethorpe Avenue	Valencia Avenue	3	2	1,566	1,690	0.93	D
	Valencia Avenue	Chapman Avenue	3	2	1,138	1,690	0.67	D
Anaheim Boulevard / Lemon Street	Katella Avenue	Cerritos Avenue	2	3	677	2,670	0.25	C
	Cerritos Avenue	Ball Rd	2	3	762	2,670	0.29	C
	Ball Rd	Broadway	3	2	488	1,690	0.29	C
	Broadway	Sycamore Street	3	2	537	1,690	0.32	C
	Sycamore Street	La Palma Avenue	3	2	574	1,690	0.34	C
	Anaheim Boulevard	Lemon Street	2	2	1,098	1,780	0.62	D
	La Palma Avenue	SR-91 EB Ramps	3	2	580	1,690	0.34	C
	SR-91	Orangethorpe Avenue	2	2	1,003	1,780	0.56	C
	Orangethorpe Avenue	Chapman Avenue	2	2	787	1780	0.44	C

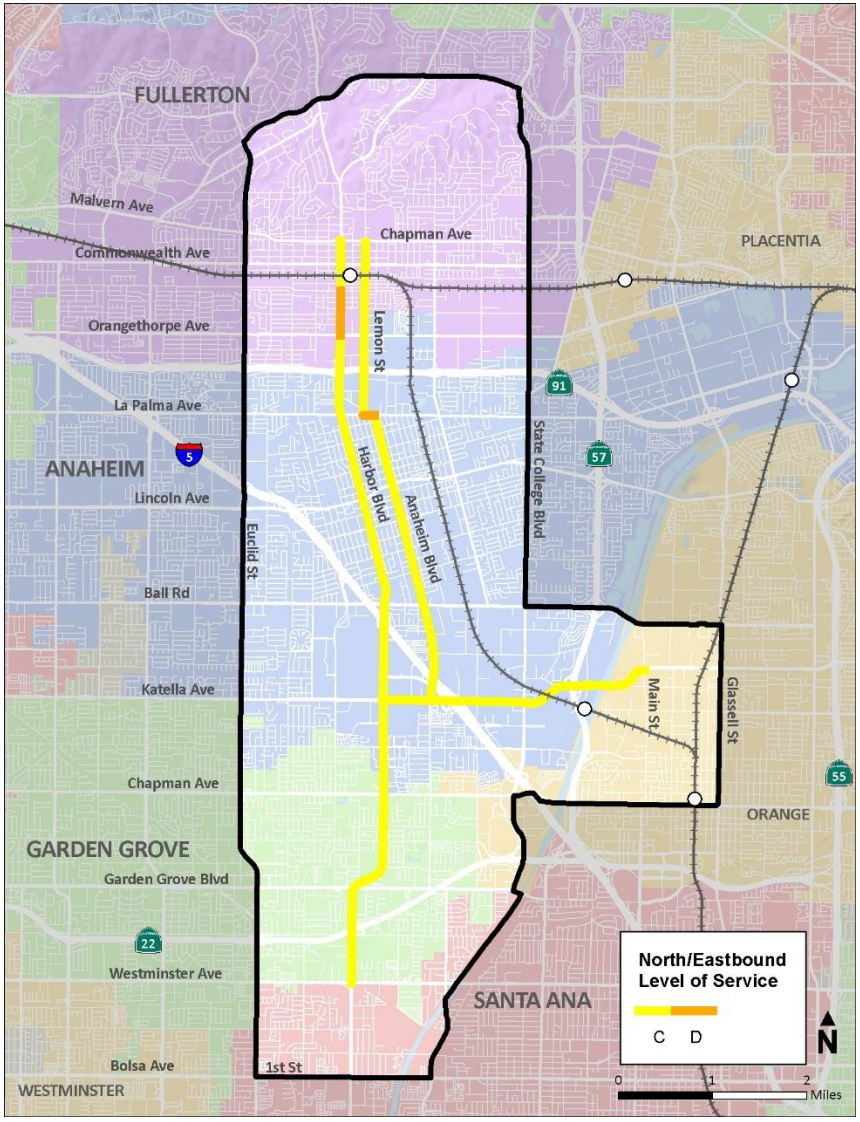
Source: Kittelson & Associates, 2016

Figure 2.1. South/Westbound Peak AM LOS



Source: STV, 2016; Kittelson & Associates, 2016

Figure 2.2. North/Eastbound Peak AM LOS



Source: STV, 2016; Kittelson & Associates, 2016

2.2.2. Transit Performance

Traffic delay on Harbor Boulevard, Anaheim Boulevard/Lemon Street, and Katella Avenue also negatively impact transit operations. Despite the success of OCTA's Bravo! 543, there are indications that the service does not perform optimally throughout the study area because of traffic conditions. An illustration of this is the lack of consistency in average bus travel speed along the approximately 8-mile Harbor Boulevard corridor, 5-mile Anaheim Boulevard/Lemon Street corridor, and 2-mile Katella Avenue corridor.

The figures and tables over the next several pages illustrate travel time variability and problem areas for transit operations during peak morning and afternoon commute periods.

Figure 2.3 and Table 2.5 on the next page show average scheduled travel speeds (in miles per hour [mph]) for OCTA's Route 50 from 6 AM to 9 AM through the following sections of Katella Avenue:

a) Brookhurst Avenue to Katella Avenue;
b) Katella Avenue to ARTIC;
c) ARTIC to Glassell Street (City of Orange).

Figure 2.4 and Table 2.6 show average scheduled travel speeds for OCTA's Route 43 from 6 AM to 9 AM through the following sections of Harbor Boulevard:

a) Westminster Avenue to Katella Avenue;
b) Katella Avenue to Lincoln Avenue;
c) Lincoln Avenue to Orangethorpe Avenue to the FTC.

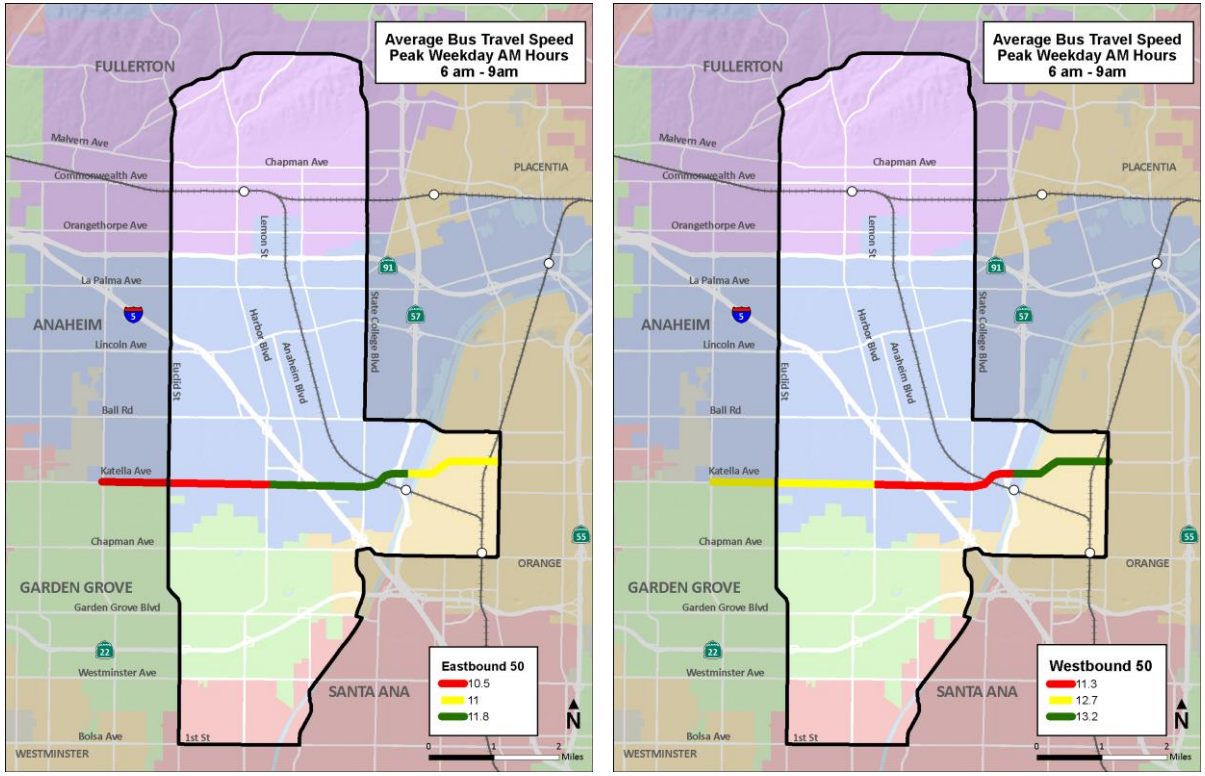
Figure 2.5 and Table 2.7 show average scheduled travel speeds for OCTA's Bravo! 543 from 6 AM to 9 AM through the following sections of Harbor Boulevard:

a) FTC to Lincoln Avenue;
b) Lincoln Avenue to Katella Avenue;
c) Katella Avenue to Westminster Avenue.

Finally, Figure 2.6 and Table 2.8 show average scheduled travel speeds for OCTA's Route 47 from 6 AM to 9 AM through the following segments of the Anaheim Boulevard/Lemon Street corridor:

a) FTC to Orangethorpe Avenue;
b) Orangethorpe Avenue to Lincoln Avenue;
c) Lincoln Avenue to Katella Avenue.

Figure 2.3. Average OCTA Route 50 Travel Speeds during AM Peak



Source: STV, 2016; OCTA, October 2015

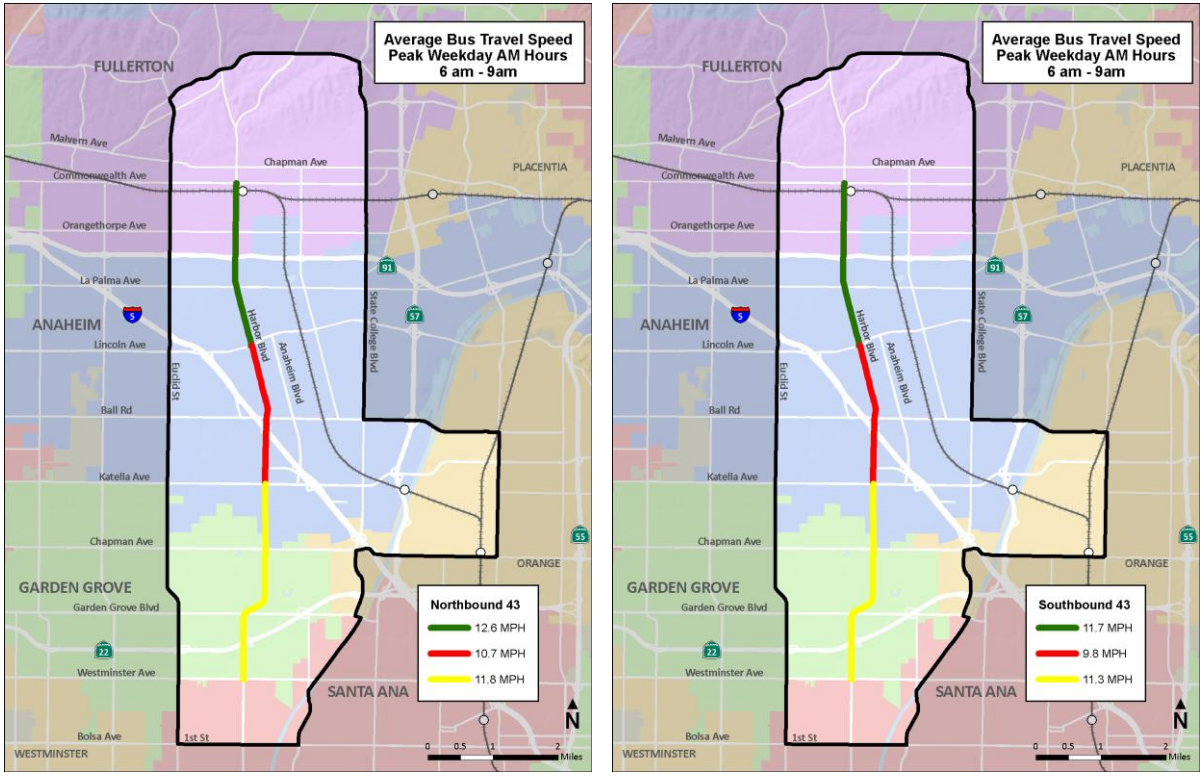
Table 2.5. Hourly Breakdown of Average OCTA Route 50 Speeds during AM Peak

	Monday-Friday: Eastbound				Monday-Friday: Westbound (Reverse Order)			
	Distance (Miles)	6 am	7 am	8 am	Distance	6 am	7 am	8 am
Brookhurst Ave – Harbor Blvd	2.6	11.7 (mph)	9.2	10.7	2.6	13.2 (mph)	12.4	13.6
Harbor Blvd - ARTIC	2.6	12.0	11.5	12.0	2.6	10.5	10.7	11.4
ARTIC – Glassell Street	1.7	11.6	9.9	11.6	1.7	10.5	10.1	9.7

Source: STV, 2016; OCTA, 2015

Note: Average travel speeds during peak travel periods for all figures were weighted equally when calculating the overall average for the three hour period.

Figure 2.4 Average OCTA Route 43 Travel Speeds during AM Peak



Source: STV, 2015; OCTA, October 2015

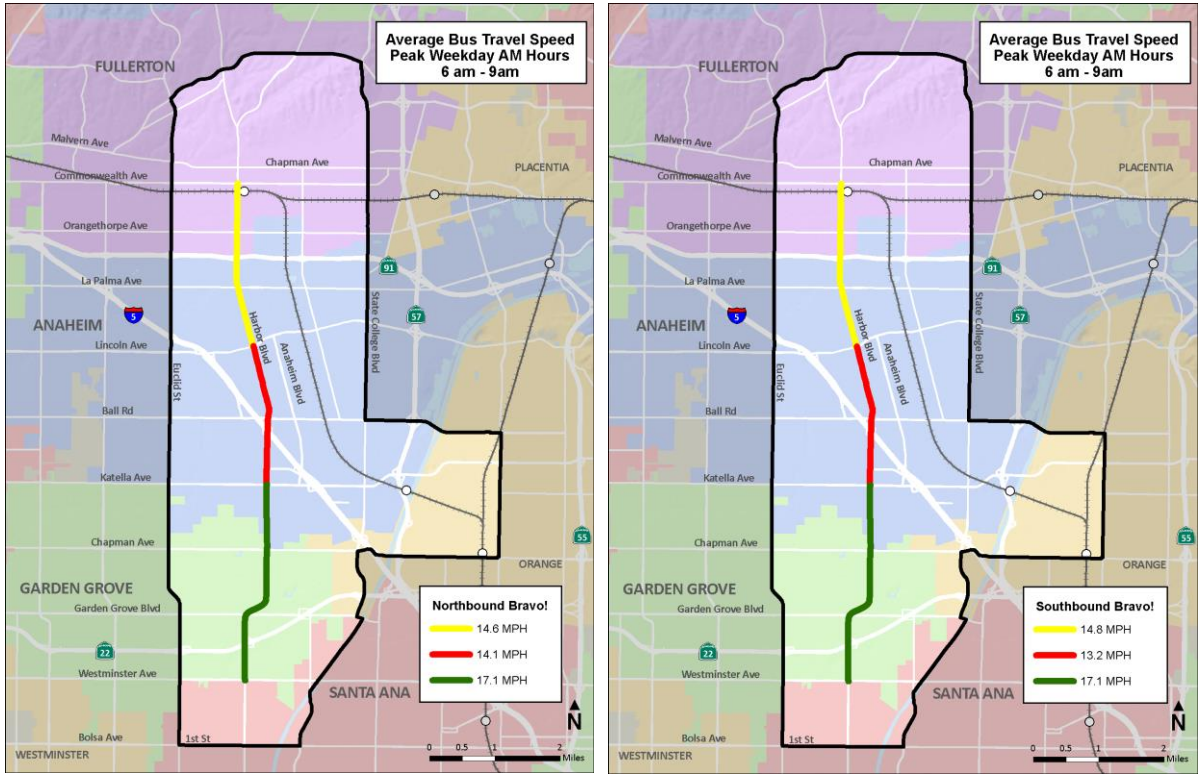
Table 2.6. Hourly Breakdown of Average Route 43 Speeds during AM Peak

	Monday-Friday: Northbound				Monday-Friday: Southbound			
	Distance (Miles)	6 am	7 am	8 am	Distance	6 am	7 am	8 am
Westminster Ave – Katella Ave	3.2	12.1 (mph)	11.4	12.1	3.2	11.6 (mph)	11.2	11.2
Katella Ave – Lincoln Ave	2.1	11.4	10.4	10.4	2.2	10.9	9.3	9.3
Lincoln Ave – Orangethorpe Ave/FTC	1.9/0.9	12.4/11.4	12.4/12.7	12.4/14.2	1.8/1.0	14.1/11.6	12.0/10.3	12.0/10.3

Source: STV, 2015; OCTA, 2015

Note: Northernmost segments (FTC-Orangethorpe Ave and Orangethorpe Ave-Lincoln Ave) have been combined to correspond with other figures.

Figure 2.5. Average Bravo! 543 Travel Speeds during AM Peak



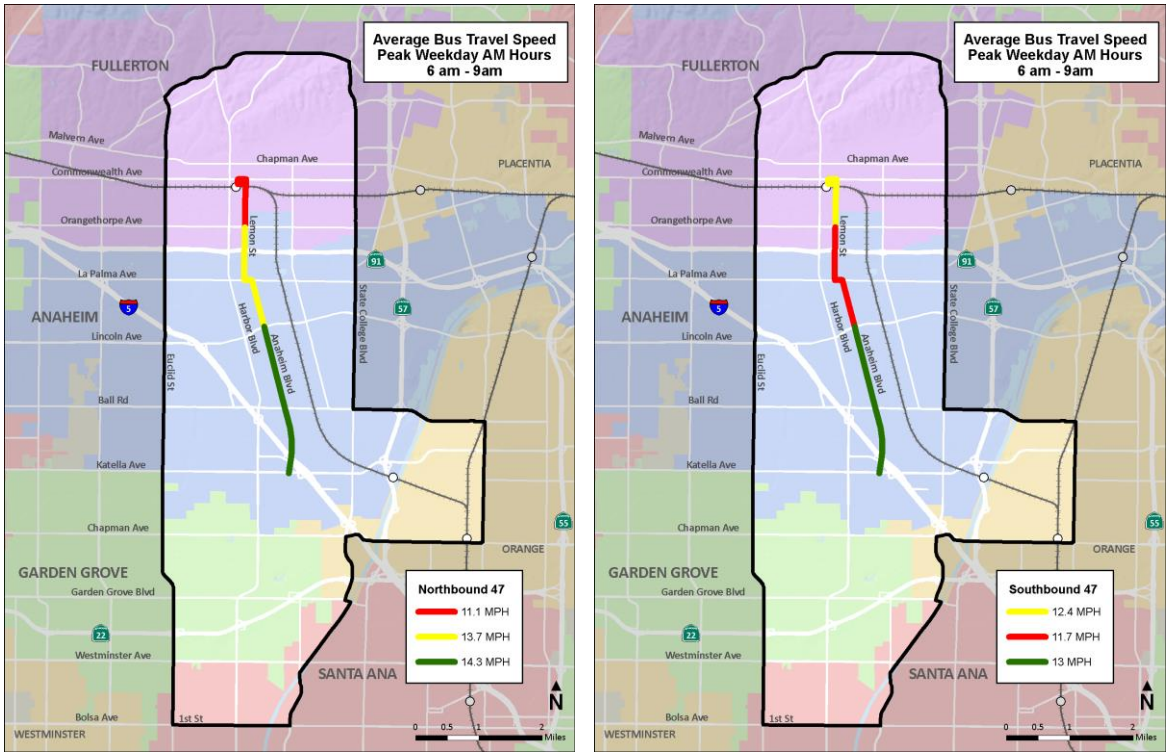
Source: STV, 2015; OCTA, October 2015

Table 2.7. Hourly Breakdown of Average OCTA Bravo! 543 Speeds during AM Peak

	Monday-Friday: Northbound				Monday-Friday: Southbound			
	Distance (Miles)	6 am	7 am	8 am	Distance	6 am	7 am	8 am
Westminster Ave – Katella Ave	3.2	17.6 (mph)	16.1	17.6	3.2	18.0 (mph)	16.2	17.0
Katella Ave – Lincoln Ave	2.1	16.0	12.8	13.6	2.2	14.9	12.3	12.5
Lincoln Ave – FTC	3.0	15.0	14.3	14.5	2.7	16.5	14.4	13.7

Source: STV, 2015; OCTA, October 2015

Figure 2.6. Average Route 47 Travel Speeds during AM Peak



Source: STV, 2015; OCTA, October 2015

Table 2.8. Hourly Breakdown of Average OCTA Route 47 Speeds during AM Peak

	Monday-Friday: Northbound				Monday-Friday: Southbound			
	Distance (Miles)	6 am	7 am	8 am	Distance	6 am	7 am	8 am
Katella Ave – Lincoln Ave	3.2	17.6 (mph)	16.1	17.6	3.2	18.0 (mph)	16.2	17.0
Lincoln Ave – Orangethorpe Ave	2.1	16.0	12.8	13.6	2.2	14.9	12.3	12.5
Orangethorpe Ave - FTC	3.0	15.0	14.3	14.5	2.7	16.5	14.4	13.7

Source: OCTA, October 2015

2.2.2.1. Travel Time: Key to Competitive Transit Service

Travel time is of critical importance to transit riders and also has important implications for the productivity and cost-effectiveness of transit service. A 25 percent improvement in travel time, for example, gets riders to their destinations and transfer points sooner, improves the attractiveness of the service, and has the added benefit of increasing the productivity of all the transit vehicles along the route—resulting commensurate reduction in operating costs. On the other hand, increasing travel times hurt the competitiveness of transit service and increase operating costs. For this reason, identifying and evaluating alternatives that produce real travel time reductions is a key objective of this study.

The following strategies for increasing transit operating speeds were considered during the course of this study:

a) *Stop Coverage*
One method for effectively reducing transit travel times is increasing the spacing between transit stops. OCTA's Bravo! 543 stops every 0.75-miles on average and has an average operating speed close to 17 mph. Meanwhile, Route 43 stops every 0.25-miles on average and has an average operating speed closer to 12 mph. Because transit riders often demonstrate a willingness to walk further distances for faster, more frequent service, this strategy could be implemented without being detrimental to existing riders.

b) *Mixed Traffic or Dedicated Transit lanes*
Dedicating a traffic lane to transit use during the peak period or all day can provide significant benefits to transit travel time. However, a high frequency of transit service is needed to make this strategy justified and traffic volume analyses need to be conducted to ensure that the impacts to other modes are minimized.

c) *Transit Stop Dwell Time*
Potential strategies for reducing the amount of time it takes for passengers to board and alight include: off-board fare collection, multi-door boarding, low-floor vehicles, level platform boarding; and improved information, signage, and branding.

d) *Address Traffic Choke Points*
Working with corridor cities helps remove or alleviate bottlenecks and employ traffic signal timing refinements or "queue jumpers" at particularly challenging intersections.

e) *Traffic Signal Priority*
Evaluating the potential benefits and impacts of providing transit signal priority to transit vehicles through strategic segments of the corridor also helps increase transit operating speeds.

2.3. DEMOGRAPHICS AND LAND USE

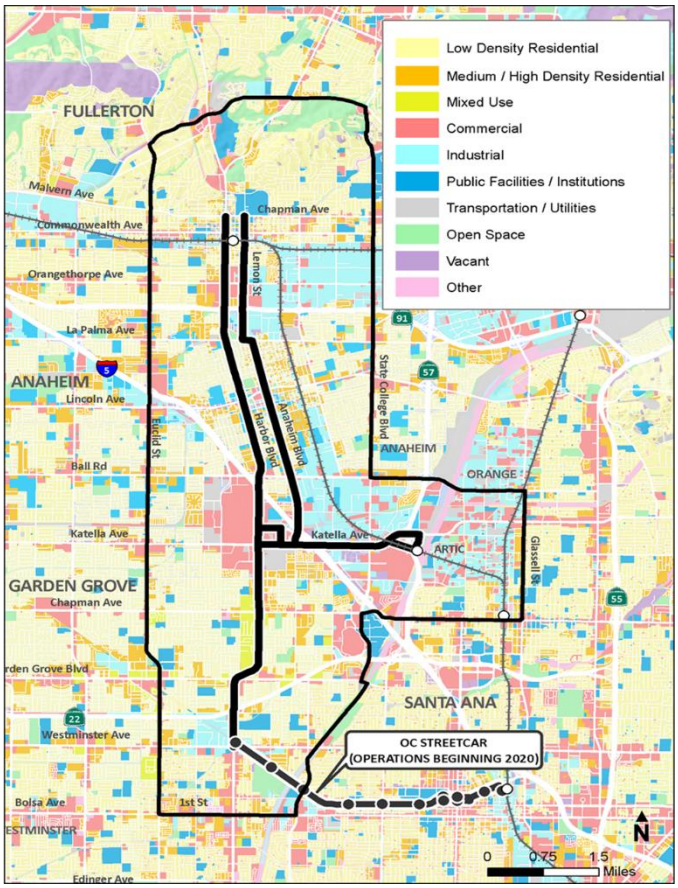
This section describes the land uses with the study area.

2.3.1. Land Use

As seen in Figure 2.7 and Table 2.9, approximately half of the land uses within the study area are residential, with approximately 36 percent designated as low-density residential, and approximately 12 percent designated as mid-to-high density residential. Commercial land uses comprise a large portion of the study area, at approximately 19 percent, and are concentrated around The Anaheim Resort, Downtown Fullerton, between State Route 22 and Ball Road along State College Boulevard. Industrial uses make up approximately 12 percent of the study area and are mostly located along rail lines.

There are large concentrations of commercial land uses around The Anaheim Resort and Platinum Triangle in Anaheim within the study area. Industrial land uses are dispersed near or off railway lines to the east of the Lemon/Anaheim corridor.

Figure 2.7. Land Uses within Study Area



Source: STV, 2016; SCAG, 2008; City of Anaheim, 2015; City of Fullerton, 2015; City of Garden Grove, 2015

Table 2.9. Land Uses within Study Area

Region	Low-Density Residential	High-Density Residential	Commercial	Industrial	Public Facilities / Institutions	Transportation / Utilities	Mixed Use	Open Space / Recreation	Vacant	Other
Study Area	36.4%	12.4%	19.1%	12.3%	8.2%	3.5%	0.4%	4.8%	1.1%	1.8%
Orange County	21.9%	5.9%	7.8%	4.1%	4.2%	2.9%	0.2%	10.1%	37.4%	5.5%

Sources: STV, 2016; SCAG, 2008; City of Anaheim, 2015; City of Fullerton, 2015; City of Garden Grove, 2015
Note: Vacant land category includes natural undeveloped areas of the county such as Cleveland National Forest.

2.3.2. Current Population and Employment

There are approximately 1.5 times as many residents as jobs within the study area. Residents are distributed fairly evenly across the area, with the exception of the area around The Anaheim Resort, and the industrial and commercial centers east of Interstate 5 between Chapman Avenue in the south and Ball Road in the north. This is in line with the heavier presence of industrial and commercial land along rail corridors in that area. Residential density in the study area is high at more than double the density of Orange County overall.

Jobs within the study area are concentrated around Fullerton College and the rail-adjacent industrial areas east of the FTC, The Anaheim Resort, the Anaheim Convention Center, Anaheim's Platinum Triangle, the Outlets at Orange, the Grove District in Garden Grove, and Downtown Santa Ana. Job density is significantly higher (nearly three times as many) than that of Orange County overall.

Table 2.10 lists current population and employment densities within the study area and Orange County overall.

Table 2.10. Population and Employment Densities within Study Area (2015)

Region	Population Density (residents/sq. mile)	Employment Density (jobs/sq. mile)
Study Area	8,872	5,757
Orange County	3,945	2,032

Source: OCP, 2015

2.3.3. Future Population and Employment

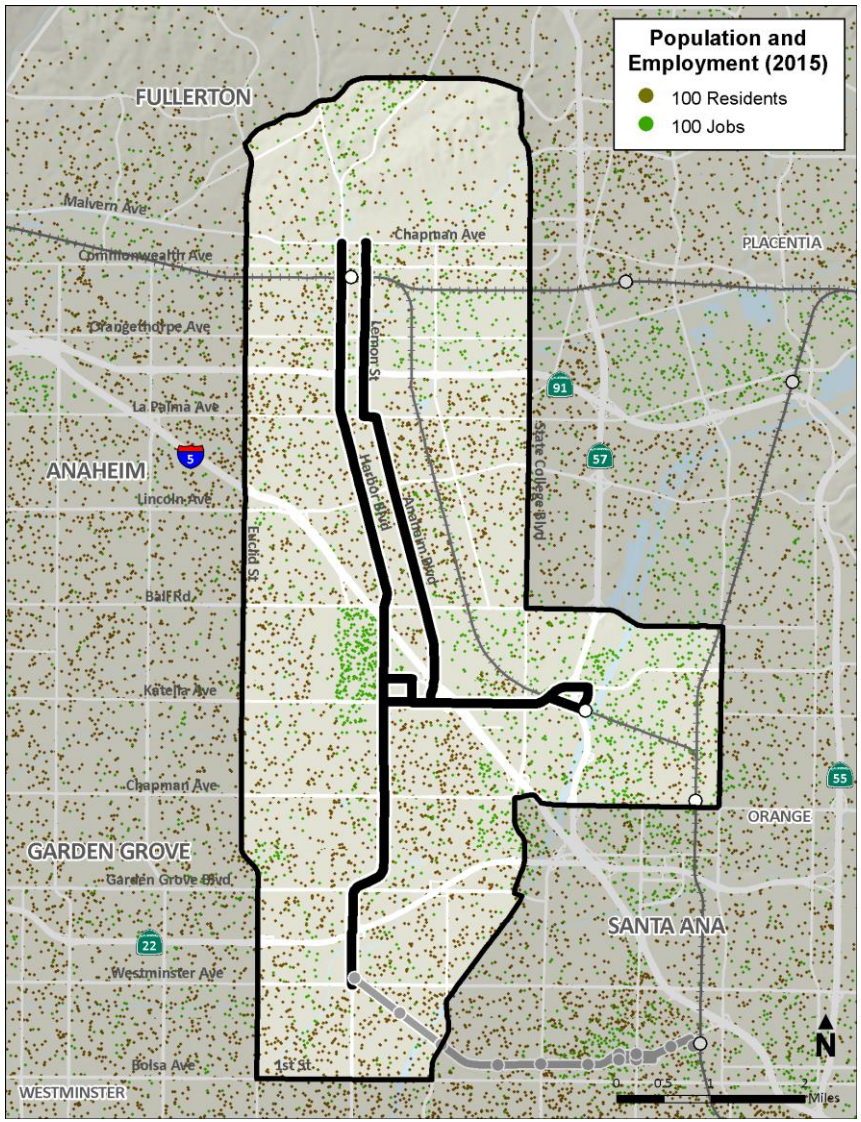
High rates of residential and employment growth are projected for the study area between 2015 and 2035. During this twenty-year period, population is expected to increase by over 15 percent and employment by over 25 percent, with most of the growth concentrated in Anaheim and Fullerton. Compared to Orange County as a whole, the study area is projected to have higher rates of growth for both residents and jobs. Table 2.11 shows projected population and employment growth for the study area and all of Orange County from 2015 to 2035. Figure 2.8 and Figure 2.9 on the next page include a side-by-side comparison of present and future spatial distribution of both jobs and population.

Table 2.11. Population and Employment Change within Study Area (2015 to 2035)

Region	Population Density (residents/sq. mile)	Employment Density (jobs/sq. Mile)	% Change in Population	% Change in Employment
Study Area	10,313	7,244	16	26
Orange County	4,297	2,430	9	15

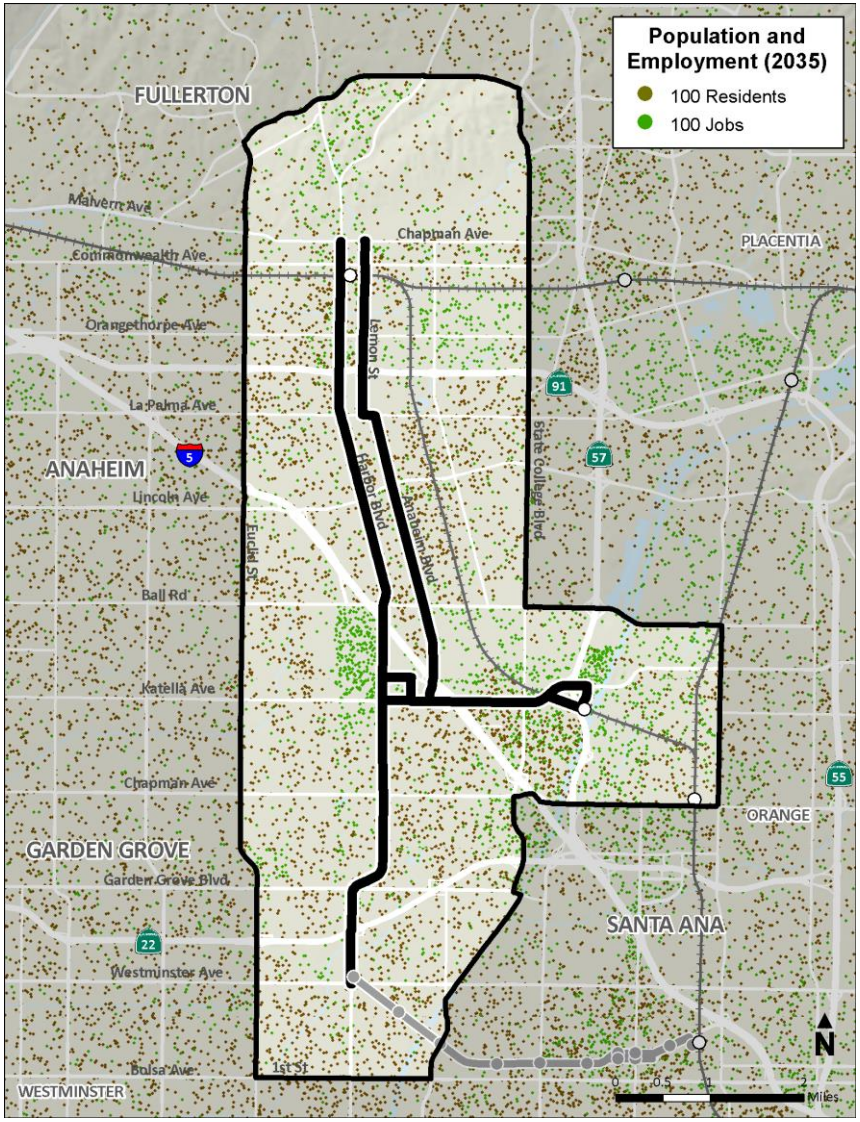
Source: STV, 2015; OCP, 2015

Figure 2.8. 2015 Population and Employment within Study Area



Source: STV, 2015; OCP, 2015

Figure 2.9. 2035 Population and Employment within Study Area



Source: STV, 2015; OCP, 2015

2.3.4. Station Area Densities and Transit Ridership

There is a strong positive relationship between residential and employment densities and transit ridership. Greater station area densities typically have a greater potential for attracting transit riders. Transit professionals have attempted to articulate a precise range of densities within a 0.5-mile radius of transit stops at which investments in enhanced bus service, bus rapid transit (BRT), Streetcar, Light Rail, or Heavy Rail (subway) systems could attract higher returns on investment. However, since there are many other variables that affect transit ridership and these variables often differ across regions, there is no standard range of densities that has become accepted as the standard for determining the appropriate level of transit investment. Transit professionals have widely acknowledged the importance of both residential and employment densities within a 0.5-mile radius (walking distance) of station areas, and a recent study of 58 transit systems in the U.S. found that employment densities within quarter-mile radius of station areas provided the best predictor of ridership. Thus, a key objective of this study is to ensure that proposed station/stop locations serve the densest residential and employment areas, as well as the key destinations and transfer points.

Projects applying for federal funding are required to evaluate both the population density within a 0.5-mile radius of proposed stops and the total employment within 0.5-miles of the proposed transit project.

2.3.5. Transit Rider Demographics

OCTA has conducted a number of surveys in recent years to help provide more information about what types of trips are being taken, how the quality of service is perceived by riders, and determine why former riders may have stopped riding transit.

The most extensive survey was the *OCTA On-Board Survey* (2013) which collected nearly 100,000 on-board surveys over a two year period across all OCTA routes. The survey found:

a) 70% of riders reported an annual household income of less than $30,000.
b) 41% of riders reported living in a zero-car household.
c) 78% of trips are work-related while 9% were related to school/college.
d) 90% reported that they arrived at a transit stop by walking, while 4.6% were dropped off by auto, and 4.5% arrived by bike.

In 2013, OCTA surveyed riders exclusively along Harbor Boulevard. The agency surveyed 1,000 passengers onboard Route 43 and Bravo! Route 543. The survey found:

a) 58% of riders reported an annual household income of less than $30,000.
b) 33% of riders reported belonging to a zero-car household.
c) 74% of riders reported that their trips were commute-related (work and school).

Other findings about travelers on Harbor Boulevard include:

a) *Core ridership* includes a large share of transit-dependent riders who live and/or work within or near the study area, rely on bus service to meet their daily travel needs, and often require transfers to reach their final destinations.

b) *Recreation-related trips* comprise a small percentage of overall trips (seven percent) despite the high concentration of entertainment-related activities in the study area. This suggests that ART serves as a primary transit option for trips to and from The Anaheim Resort and serves many visitors traveling to other activity centers. Better access to information materials, enhanced branding, fare media, and stop/shelter amenities could help make OCTA services more attractive to tourists visiting the corridor or connecting to/from ARTIC.

Finally, the *OCTA Bus Customer Survey* (2014) asked respondents to rank their most desired improvement:

1) Frequency of Service (58%).
2) Overcrowding inside buses (27%).
3) More weekend Service (24%).
4) More evening service (23%).
5) Security and safety at bus stops (23%).

2.4. TRANSPORTATION NETWORK

This section describes the existing transportation network and services in the study area.

2.4.1. Freeways and Arterials

The study area is served by four major freeways: Interstate 5 (I-5) and State Routes (SR) 91, 22, and 57. Arterial roads are typically laid out in a grid pattern with major streets approximately one mile apart.

This convergence of four major freeways in an area of high job density and activity centers results in high volumes of traffic during peak commuting hours on Harbor Boulevard, Anaheim Boulevard/Lemon Street, Katella Avenue, and other major arterials. This affects drivers and has adverse consequences on transit operations throughout certain hours of the day.

2.4.2. Transit Network

The following concepts help describe the nature and quality of transit in the study area:

a) *Service Coverage*
This relates to the destinations covered by the bus route and the number of stops along the corridor.

b) *Headways/Frequency/Span of Service*
This refers to the time interval with which bus service is provided and the daily hours of operation for each route. Generally, transit service that is provided on an interval of every 15 minutes or less is considered “frequent” while wider time intervals are considered “infrequent.”

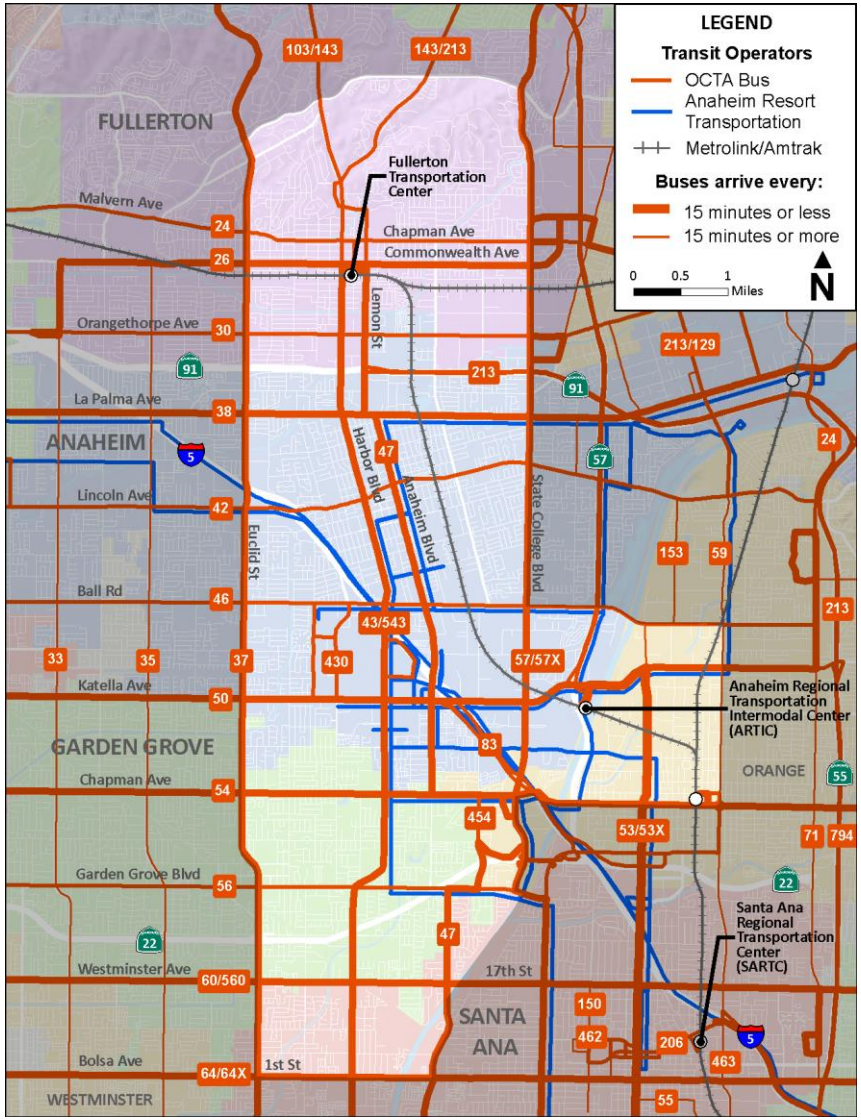
c) *Mixed Flow Traffic or Dedicated Transit Lanes*
All transit services in Orange County (except Amtrak and Metrolink commuter rail) operate in mixed-flow traffic with other automobiles. Time schedules and on-time performance are at least partially dependent on traffic conditions.

d) *Bus Stop/Shelter Amenities*
The provision and quality of bus stop amenities is largely determined by the local jurisdiction in which the stops are located. Provision of amenities throughout the study area is inconsistent and varies across jurisdictions.

e) *Connectivity to the Network*
This concept refers to how the services in the corridor connect to the overall transit network and other modes.

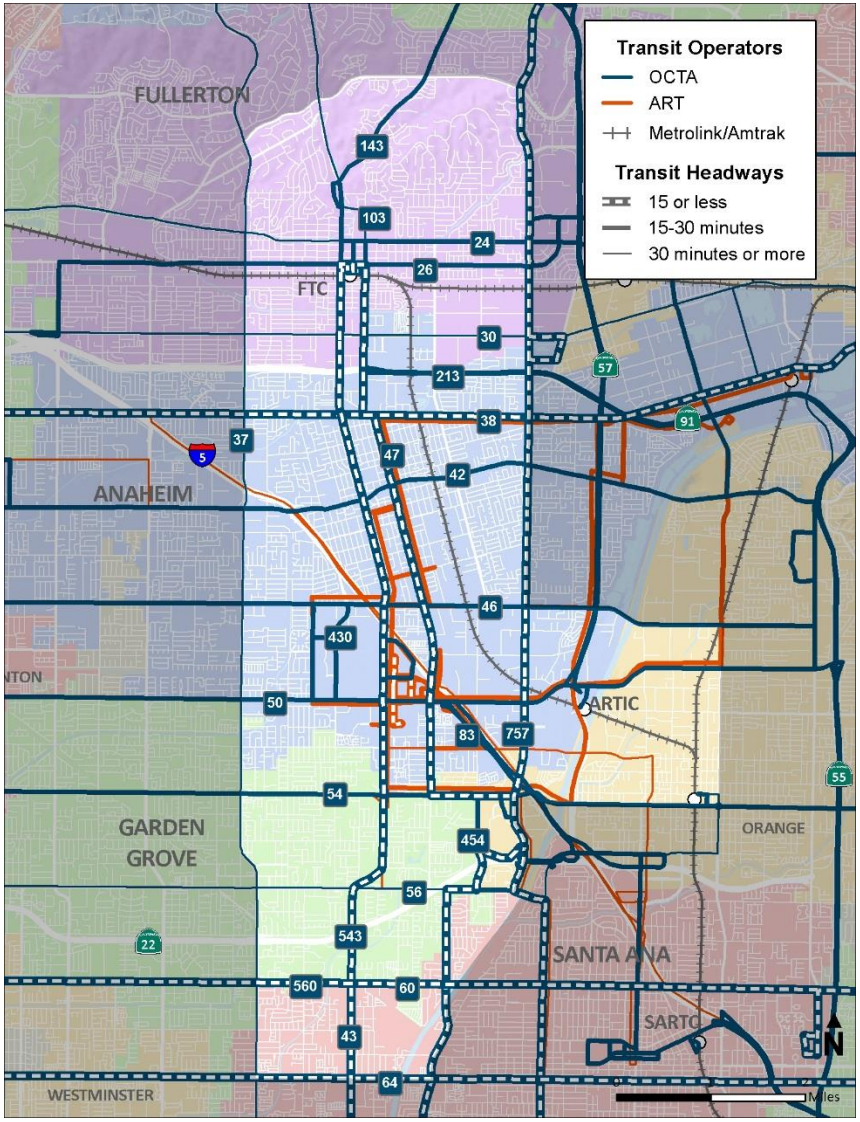
This section also introduces the multiple operators providing a variety of transit options in the study area as well as existing frequencies on OCTA routes. These are shown in Figure 2.10 and Figure 2.11, respectively.

Figure 2.10. Transit Lines through Study Area



Source: STV, 2017; OCTA, 2017

Figure 2.11. Transit Service Frequency through Study Area



Source: STV, 2017; OCTA, 2017

2.4.2.1. Orange County Transportation Authority

Harbor Boulevard

OCTA operates two bus routes on Harbor Boulevard: Route 43 (local) and Bravo! 543 (limited stop). These two routes provide a high level of coverage and frequency when both routes are in service.[1] Table 2.12 below provides a summary of service characteristics. While Route 43 provides a high level of coverage with stops located an average of 0.25-miles apart, it has a lower frequency of every 20 minutes. Bravo! 543 runs more frequently (12 minutes during peak hours and 18 minutes during non-peak weekday service) and provides a faster travel time with stops spaced approximately 0.75-miles apart.

Table 2.12 Bus Service on the Harbor Boulevard Corridor

Route	Route Limits	Distance (miles)	Stop Spacing	Frequency (minutes)	Hours of Operation	Run Time (minutes)
43 (SB)	North Court to Newport Blvd/19th St	18.0	0.25	20, 30, 60	3:50 am - 1:29 am	90
Bravo! 543 (SB)	FTC to MacArthur Blvd	13.0	0.75	12-20, 60	5:02 am - 7:50 pm	48
43 (NB)	19th St/Newport Blvd to North Court	18.0	0.25	20, 30, 60	4 am - 1:30 am	90
Bravo! 543 (NB)	MacArthur Blvd to FTC	13.0	0.75	12-20, 60	5:46 am - 8:00 pm	50

Note: Service frequency on Bravo! 543 is 12 minutes during peak hours while service frequency on Route 43 is 20 minutes during peak hours.
NB = Northbound
SB = Southbound

[1] Bravo! 543 operates between approximately 5 AM and 8 PM on weekdays. Route 43 operates between approximately 4 AM and 1:30 AM on weekdays.

Anaheim Boulevard/Lemon Street

OCTA operates Route 47 (local) between the FTC and the City of Newport Beach. This route travels north to south along Lemon Street and Anaheim Boulevard-Haster Street to Chapman Avenue. Past Chapman Avenue, Route 47 travels primarily along Fairview Street. Route 47 is 22 miles in length and has stops spaced about 0.3-miles apart. Stop spacing provides good coverage on this route but results in a long run time of 100 minutes. The frequency of service is 14 minutes during peak hours and up to 40 minutes during non-peak hours. Service operates from 4 AM to 11:30 PM. Table 2.13 provides a summary of service characteristics.

Table 2.13. Bus Service on the Lemon Street/Anaheim Boulevard Corridor

Route	Route Limits	Distance (Miles)	Stop Spacing	Frequency (Minutes)*	Hours of Operation	Run Time (mins.)
47 (SB)	FTC to Oceanfront/Palm St	22.0	0.3	14, 20-40	4:34 am - 11:27 pm	100
47 (NB)	Oceanfront/Palm St to FTC	22.0	0.3	20, 30-60	3:55 am- 11:37 pm	98

**Service frequency is 14 minutes during peak hours.*
NB = Northbound
SB = Southbound

Katella Avenue

OCTA operates Route 50 (local) between the cities of Long Beach and Orange. This route primarily travels east to west along Katella Avenue, through the cities of Long Beach, Los Alamitos, Cypress, Stanton, Garden Grove, Anaheim (including ARTIC), and Orange. Route 50 is approximately 20 miles in length and has stop locations spaced at various intervals ranging from under 0.2 miles to approximately 0.35 miles apart. Stop spacing and skipped stops on this route result in a total run time of approximately 90 to 100 minutes. The frequency of service is 15 minutes during peak hours and up to 30-60 minutes during off-peak hours. Service operates from approximately 4 AM to 1:30 AM during weekdays. Table 2.14 provides a summary of service characteristics.

Table 2.14. Bus Service on the Katella Avenue Corridor

Route	Route Limits	Distance (Miles)	Stop Spacing	Frequency (Minutes)*	Hours of Operation	Run Time (mins.)
50 (WB)	The Village at Orange to 7th St/Channel Dr	20	0.2-0.35	15, 30, 60	4:34 am - 11:27 pm	90- 100
50 (EB)	7th St/Channel Dr to The Village at Orange	20	0.2-0.35	15, 30, 60	3:55 am- 11:37 pm	90-100

**Service frequency is 15 minutes during peak hours.*
WB = Westbound
EB = Eastbound

OCTA also operates a limited-stop shuttle on weekdays between ARTIC and Walnut Street/Calle de las Estrellas outside of the Disneyland Hotel on the western edge of the Disneyland Resort.

Other Corridors

There is an extensive network of other OCTA bus lines in the study area, including local, express, and station connector services. Table 2.15 lists the routes that run through the study area. As noted previously, Harbor Boulevard intersects more than two dozen major east-west corridors.

Table 2.15. OCTA Transit Lines through Study Area

Route Type	Routes
Local/Fixed Routes	24: Fullerton – Orange via Chapman Avenue 26: Buena Park – Huntington Beach via Commonwealth Avenue 30: Cerritos – Anaheim via Orangethorpe Avenue 37: La Habra – Fountain Valley via Euclid Street 38: Lakewood – Anaheim Hills via La Palma Avenue 42: Seal Beach – Orange via Lincoln Avenue 43: Fullerton – Costa Mesa via Harbor Boulevard 46: Los Alamitos – Orange via Ball Road 47: Fullerton – Newport Beach via Anaheim Boulevard 50: Long Beach – Orange via Katella Avenue 54: Garden Grove – Orange via Chapman Avenue 56: Garden Grove – Orange via Garden Grove Boulevard 57/57X: Brea – Newport Beach via Bristol Street 60: Long Beach – Tustin via Westminster Avenue 64: Huntington Beach – Tustin via 1st Street 83: Anaheim – Laguna Hills Express via Manchester Avenue 543: Fullerton – Santa Ana via Harbor Boulevard 560: Santa Ana – Long Beach via Westminster Ave
Community Routes	103: La Habra Express via Harbor Boulevard 143: La Habra – Brea Mall via Harbor Boulevard
Intracounty Express	213: Brea – Irvine via Brea Boulevard
Stationlink	430: Anaheim Resort – ARTIC via Katella Avenue 454: Garden Grove – Orange Transportation Center via Chapman Avenue
Intercounty Express	757: Diamond Bar – Santa Ana via SR-57

2.4.2.2. Anaheim Resort Transportation

ART provides transit service to The Anaheim Resort, the Platinum Triangle, and Anaheim's downtown district, known as "CtrCity" Anaheim. ART also provides service to limited locations in other cities, including Garden Grove, Orange, Buena Park, Santa Ana, and Costa Mesa. There are 21 fixed route lines which originate from the Disneyland Resort Transportation Center. These routes travel to multiple destinations, retail districts, lodging establishments, and activity centers nearby. ART routes are listed and described in Table 2.16.

Table 2.16. ART Routes Through Study Area

Route	Destination
Harbor Boulevard Lines 1-2	Garden Grove Entertainment District, via Harbor Boulevard
Grand Plaza Lines 3/4/5	Anaheim Convention Center via Harbor Boulevard
Hotel Circle Clementine Lines 6/7/8	Anaheim Hotel Circle via Harbor Boulevard, Katella Avenue, and Manchester Avenue
Katella Line 9	Harbor Boulevard and westbound on Katella Avenue to Walnut Street
Downtown Packing District Line 10	Downtown Anaheim Packing District via Harbor Boulevard, Anaheim Boulevard, and Ball Road
Ball Road Line 11	Harbor Boulevard and Ball Road to Walnut Street
Manchester Ave Line 12	Harbor Boulevard, Katella Avenue, Haster Street, Orangewood Avenue, Manchester Way, and Disney Way
ARTIC Sports Complex Lines 14/15	Anaheim Convention Center, Angel Stadium of Anaheim, Honda Center, State College Boulevard, Outlets at Orange, and ARTIC
Orange Line 16	Garden Grove Entertainment District and The Outlets at Orange via Harbor Boulevard, Garden Grove Boulevard, The City Drive, and Chapman Avenue
Buena Park Line 18	Activity centers in Buena Park via Harbor Boulevard, Disney Way, Manchester Avenue, La Palma Avenue, and Beach Boulevard
Canyon Line 17/21	Anaheim Canyon Metrolink Station via Harbor Boulevard, Ball Road, SR-57, and La Palma Avenue
Santa Ana Line 19	Activity centers in Santa Ana via Harbor Boulevard, Orangewood Avenue, and Main Street
Toy Story Line 20	Toy Story Transportation Center via Harbor Boulevard
Costa Mesa/ South Coast Plaza Line 22	Costa Mesa South Coast Plaza, via Harbor Boulevard, Chapman Avenue, Anaheim Way, SR-55, and Bristol Street

2.4.2.3. Metrolink and Amtrak

This study considers three multi-modal transportation hubs located within or near the study area: the Fullerton Transportation Center (FTC), the Anaheim Regional Transportation Intermodal Center (ARTIC), and the Santa Ana Regional Transportation Center (SARTC). Metrolink commuter rail services and Amtrak regional/national rail services can be accessed from each of these hubs. The FTC is located off Harbor Boulevard and provides transit connections to/from the college campuses located in Fullerton and to/from the jobs-dense Harbor corridor. ARTIC is located south of Angel Stadium of Anaheim off of Douglass Road. This study considers enhancements to connections between this station, which has been identified as a future potential California High Speed Rail station, and The Anaheim Resort, Angel Stadium of Anaheim, the Honda Center, and Anaheim's Platinum Triangle district. Finally, SARTC is located at East Santa Ana Boulevard and Penn Way in Santa Ana and provides access to Downtown Santa Ana and the Santa Ana Civic Center. Metrolink and Amtrak lines are listed below in Table 2.17. In 2020, the OC Streetcar project will also connect SARTC to a new terminus station at Harbor Boulevard.

Table 2.17. Commuter and Regional Rail Lines Through and Near Study Area

Route	Destination
Metrolink 91	Los Angeles to Riverside with stop at FTC
Metrolink Orange County Line	Los Angeles to Oceanside with stops at FTC, ARTIC, and SARTC
Metrolink Inland Empire Line	San Bernardino to Oceanside with stop at SARTC
Amtrak Southwest Chief	Los Angeles to Chicago with stop at FTC
Amtrak Pacific Surfliner	San Luis Obispo to Los Angeles to San Diego with stops at FTC, ARTIC, SARTC

2.4.2.4. Los Angeles County Metropolitan Transportation Authority

Additionally, the Los Angeles County Metropolitan Transportation Authority operates Local and Express Bus Route 460 between Downtown Los Angeles and The Anaheim Resort via local streets through southeastern Los Angeles County/northwestern Orange County and Interstate 5. Within the study area, Route 460 stops at the Disneyland Resort and at Manchester Avenue/Harbor Boulevard.

2.4.3. Active Transportation

2.4.3.1. Bicycle Transportation

Bicycle facilities are currently limited within the study area and nearly non-existent along Harbor Boulevard. Most of the existing bike lanes and paths within the study area run east to west along local roads in Fullerton and arterials in Garden Grove. In Anaheim, there are short segments of north-south running bike lanes along Anaheim Boulevard. The sparse bikeway network and few connections to transit reflects the auto-centric nature of the corridor when originally developed.

In recent years, several cities have proposed additions to the existing regional bikeway network. Anaheim, for example, is proposing several Class II[2] and III bikeways along east-west streets that connect CtrCity and the Colony Historic District. On the southern end of the study corridor, Garden Grove and Santa Ana are proposing several Class II and III facilities along Orangewood Avenue, Chapman Avenue, Lampson Avenue, and Westminster Avenue.

Santa Ana, in the *Harbor Mixed Use Transit Corridor Specific Plan* (October 2014), has identified conceptual roadway designs to improve its bikeway system. These include a Class II facility on Harbor Boulevard and on east-west running arterials like Westminster Avenue, Hazed Avenue, 5th Street, 1st Street, McFadden Avenue. Santa Ana is also proposing a Class I facility along the Pacific Electric Right-of-Way (which will also be utilized by the OC Streetcar). This bike path will connect the station at Harbor Boulevard and Westminster Avenue to the existing Class I Santa Ana River Trail. These additions would create a strong regional network throughout the study area.

Due to existing and projected traffic/transit volumes, however, this study does not currently recommend enhanced bicycle amenities along Harbor Boulevard outside of those under consideration by each corridor city.

2.4.3.2. Complete Streets

In May 2016, the Orange County Council of Governments completed the Orange County *Complete Streets Initiative Design Handbook*. The handbook establishes criteria to create a transportation network that serves all users by enhancing mobility choices and offering a variety of improvements that improve safety, health, environmental, financial, and social issues. With respect to the study area, the plan offers a variety of treatments to the different street typologies found within the study area.

2.4.4. Other Planned Projects and Studies

This section introduces the major planned projects and studies in the area that seek to improve mobility in this region.

2.4.4.1. OC Streetcar (In Design)

The Santa Ana-Garden Grove Fixed Guideway Project (also known as the "OC Streetcar"), is a $289 million, Measure M2-initiated, streetcar project scheduled to begin operations in 2020. The approximately 4-mile route will travel from SARTC to a new multimodal hub in Garden

[2] Bikeways are classified into three classes according to their interaction with auto travel lanes. A Class I facility, also referred to as a "Bike Path" provides a separated right-of-way for the exclusive use of bicycles and pedestrians with minimum cross-flow. A Class II facility, also referred to as a "Bike Lane," provides a striped lane for one-way bike travel on a street or highway. A Class III facility, also referred to as a "Bike Route," is a signed shared roadway that provides for shared use with pedestrians or motor vehicle traffic, typically on lower volume roadways. A bike route is only distinguishable by signs identifying it as such.

Grove on the northeast corner of Harbor Boulevard and Westminster Avenue. When completed, the project will provide first/last mile connections to Metrolink and Amtrak service at SARTC. The streetcar will travel along a combination of local streets and a dedicated ROW. The project is currently in the engineering and design phase and has achieved several milestones to date. The Revised Environmental Assessment/Final Environmental Impact Report was certified by the City of Santa Ana in January 2015, and the Federal Transit Administration (FTA) approved a Finding of No Significant Impact in March 2015. In May 2015, the FTA also approved the project for entry into project development.

2.4.4.2. Fullerton College Connector (Feasibility Study)

The Fullerton College Connector Feasibility Study evaluated the opportunities, challenges, and costs associated with implementing an "urban circulator" system between Downtown Fullerton/FTC and numerous educational institutions (most notably Fullerton College and CSUF) located northeast of Downtown Fullerton. The study, initiated by the City of Fullerton, developed numerous alternatives for enhanced transit service primarily along Commonwealth Avenue and/or Chapman Avenue. Transit technologies considered in the study consisted of light rail, streetcar, heritage/historic streetcar, and rubber-tire or hybrid buses on a combination of mixed-flow traffic and dedicated lanes. Total projected capital costs for implementation ranged from $140-$173.8 million.

2.4.4.3. Central County Corridor Major Investment Study (Planning Document)

The 2010 *Central County Corridor Major Investment Study* helped establish a long-term transportation vision by studying the need for strategic investments that address current and future mobility problems in central Orange County through 2035. The study resulted in a consensus on a multimodal strategy that includes improvements to arterials, freeways, bus, and rail transit. Proposed specific improvements range from arterial and intersection optimization/widening, additional high-occupancy vehicle lanes and interchanges to local freeways, enhanced connections to Metrolink/Amtrak passenger rail, investment in community-based shuttles (e.g., ART), the development of high-capacity fixed-guideways in Anaheim (ARC) and Santa Ana/Garden Grove (OC Streetcar), and substantial improvements to local bus service in conjunction with the implementation of six BRT routes (including Harbor Boulevard and Katella Avenue). The study also suggested an intersection improvement feasibility study for the intersection of Harbor Boulevard and Ball Road.

2.4.4.4. Anaheim Rapid Connection

The City of Anaheim's "ARC" project evaluated a fixed guideway connection along a 3.2-mile corridor between The Anaheim Resort and ARTIC. The project was intended to serve the major job and activity centers in The Anaheim Resort (i.e., the Anaheim Convention Center, the Disneyland Resort, and Anaheim GardenWalk) and provide a direct connection to ARTIC. On October 24, 2016, the OCTA Board of Directors and the City of Anaheim agreed to discontinue

planning efforts for the ARC, and instead evaluate transit connections between The Anaheim Resort and ARTIC as part of this study.

Implications

The projects listed above indicate a willingness from local municipalities and OCTA to make significant investments in transportation improvements on or near Harbor Boulevard. These enhanced transit options are essential to improving quality of life for residents, workers, and visitors alike.

In Fullerton, the FCC seeks to enhance connections between CSUF and Downtown Fullerton. In Santa Ana and Garden Grove, the OC Streetcar will enhance connections to SARTC, Downtown Santa Ana's Civic Center, and the proposed developments on Harbor Boulevard and Westminster Avenue. In Anaheim, this study will examine options to provide a direct connection between ARTIC and The Anaheim Resort.

2.5. TRAVEL MARKET ASSESSMENT

2.5.1. Existing Commute Flow

This section describes existing commute patterns into, within, and outside of the study area.

2.5.1.1. Jobs

The study corridors are some of the busiest and densest transit corridors in all of Orange County. Harbor Boulevard averages over 12,000 daily boardings, the Anaheim Boulevard/Lemon Street corridor averages an additional 9,000 daily boardings, while Katella Avenue averages over 4,000 daily boardings. The great majority of trips on these routes are commute-related: home-to-work and home-to-school trips. Thus, people who both reside and work/study within the study, in particular, stand to benefit from transit improvements.

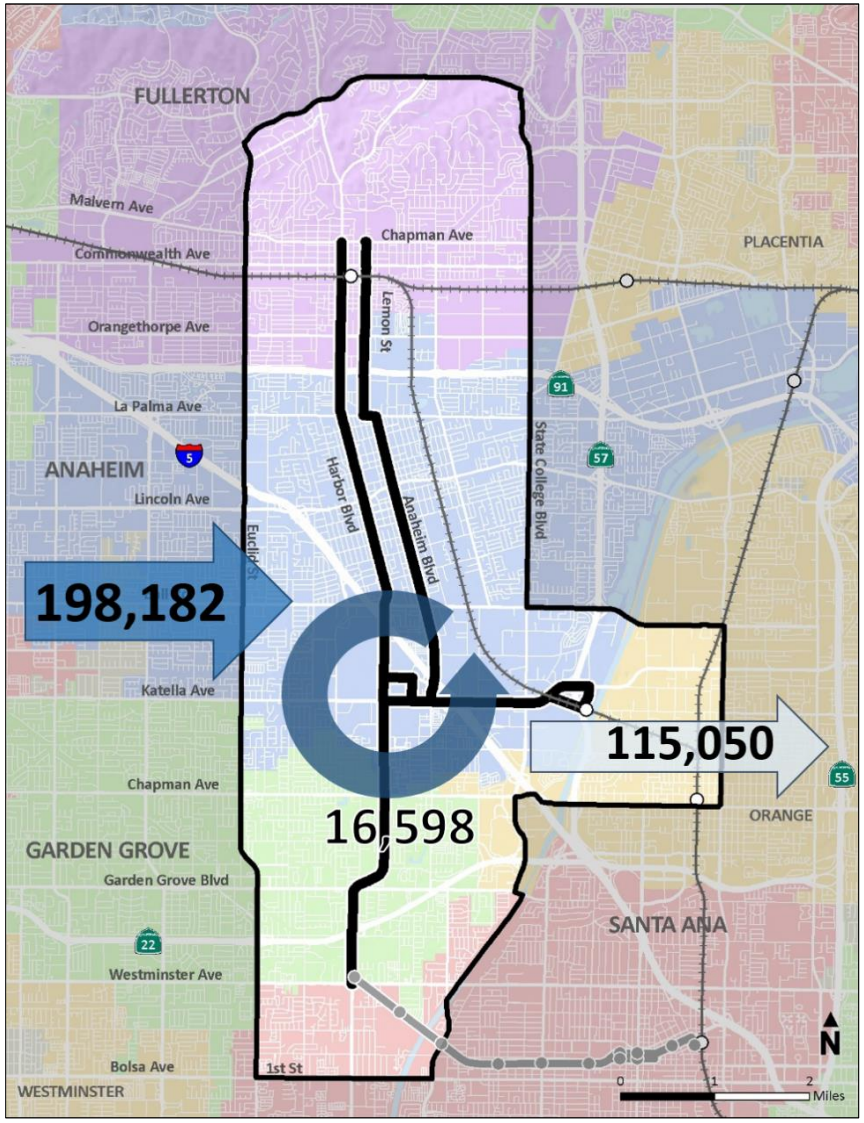
In addition to the demographics listed in section 2.3, sudy area commute patterns, as shown on Figure 2.12 on the next page, suggest that the study area has a greater concentration of jobs than housing. In 2013, according to the U.S. Census Bureau's Longtitudinal Employment-Household Dynamics program, approximately 198,182 people commuted into the study area each day, while over 115,000 commuted to areas outside of the study area for work. In the same year, only 16,598 both lived and worked in the study area.

2.5.1.2. Activity Centers

The study corridors provide connections to many local and regional activity centers and three major transportation hubs. Figure 2.13 on the next page displays the distribution of activity centers throughout the study area. Along Harbor Boulevard, a significant number of transfers occur at the FTC, La Palma Avenue, Lincoln Avenue, Katella Avenue, and Westminster Avenue. La Palma Avenue and Lincoln Avenue in the northern half of the study area, in particular, along with Westminster Avenue on the southern end, experience high volumes of transfers on the eastern edge of the study corridor at State College Boulevard (for La Palma and Lincoln Avenue) and Fairview Street at Westminster Avenue.

Therefore, improvements to the frequency and quality of transit service in the study area, as designated under OCTA's *2016 Service Plan* (approved February 2016), would provide benefits to passengers transferring to/from east-west corridors. According to the Plan, frequencies along several key east-west routes would be elevated to 15 minutes or less, or similar to Bravo! (12 minutes during peak hours). Frequencies along local routes 26 (Commonwealth Avenue), 50 (Katella Avenue), 54 (Chapman Avenue [South]) will be upgraded to 15 minutes during peak hours. OCTA's second Bravo! line (Route 560) travels along Westminster Avenue with a peak-hour frequency of 12 minutes. Changes outlined in the Plan went into effect in the summer and fall of 2016.

Figure 2.12. Study Area Commute Patterns



Source: LEHD, U.S. Census 2013: Kittelson & Associates, 2015

Figure 2.13. Study Area Activity Centers

Source: STV, 2016

2.5.2. Commute Mode Share

The vast majority of workers in the study area commute by driving alone. Carpooling and bus transit appear to be the other major means of transportation to work (comprising nearly 20 percent overall) while walking and working from home are the only other modes above one percent. Commute mode choice percentages are shown by corridor city in Table 2.18 below.

Table 2.18. Means of Transportation to Work by Sub-Area*

Corridor Area	Drive Alone	Carpool	Transit	Bike	Walk	Other Means	Worked at Home
Fullerton	75.9%	12.1%	4.0%	1.2%	3.2%	0.4%	3.2%
Anaheim	70.1%	15.9%	6.5%	1.3%	2.5%	1.0%	2.7%
Garden Grove	73.8%	12.8%	7.0%	1.4%	2.4%	1.0%	1.6%
Santa Ana	75.6%	13.3%	5.1%	1.0%	2.2%	1.2%	1.7%
Total	73.0%	14.5%	5.4%	1.2%	2.5%	1.0%	2.4%
Orange County	78.0%	10.1%	2.8%	1.0%	2.0%	1.1%	5.0%

Source: Kittelson & Associates, 2015; US Census Bureau, ACS 5-Year Estimates, 2009-2013.

** For residents living along the corridor, the most recent 5-year estimates from the American Community Survey (ACS) were used based on the 5-year period of 2009 to 2013. Sub-areas in Table 2.18 correspond with the following boundaries:*

a. Fullerton: From Commonwealth Avenue to the City of Fullerton/City of Anaheim border;
b. Anaheim: From the City of Fullerton/City of Anaheim border to Katella Avenue;
c. Garden Grove: From Katella Avenue to Westminster Boulevard; and,
d. Santa Ana: From Westminster Boulevard to 1st Street.

2.6. ROADWAY INFRASTRUCTURE

2.6.1. Roadway Configuration/Constraints

Harbor Boulevard becomes progressively narrower as it continues northward from Garden Grove and The Anaheim Resort. While traffic and transit service implications were described in Section 2.2, it is worth noting that there is on-street parking in the narrowest parts of the corridor and only a handful of bus turnouts. Consideration may be given to the appropriateness of on-street parking, particularly in already constrained areas. Table 2.19 lists the number of travel lanes throughout the study area.

Table 2.19. Number of Travel Lanes per Section of Harbor Boulevard

	City	Segment	SB/WB Lanes	NB/EB Lanes
Harbor Boulevard	Fullerton	N Chapman Avenue to Orangethorpe Avenue	2	2
		Orangethorpe Avenue to SR-91	3	3
	Anaheim	SR-91 to La Palma Avenue	2	3
		La Palma Avenue to Vermont Avenue	2	2
		Vermont Avenue to Ball Road	3	3
		Ball Road to I-5	4	4
		I-5 to S Chapman Avenue	3	3
	Garden Grove	S Chapman Avenue to Westminster Avenue	3	3
Anaheim Boulevard/ Lemon Street	Fullerton	N Chapman Avenue to SR-91 (WB Ramps)	2	2
		SR-91 (WB Ramps) to SR-91 (EB Ramps)	3	2
	Anaheim	SR-91 – La Palma Avenue	2	2
		La Palma Avenue to Center Street	2	2
		Center Street to Broadway	2	3
		Broadway to Winston Road	2	2
		Winston Rd to Cerritos Avenue	3	2
		Cerritos Avenue to Katella Avenue	3	3
Katella Avenue	Anaheim	Euclid Avenue to Manchester Avenue	3	3
		Manchester Avenue to Anaheim Way	4	4
		Anaheim Way to Lewis Street	3	3
		Lewis Street to State College Boulevard	4	4
		State College Boulevard to Stadium Crossing	3	4
		Stadium Crossing to Glassell Street	3	3

Source: STV, 2015
NB = Northbound
SB = Southbound
EB = Eastbound
WB = Westbound

As lane configurations change, overall transit performance and vehicle traffic speeds are affected due to a number of areas where the road widens/narrows and conflicts with other vehicles. A more consistent roadway configuration could help ease some of the conflicts between motorists and transit vehicles.

Katella Avenue consistently varies between three and four lanes as it extends between Euclid Avenue and Glassell Street. In contrast to the Anaheim Boulevard/Lemon Street corridor, on-street parking is not permitted through this segment of Katella Avenue. Moreover, the presence of median strips and a frontage road (west of Harbor Boulevard) likely suggests that any delays to transit service are not largely attributable to the varying roadway width or conflicts with parked or turning vehicles.

2.7. USER EXPERIENCE

One mobility problem specific to transit is user experience, which includes user perceptions as well as the physical conditions of transit stops. In addition to optimizing operations, strategies to improve transit ridership should also seek to improve stops and transfer procedures.

2.7.1. Stop Conditions

Land uses surrounding a station greatly influence transit ridership as denser and more walkable environments typically lead to higher transit usage. In addition to this, the conditions of the stops themselves, and the level of amenities they provide, have the potential to influence transit usage. Safety, comfort, and legibility of signage and information displays can influence a non-riders' willingness to use transit and encourage existing riders to continue to use the system. Stop conditions, as first discussed in the *Mobility Problem Definition Report* (April 2016) vary widely throughout the study corridors—ranging from a simple pole and concrete pad to bus stops with shelters, benches, and information displays. Accordingly, stops along the study corridors were classified into three categories based on their level of amenities present:

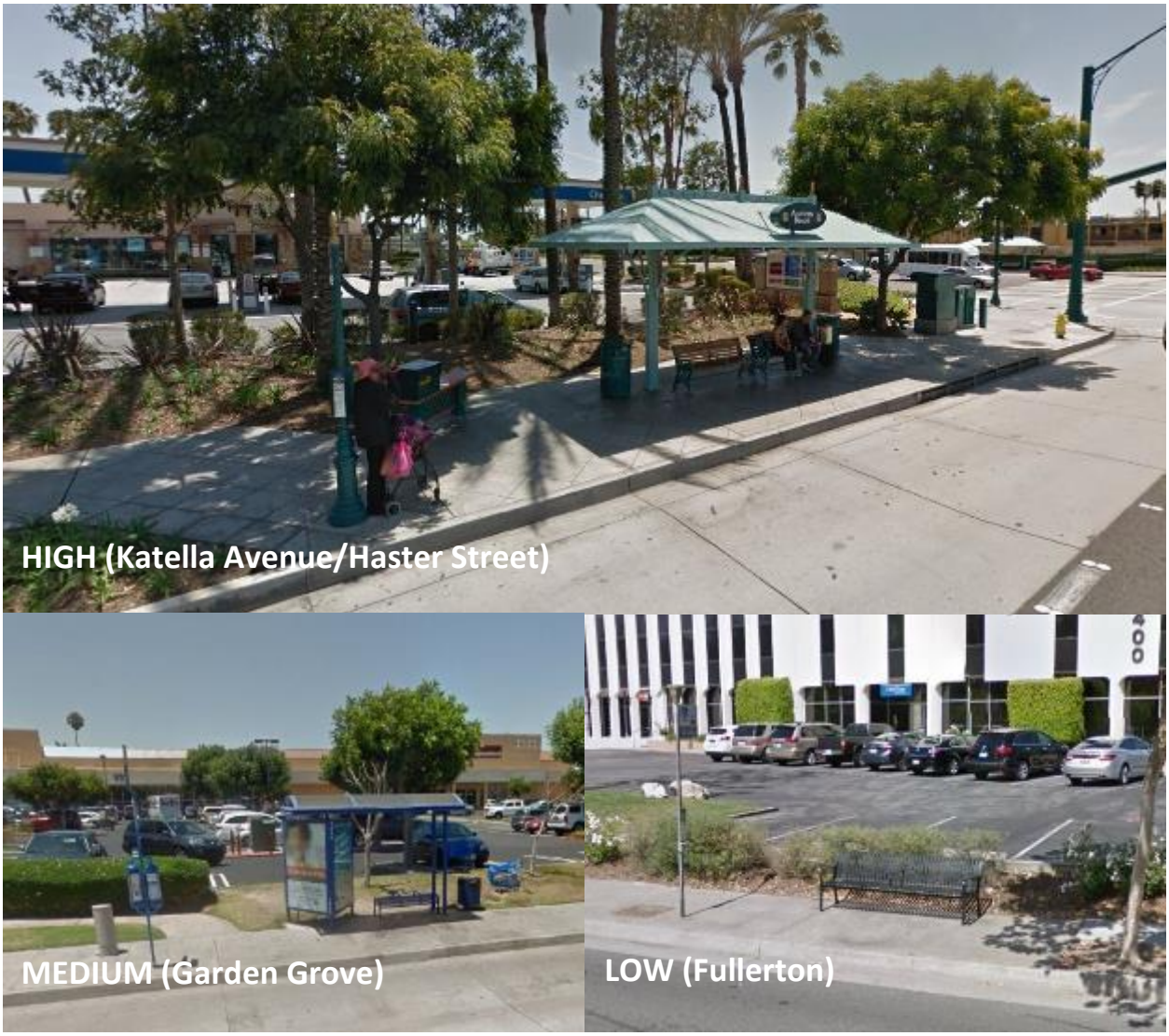
a) *High*
   Types of amenities include one or two large shade structures, each with two benches and two trash cans, route information, and additional signage. This type of stop serves both ART and OCTA service and is typically found in Anaheim.

b) *Medium*
   Types of amenities include a shade structure, bench, trash can, and route information. This type of stop is found along the study corridors, but with concentrations in Garden Grove and Fullerton.

c) *Low*
   This type of stop usually consists of a single pole. Concrete pads and benches are sometimes also included. This type of stop is found throughout the cities within the study corridors.

Figure 2.14 shows representative images of the different types of amenities found along the study corridors.

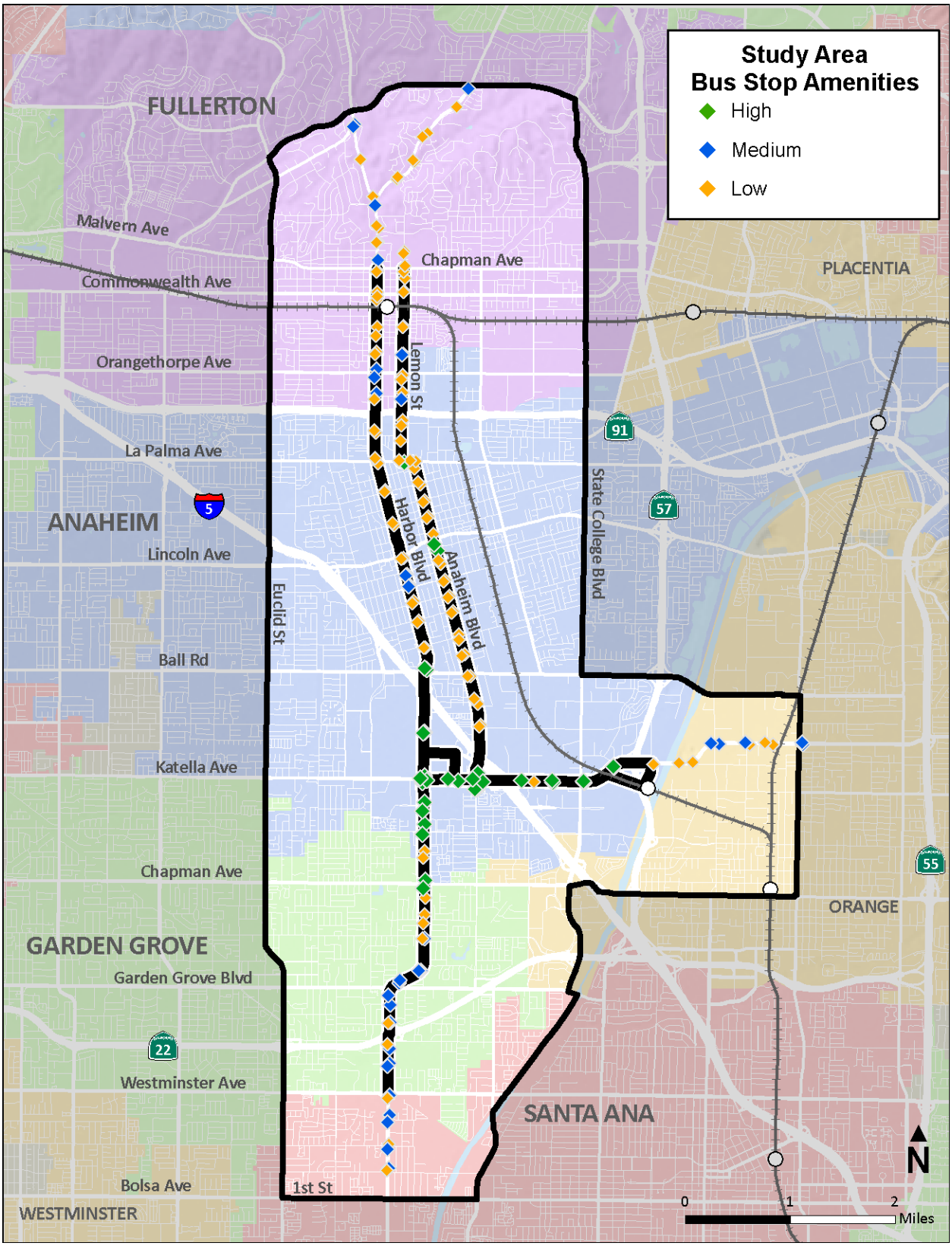
Figure 2.14. Sample Bus Stop Amenity Levels in Study Area



Source: Google Maps

Figure 2.15 shows the types of bus stops along the study corridors. The types of stops generally correlate with the surrounding land use or location/proximity to a particular district. Stops with the highest level of amenities are located within The Anaheim Resort or nearby. These stops are used by OCTA and ART buses to promote the Anaheim Resort brand.

Figure 2.15. Amenity Level per OCTA Bus Stop



Source: STV, 2016

2.8. MOBILITY PROBLEMS

From the preceding analysis in this section, six general "problem statements" were developed for the study area. These statements describe transportation- and mobility-related issues within the study area.

1) *Transit and Roadway Performance*: Traffic conditions limit the speed and reliability of transit service.
    a. LOS is generally poor in the study area and will likely continue to deteriorate as population and employment grow. With average transit travel speeds during peak hours around 10 mph, modifications to operations would have limited benefits due to external problems such as congestion.
2) *Land Use*: There are many existing land uses within the study area that are not easily or efficiently served by transit.
    a. The land use patterns along Harbor Boulevard vary and in general are not ideal for encouraging greater transit usage. Additionally, the auto-centric nature of the study area creates a heavy transportation and environmental impact burden on communities protected under Title VI of the Civil Rights Act of 1964.
3) *Connectivity*: Connections to/from major activity centers are difficult for many transit users.
    a. While there are three transportation hubs (FTC, ARTIC, and SARTC) within or just outside of the study area, connections between each of these and other key activity and employment centers throughout the study area are often cumbersome and inefficient. Poor transit connections, combined with uncompetitive travel times, make transit an unattractive option for many commuters.
4) *Corridor Constraints:* Constrained corridor infrastructure is mainly allocated to auto uses.
    a. With much of the study area currently developed, there is little room to expand roadways. Moreover, the space within the public ROW is mainly dedicated to general lanes for automobiles, with few, if any, transit-, bicycle-, and pedestrian-specific treatments.
5) *Mode Choices/User Experience*: Inconsistent user experience at transit stops can be confusing; for many study area trips, mode choices are limited.
    a. People's perceptions of transit can exert significant influence over their decision to use transit. With the exception of stops in The Anaheim Resort, the vast majority of stops in the study area are equipped with minimal amenities. Moreover, long transit trip times also negatively affect a person's decision to use transit (assuming that there are viable alternatives available). For many users, current transit service is simply not competitive with the automobile.

6) *Cost-Effectiveness*: Limited availability of transportation funding imposes a significant constraint on the design and extent of the final project.[3]

    a. Best practices suggest that significant consideration be given to an alternative that is cost-effective, makes the best use of local funding sources, and is attractive to outside funding sources. This does not require a project alternative to necessarily be the least costly of all alternatives.

The intent of this study is to define and evaluate transportation alternatives which best address the mobility problems listed above. Therefore, the evaluation criteria goals listed in Section 4.1. were developed in accordance with the mobility problem statements in this section.

[3] Although not a mobility problem in and of itself, "Cost-Effectiveness" will be analyzed alongside mobility problems for its incorporation of industry best practices that allow OCTA to pursue cost effective and financially feasible projects to ensure the best use of public funds and assets.

3. CONCEPTUAL ALTERNATIVES

This section defines the four mode options, four corridor options, and twelve alternatives considered in this study, with the existing transit system serving as the "baseline" alternative for purposes of comparison.

Each proposed alternative consists of a unique combination of corridor and mode technologies and is therefore grouped into a different "corridor family" according to:

a) Mode: enhanced bus, streetcar, bus rapid transit (BRT), and "rapid streetcar."[4]
b) Corridor: Harbor Boulevard, Harbor Boulevard (South), Anaheim Street/Lemon Boulevard, and Katella Avenue (Figure 3.1).

Regardless of mode, corridor, and transitway configuration, each alternative includes a combination of premium features such as enhanced station amenities, off-board fare collection, and all-door boarding. See Table 3.1 for a summary of the twelve alternatives.

Section 3.1 of this report describes the four mode options considered in this study. Section 3.2 generally describes the four corridors evaluated in this study. Finally, section 3.3, lists and describes all 12 alternatives considered in this study.

3.1. MODE OPTIONS

This study considers a total of four mode options: "enhanced" bus, bus rapid transit, streetcar, and "rapid" streetcar.

3.1.1. Enhanced Bus

The "enhanced" bus mode is similar to existing buses operating on the majority of existing OCTA routes. This is a non-articulated bus that operates in shared traffic lanes and carries up to 70 people at once. This mode differs from existing local service, however, with enhancements at intersections (namely, signal priority and queue jump lanes) and at stops (enhanced amenities and ticket vending machines for off-board fare collection). As this option offers minimal enhancements, it is the least expensive to implement.

OCTA's Bravo! 543 line along Harbor Boulevard
Source: Flickr user "crown426."

[4] "Enhanced bus," in this study, refers to rubber-tire service without BRT features such as exclusive lanes. "Rapid Streetcar" is defined as a streetcar with the added benefit of exclusive lanes and other premium features.

3.1.2. Bus-Rapid Transit (BRT)

BRT includes the intersection and stop enhancements listed above, but also operates within a dedicated bus-only lane.[5] This offers operational benefits that allow BRT to perform better than normal bus service. This mode also carries a greater number of people (up to 120) on a longer, 60-foot articulated bus. BRT is more expensive than enhanced bus due to higher capital and operational costs associated with a dedicated ROW and longer vehicles.

The HealthLine BRT in Cleveland, OH
Source: Flickr user John Greenfield.

3.1.3. Streetcar

Streetcars travel in shared traffic lanes on a track embedded in the roadway while being powered by overhead lines via a pantograph affixed to the top of the vehicle. In addition to the intersection and stop features listed under enhanced bus and BRT, streetcar vehicles allow riders to easily board from rear or front doors.[6] Streetcars can also carry up to 150 people (three times as much as regular buses). This mode incurs greater costs than BRT.

The South Lake Union streetcar in Seattle, WA
Source: The Seattle Times.

3.1.4. Rapid Streetcar

"Rapid" streetcars offer premium streetcar service within a dedicated transit lane, operating similar to a light rail line. In addition to the features listed under streetcar, a rapid streetcar offers faster travel times because it operates in a dedicated lane. As this option offers the highest quality of service among the four options listed in this study, it is also the most expensive option to construct and operate.

The TRAX Green Line in Salt Lake City, UT
Source: Flickr user "Garrett."

[5] For the purposes of modeling alternatives in this study, all dedicated travel lanes are assumed to be side-running and curb-adjacent. Actual service may operate in a combination of mixed-flow and dedicated lanes.
[6] Study does not preclude bus modes from also offering all-door boarding.

3.2. CORRIDORS

This study considers four general corridor options across numerous alternatives and their respective alignments. The four corridor options are represented in Figure 3.1.

a) *Harbor "South"* (denoted in green)
Extends north-south from Disney Way in The Anaheim Resort to the intersection of Harbor Boulevard and Westminster Avenue—western terminus of the future OC Streetcar.

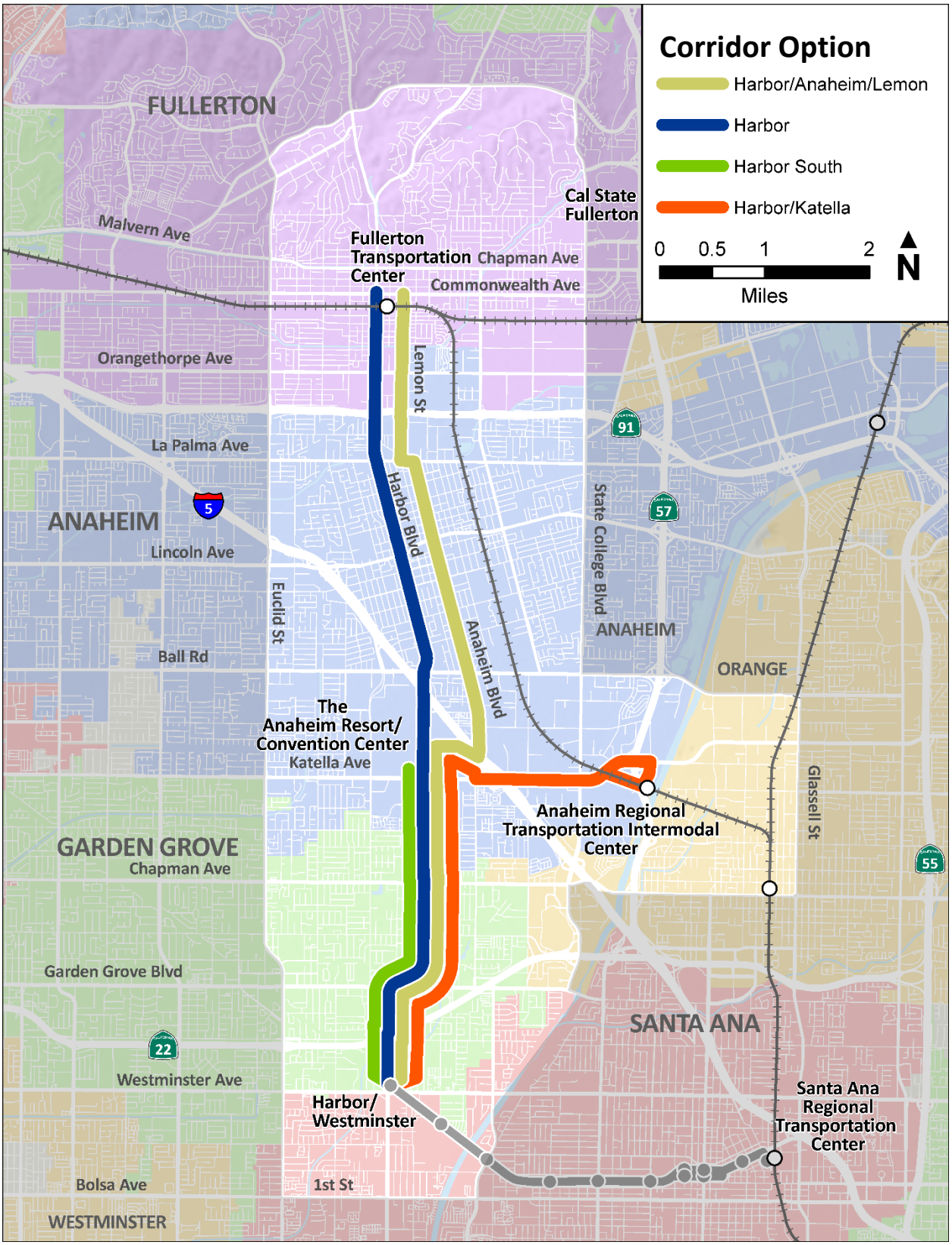
b) *Harbor* (denoted in blue)
Extends north-south from the FTC in Downtown Fullerton, through The Anaheim Resort, to the intersection of Harbor Boulevard and Westminster Avenue—western terminus of the future OC Streetcar.

c) *Anaheim Boulevard/Lemon Street* (denoted in gold)
Extends north-south from the FTC to Disney Way-Manchester Avenue via Anaheim Boulevard (corridor travels east-west for a short segment of La Palma Avenue between Lemon Street and Anaheim Boulevard), and from Disney Way-Manchester Avenue to Westminster Avenue via Harbor Boulevard—western terminus of the future OC Streetcar.

d) *Katella* (denoted in Orange)
Extends north from Harbor Boulevard and Westminster Avenue to The Anaheim Resort, then east to ARTIC via Disney Way, Clementine Street, Katella Avenue, and Douglass Road/the existing Los Angeles-San Diego-San Luis Obispo (LOSSAN) Rail corridor.

With the exception of alternatives along the Katella Corridor, all alternative alignments generally travel along the same path of their respective corridor as depicted in Figure 3.1.

Figure 3.1. The Four Corridor Options



Source: STV, 2017

3.3. 12 ALTERNATIVES

This section introduces the 12 alternatives analyzed in this report. This section contains a brief description of each alternative accompanied by a general overview map. Detailed alignment drawings for all alternatives are available in Appendix A.

3.3.1. Baseline/No-Build Alternatives

OCTA operates numerous north-south and east-west crossing routes through the study area. The pertinent routes to this study are the local and express routes that currently operate along the study corridors illustrated in Figure 3.1. These include:

a) *Route 43*
Fullerton to Costa Mesa via Harbor Boulevard.

b) *Route 47/A*
Fullerton to Balboa via Anaheim Boulevard/Fairview Street.

c) *Route 50*
Long Beach to Orange via Katella Avenue.

d) *Bravo! 543*
Fullerton Transportation Center to Santa Ana via Harbor Boulevard.

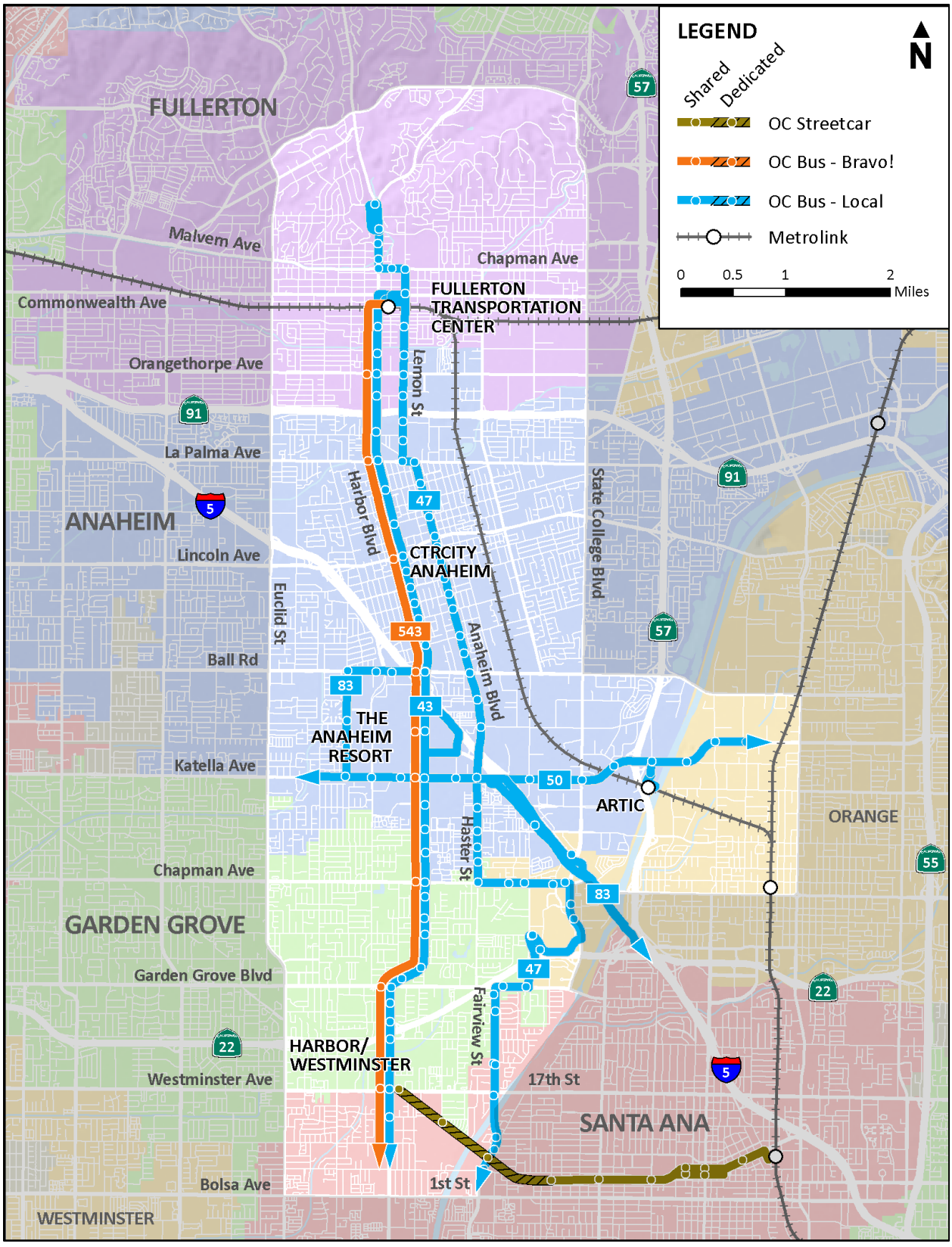
Additionally, the future OC Streetcar will connect the southern termini of a project alternative at Harbor Boulevard and Westminster Avenue to SARTC.

These routes represent baseline conditions that would remain under a “no-build” project scenario.

Table 3.1. Draft Alternatives

	Alternative	Mode	Transitway	Stop Spacing	Potential Features
	No-Build	-	-	-	-
H	**H-1:** Harbor Short Streetcar	Streetcar	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
H	**H-2:** Harbor Long Streetcar	Streetcar	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
H	**H-3:** Harbor Rapid Streetcar	Rapid Streetcar	Dedicated	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
H	**H-4:** Harbor Enhanced Bus	Bus	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
H	**H-5:** Harbor BRT	BRT	Dedicated	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
L	**L-1:** Anaheim-Lemon Streetcar	Streetcar	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
L	**L-2:** Anaheim-Lemon Rapid Streetcar	Rapid Streetcar	Dedicated	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
L	**L-3:** Anaheim-Lemon Enhanced Bus	Bus	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
L	**L-4:** Anaheim-Lemon BRT	BRT	Dedicated	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
K	**K-1:** Harbor-Katella Streetcar	Streetcar	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
K	**K-2:** Katella + Anaheim-Lemon Enhanced Bus	Bus	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding
K	**K-3:** Katella + Harbor Hybrid	Bus/ Streetcar	Shared	3/4-mile	Curb-Running, Station Amenities, Off-Board Fare Pay, All-Door Boarding

Figure 3.2. Baseline/No-Build Alternative



Source: STV, 2016

3.3.2. Harbor Boulevard Alternatives

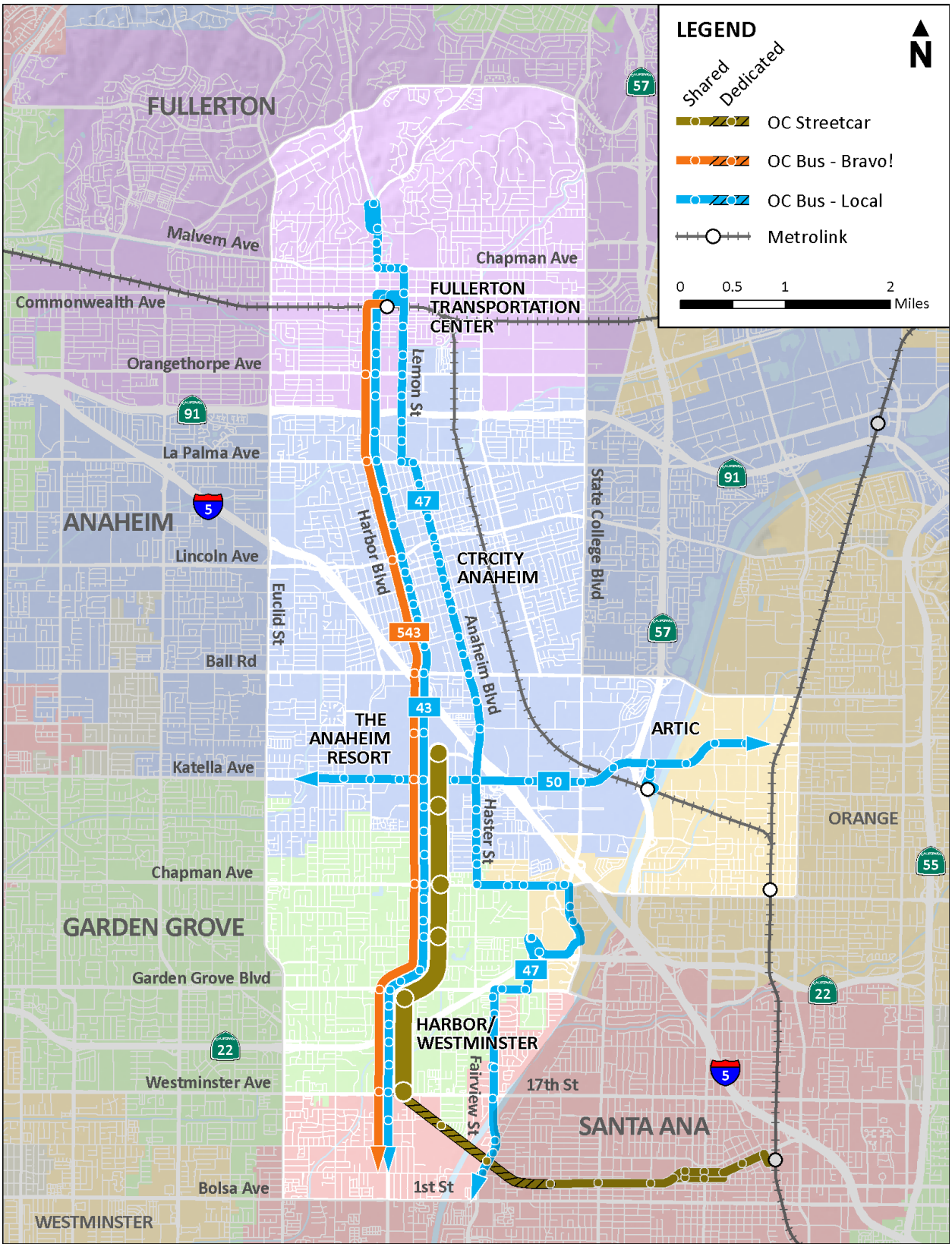
3.3.2.1. H-1: Harbor Short Streetcar

Alternative H-1: *Harbor Short Streetcar* would travel north to south along Harbor Boulevard between Disney Way in Anaheim and Westminster Avenue in Garden Grove. The approximately 3.4-mile streetcar alignment would operate in a shared traffic lane with other vehicles and stop at major arterials generally spaced 0.75-1.0 miles apart.

This alternative would function as a northward extension of the future OC Streetcar currently in development in Santa Ana and would provide a direct connection between SARTC and key activity centers at The Anaheim Resort. This alternative would operate in a shared traffic lane within the existing ROW.[7] Consequently, existing OCTA transit service along Harbor Boulevard (Bravo! 543 and local Route 43) would remain unchanged.

[7] Potential modifications to ROW in shared transitway configuration may include queue jump lanes and turnouts at stops.

Figure 3.3. Alternative H-1: Harbor Short Streetcar



Source: STV, 2016

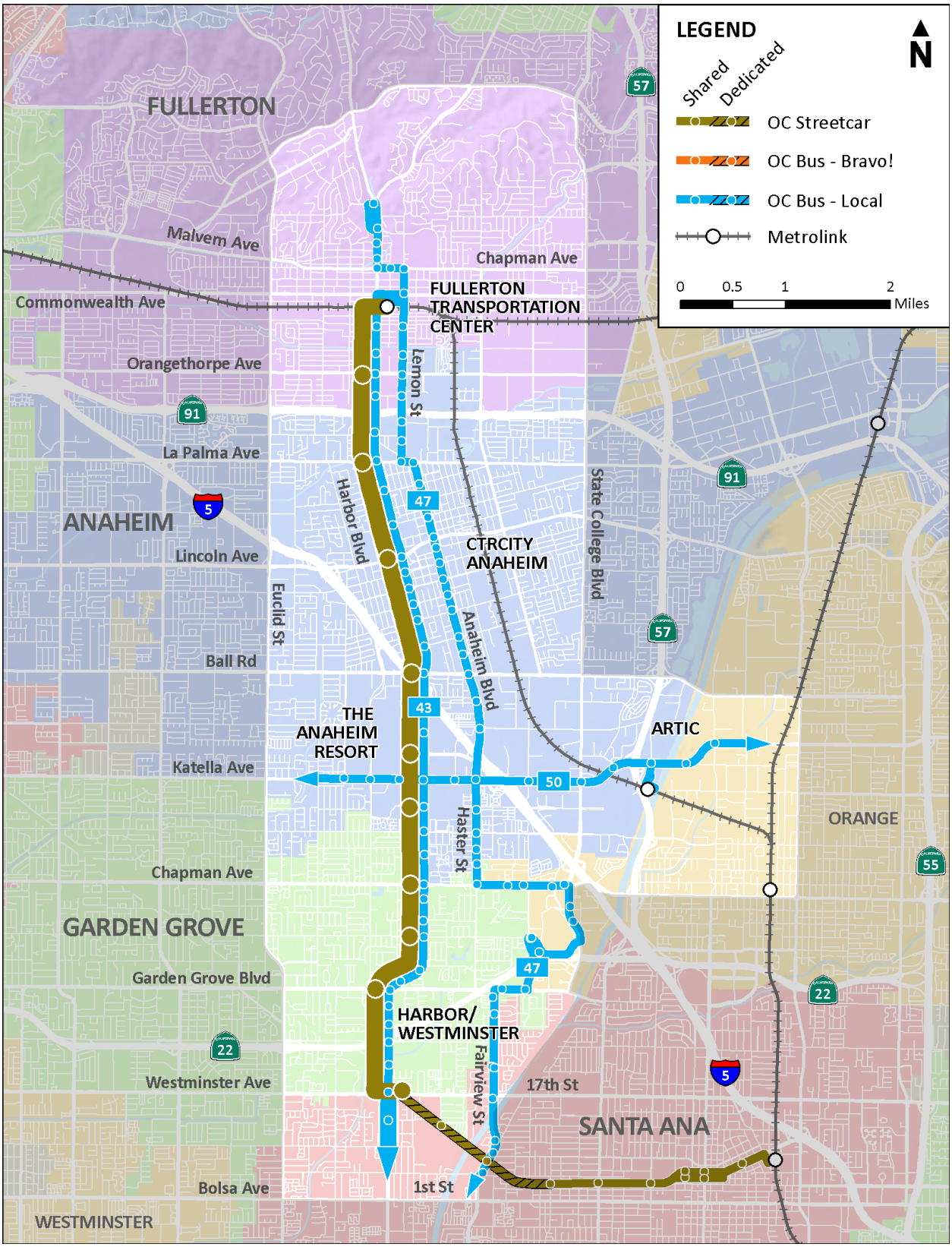
3.3.2.2. H-2: Harbor Long Streetcar

Alternative H-2: *Harbor Long Streetcar* would travel north to south along Harbor Boulevard between the FTC in Fullerton and Westminster Avenue in Garden Grove. The approximately 8-mile streetcar alignment would operate in a shared traffic lane with stops at major east-west arterials generally spaced 0.75-1.0 miles a mile apart.

This alternative would function as a northward extension of the future OC Streetcar and would provide a direct connection between SARTC, key activity centers at The Anaheim Resort, and the FTC. This alternative would operate in a shared traffic lane within the existing ROW.[8] To avoid duplication of service, OCTA will offer enhanced service on Route 43 south of Westminster Avenue in lieu of Bravo! 543, which will be discontinued under this alternative.[9]

[8] See footnote 7 for potential ROW implications.
[9] Bravo! 543 currently operates between the FTC and MacArthur Boulevard in Santa Ana during peak weekday travel periods.

Figure 3.4. Alternative H-2: Harbor Long Streetcar



Source: STV, 2016

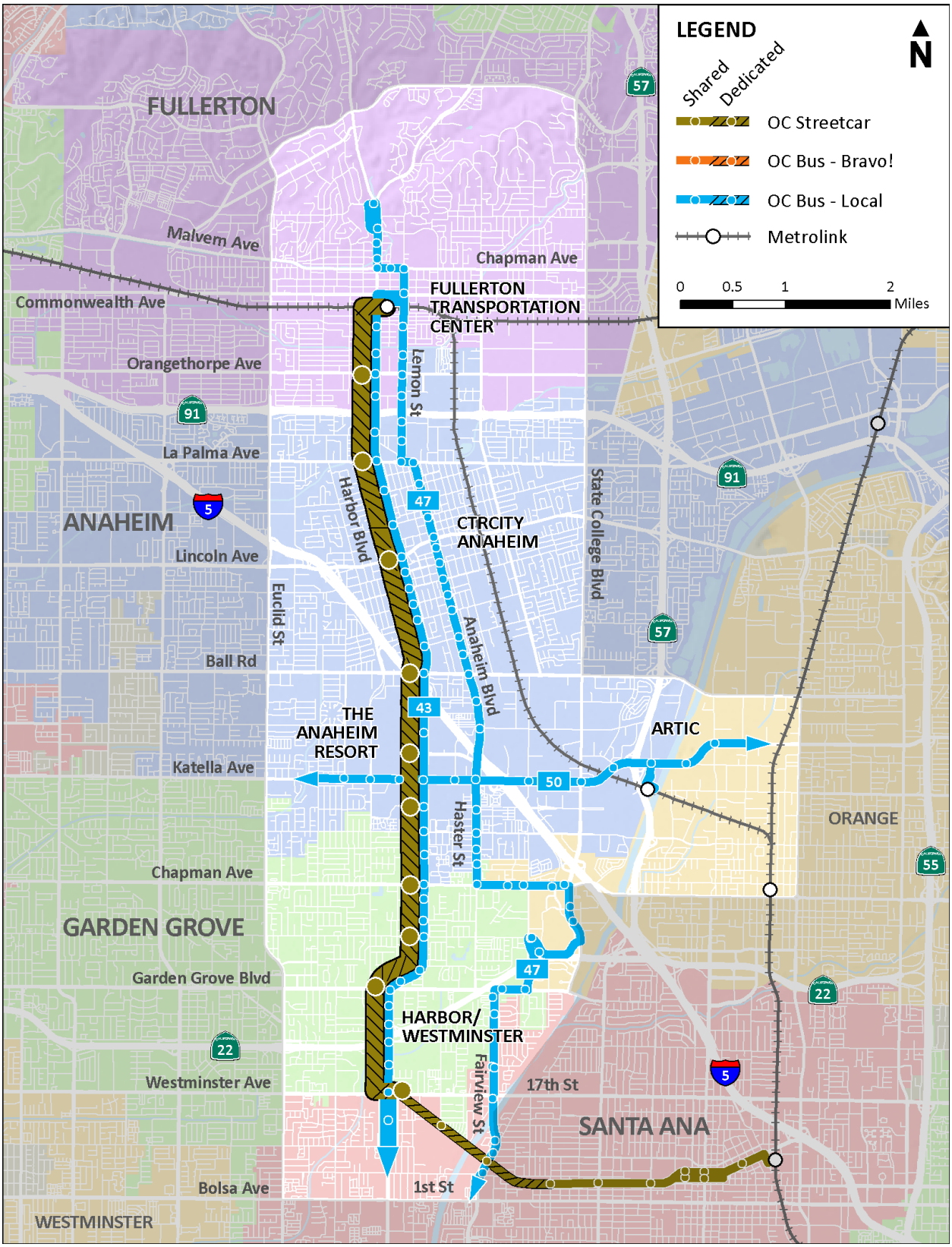
3.3.2.3. H-3: Harbor Rapid Streetcar

Alternative H-3: *Harbor Rapid Streetcar* would travel north to south along Harbor Boulevard between the FTC in Fullerton and Westminster Avenue in Garden Grove. The approximately 8-mile streetcar alignment would operate in a dedicated transit lane with stops at major east-west arterials generally spaced 0.75-1.0 miles apart.

This alternative would function as a northward extension of the future OC Streetcar and would provide a direct connection between SARTC, key activity centers at The Anaheim Resort, and the FTC. This alternative would operate in a dedicated transit lane for much of the alignment.[10] Similar to Alternative H-2, OCTA would offer enhanced service south of Westminster Avenue in lieu of Bravo! 543, which would be discontinued under this alternative.

[10] This alternative was modeled with the assumption that the entire length of the route will operate in a dedicated transit lane. Actual service may operate in a combination of both mixed-flow and dedicated travel lanes.

Figure 3.5. Alternative H-3: Harbor Rapid Streetcar



Source: STV, 2016

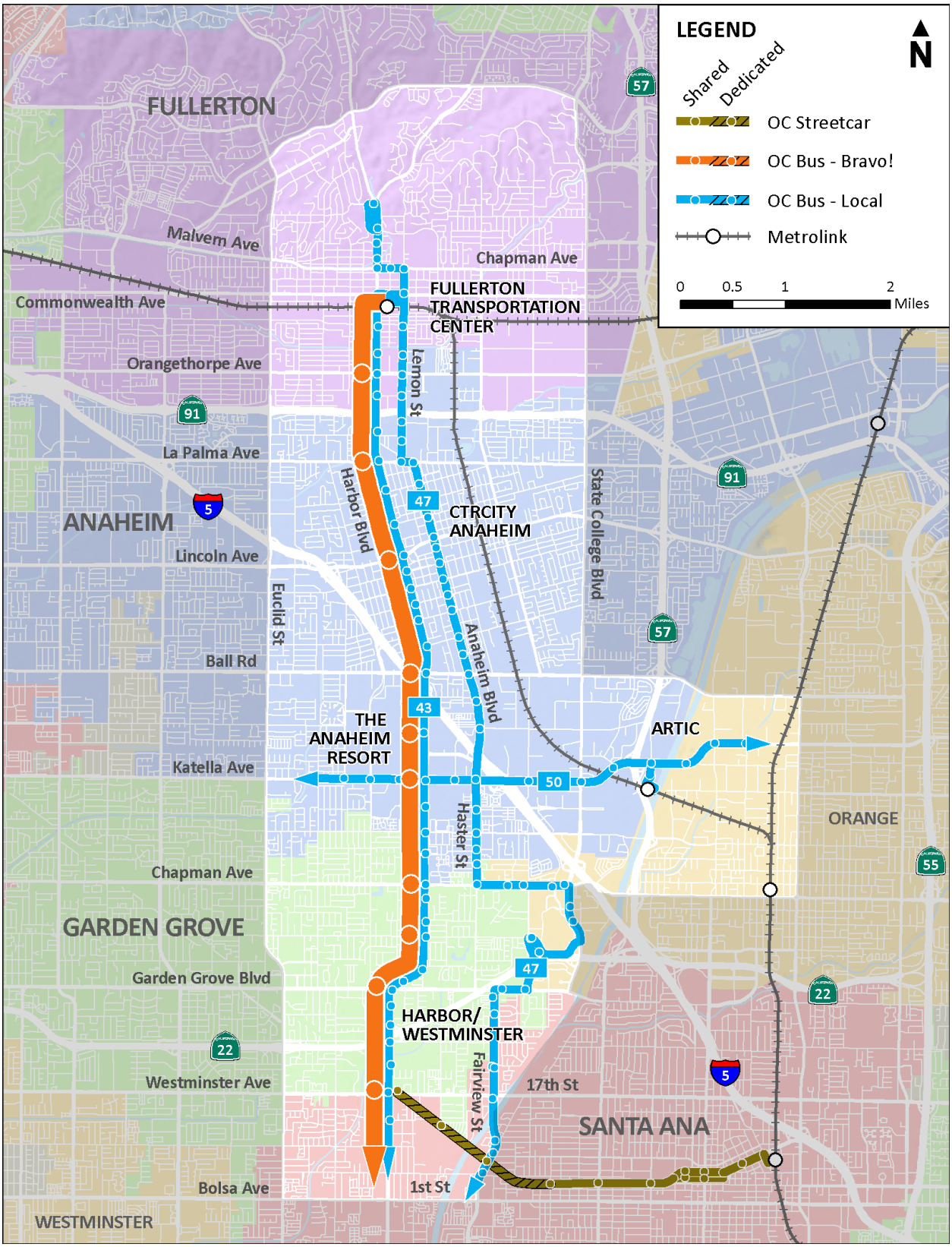
3.3.2.4. H-4: Harbor Enhanced Bus

Alternative H-4: *Harbor Enhanced Bus* would travel north to south along Harbor Boulevard between the FTC in Fullerton and MacArthur Boulevard in Santa Ana—the current southern terminus of Bravo! 543. Similar to the existing Bravo! 543, the approximately 12-mile bus alignment would operate in a shared traffic lane with stops at major east-west arterials generally spaced 0.75 to 1.0 miles apart.

This alternative would provide a connection to the future OC Streetcar project and provide a direct connection between a future OC Streetcar transfer point at Harbor Boulevard and Westminster Avenue, key activity centers at The Anaheim Resort, and the FTC. This alternative would operate in a shared traffic lane within the existing ROW.[11] This alternative would function as an enhanced Bravo! 543 and would not affect existing transit service along Harbor Boulevard south of Westminster Avenue.

[11] See footnote 7 for potential ROW implications.

Figure 3.6. Alternative H-4: Harbor Enhanced Bus



Source: STV, 2016

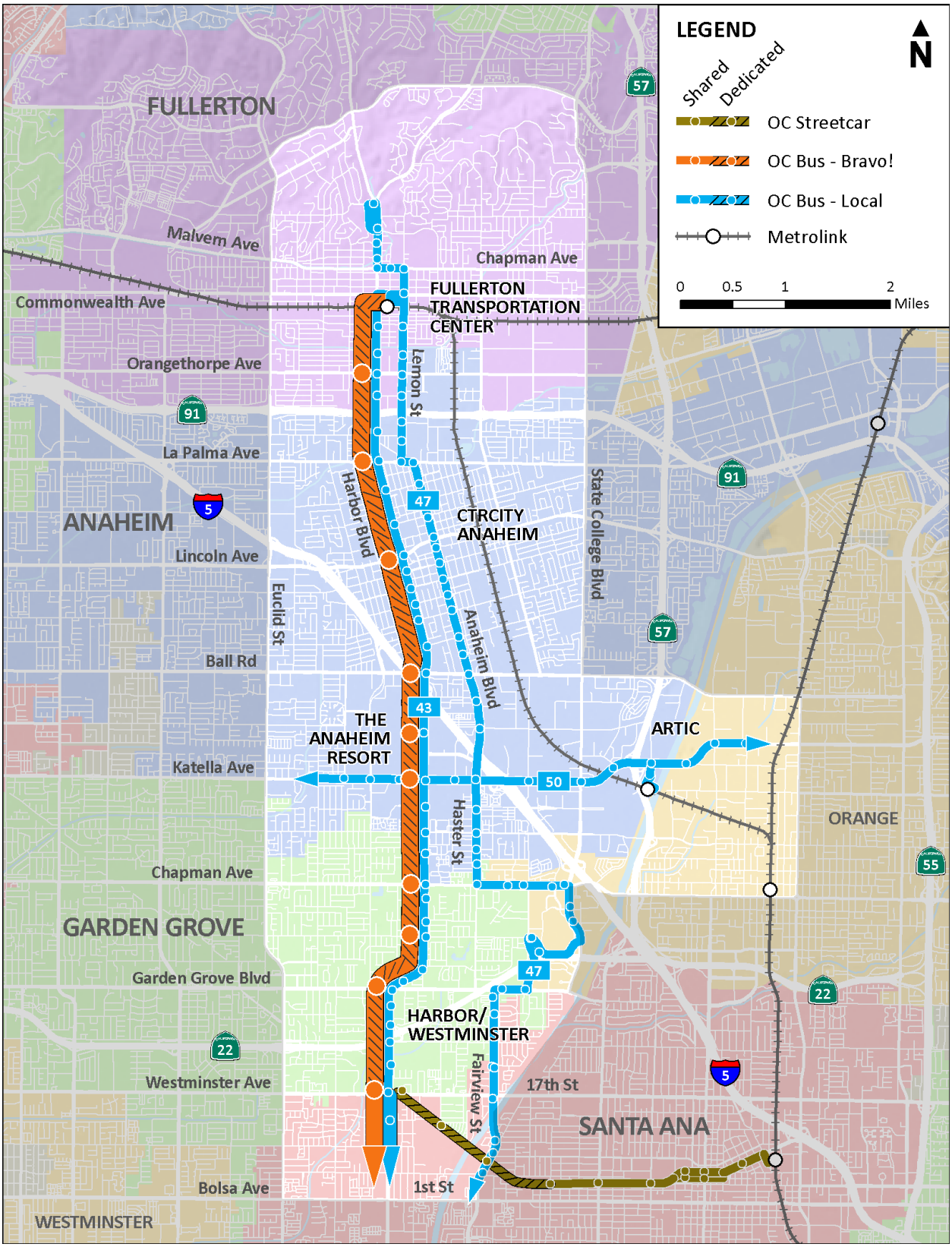
3.3.2.5. H-5: Harbor BRT

Alternative H-5: *Harbor BRT* would travel north to south along Harbor Boulevard between the FTC in Fullerton and MacArthur Boulevard in Santa Ana—the current southern terminus of Bravo! 543. The approximately 12-mile Bus Rapid Transit alignment would operate in a dedicated transit lane between FTC and Westminster Avenue, with stops at major east-west arterials generally spaced 0.75-1.0 miles a mile apart.

This alternative would provide a connection to the future OC Streetcar and a direct connection between a future OC Streetcar transfer point at Harbor Boulevard and Westminster Avenue, key activity centers at The Anaheim Resort, and the FTC. This alternative would operate in a dedicated transit lane for much of the alignment.[12] Enhanced service south of Westminster Avenue would support high-quality transit service in Santa Ana in lieu Bravo! 543 which would be discontinued under this alternative.

[12] See footnote 9 for potential ROW implications.

Figure 3.7. Alternative H-5: Harbor Bus Rapid Transit



Source: STV, 2016

3.3.3. Anaheim Boulevard/Lemon Street Alternatives

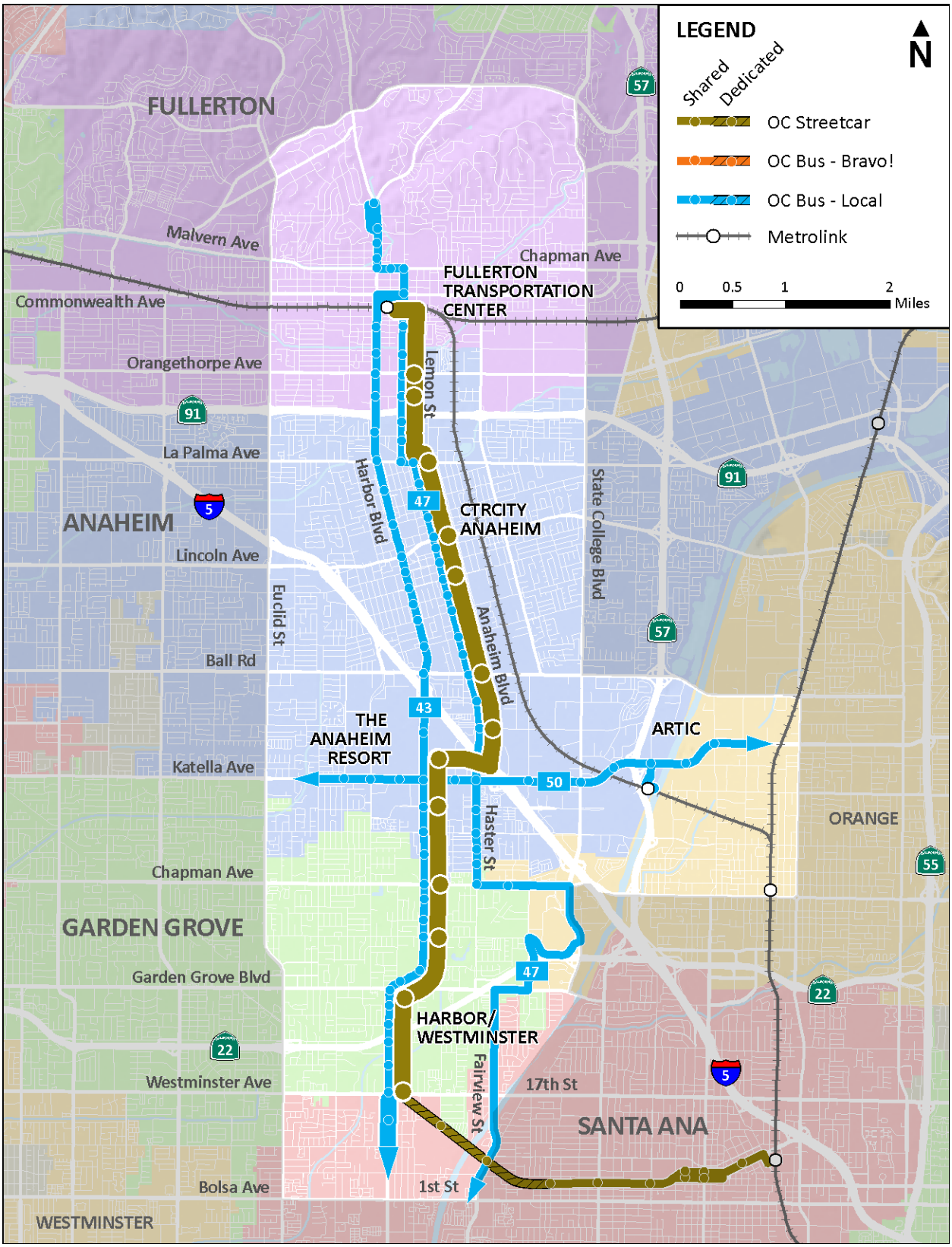
3.3.3.1. L-1: Anaheim-Lemon Streetcar

Alternative L-1: *Anaheim-Lemon Streetcar* would travel north to south along Anaheim Boulevard and Lemon Street (transitioning between Lemon Street and Anaheim Boulevard via La Palma Avenue) and Harbor Boulevard (transitioning between Anaheim Boulevard and Harbor Boulevard via Disney Way), between the FTC in Fullerton and Westminster Avenue in Garden Grove. The approximately 8.5-mile streetcar alignment would operate in a shared traffic lane with stops at major east-west arterials generally spaced 0.75-1.0 miles a mile apart

This alternative would function as a northward extension of the future OC Streetcar and provide a direct connection between SARTC, key activity centers at The Anaheim Resort, a new transit center on Disney Way, CtrCity Anaheim, and the FTC. This alternative would operate in a shared traffic lane within the existing ROW.[13] To avoid duplication of service, OCTA would offer enhanced service on south of Westminster Avenue on Route 43 in lieu of Bravo! 543 which would be discontinued under this alternative.

[13] See footnote 7 for potential ROW implications.

Figure 3.8. Alternative L-1: Anaheim-Lemon Streetcar



Source: STV, 2016

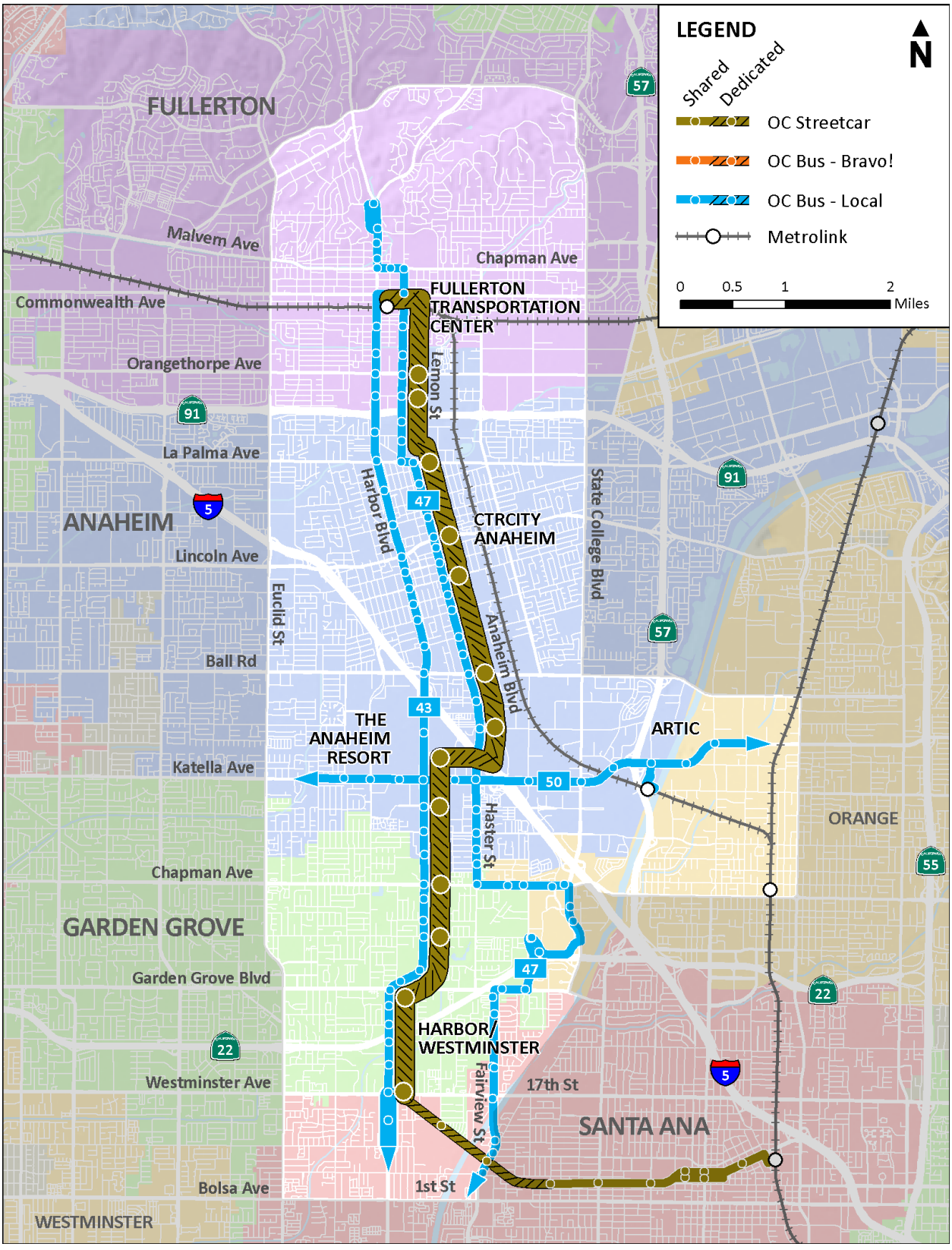
3.3.3.2. L-2: Anaheim-Lemon Rapid Streetcar

Alternative L-2: *Anaheim-Lemon Rapid Streetcar* would travel north to south along Anaheim Boulevard and Lemon Street (transitioning between Lemon Street and Anaheim Boulevard via La Palma Avenue) and Harbor Boulevard (transitioning between Anaheim Boulevard and Harbor Boulevard via Disney Way), between the FTC in Fullerton and Westminster Avenue in Garden Grove. The approximately 8.5-mile streetcar alignment would operate in a dedicated transit lane with stops at major east-west arterials generally spaced 0.75-1.0 miles a mile apart.

This alternative would function as a northward extension of the future OC Streetcar and provide a direct connection between SARTC, key activity centers at The Anaheim Resort, a new transit center on Disney Way, CtrCity Anaheim, and the FTC. This alternative would operate in a dedicated transit lane for much of the alignment.[14] Similar to Alternative L-1: *Anaheim-Lemon Streetcar*, OCTA would offer enhanced service south of Westminster Avenue on Route 43 in lieu of Bravo! 543 which would be discontinued under this alternative.

[14] See footnote 9 for potential ROW implications.

Figure 3.9. Alternative L-2: Anaheim-Lemon Rapid Streetcar



Source: STV, 2016

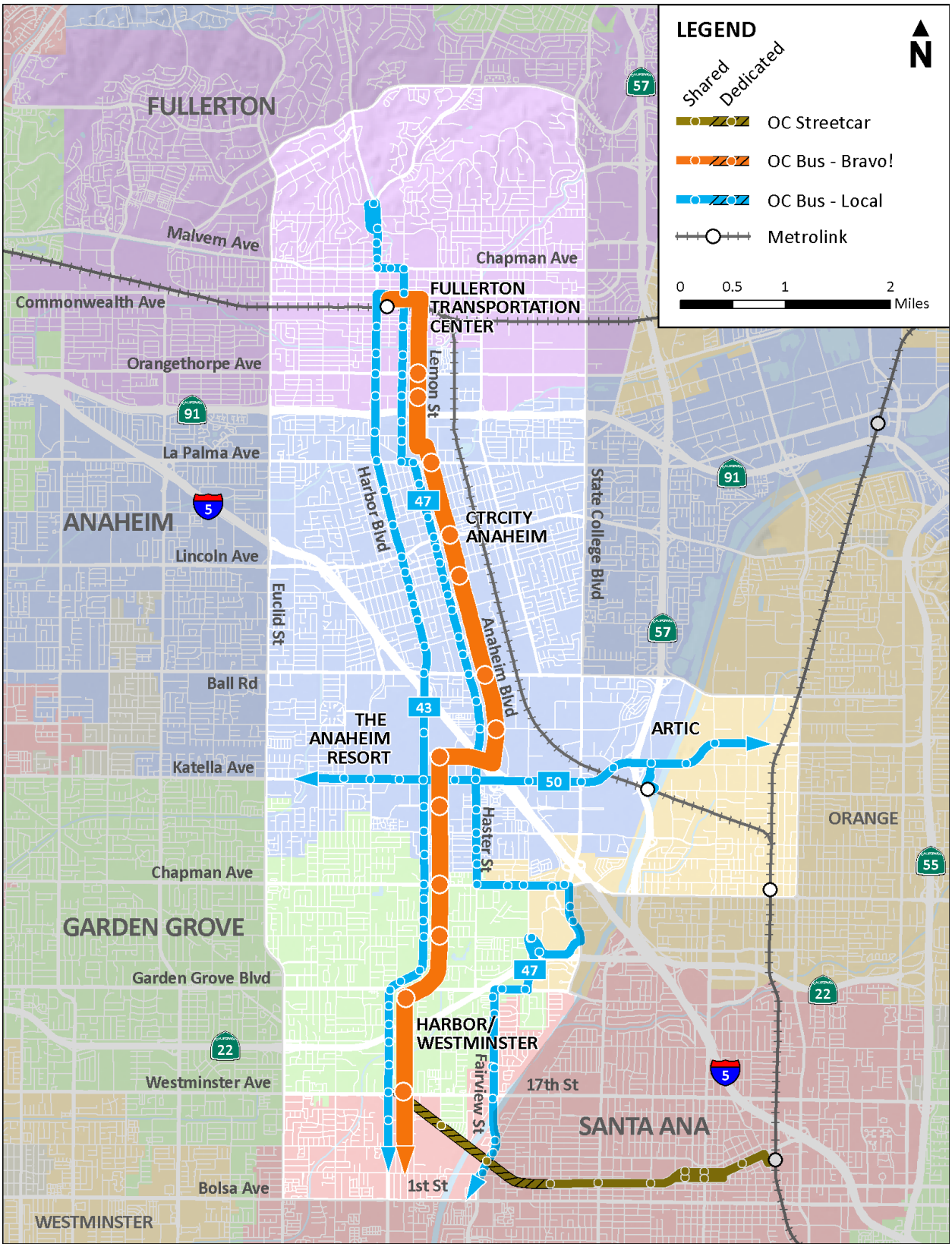
3.3.3.3. L-3: Anaheim-Lemon Enhanced Bus

Alternative L-3: *Anaheim-Lemon Enhanced Bus* would travel north to south along Anaheim Boulevard and Lemon Street (transitioning between Lemon Street and Anaheim Boulevard via La Palma Avenue) and Harbor Boulevard (transitioning between Anaheim Boulevard and Harbor Boulevard via Disney Way), between the FTC in Fullerton and MacArthur Boulevard in Santa Ana. The approximately 12.5-mile bus alignment would operate in a shared traffic lane with stops at major east-west arterials generally spaced 0.75-1.0 miles a mile apart.

This alternative would provide a connection to the future OC Streetcar and provide a direct connection between a future OC Streetcar transfer point at Harbor Boulevard and Westminster Avenue, key activity centers at The Anaheim Resort, a new transit center on Disney Way, CtrCity Anaheim, and the FTC. This alternative would operate in a shared traffic lane within the existing ROW.[15] This alternative would function as an enhanced Bravo! 543 and would not affect existing transit service south of The Anaheim Resort or south of Westminster Avenue. Service along Harbor Boulevard north of The Anaheim Resort, however, would be discontinued as Bravo! 543 service would be shifted onto Anaheim Boulevard and Lemon Street.

[15] See footnote 7 for potential ROW implications.

Figure 3.10. Alternative L-3: Anaheim-Lemon Enhanced Bus



Source: STV, 2016

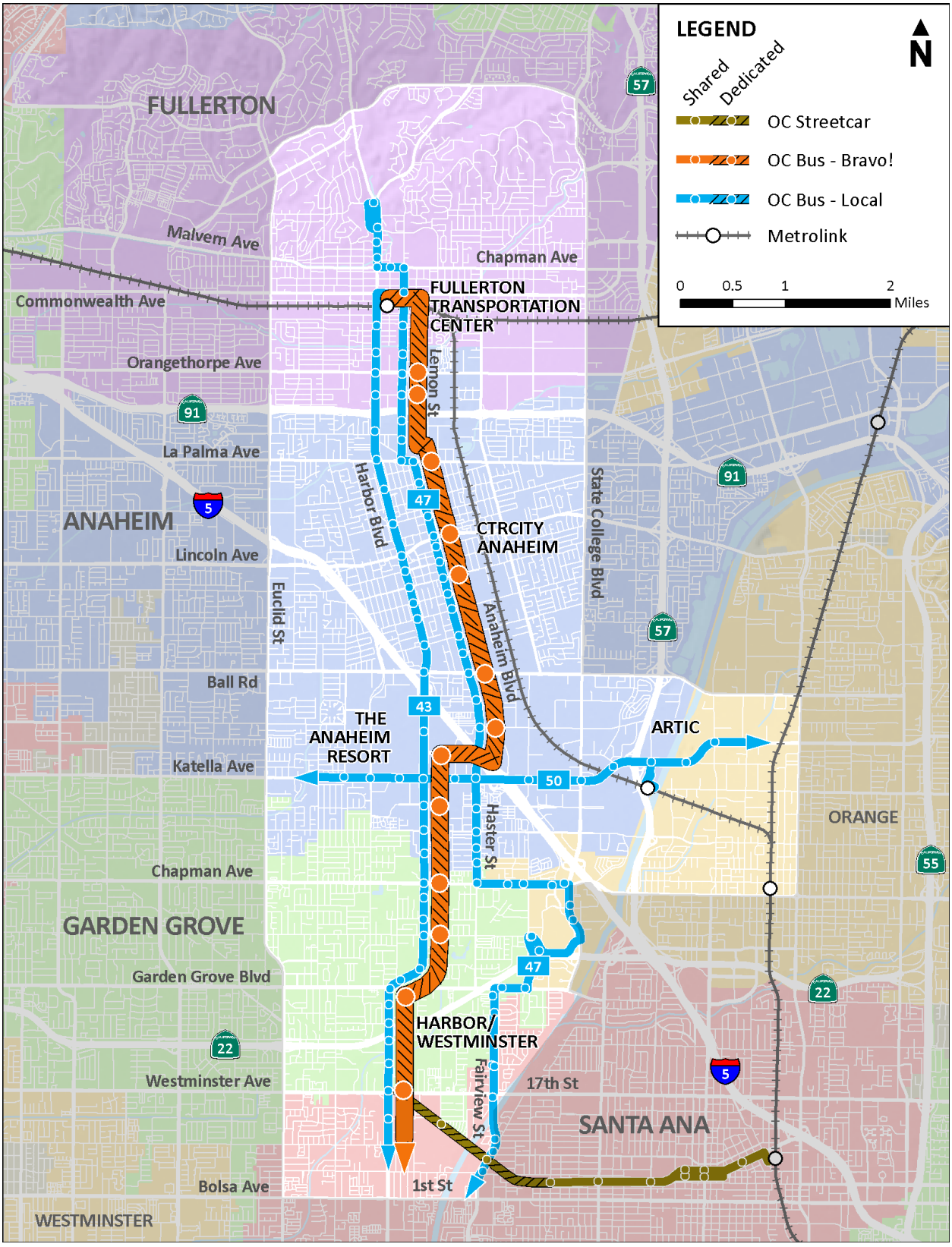
3.3.3.4. L-4: Anaheim-Lemon BRT

Alternative L-4: *Anaheim-Lemon BRT* would travel north to south along Anaheim Boulevard and Lemon Street (transitioning between Lemon Street and Anaheim Boulevard via La Palma Avenue) and Harbor Boulevard (transitioning between Anaheim Boulevard and Harbor Boulevard via Disney Way) between the FTC in Fullerton and MacArthur Boulevard in Santa Ana. The approximately 12.5-mile bus alignment would operate in a dedicated transit lane between the FTC and Westminster Avenue with stops at major east-west arterials generally spaced 0.75-1.0 miles apart.

This alternative would provide a connection to the future OC Streetcar and a direct connection between a future OC Streetcar transfer point at Harbor Boulevard and Westminster Avenue, key activity centers at The Anaheim Resort, a new transit center on Disney Way, CtrCity Anaheim, and the FTC. This alternative would operate in a dedicated transit lane for much of the alignment.[16] Enhanced service south of Westminster Avenue on Route 43 would support high-quality transit service in Santa Ana in lieu of Bravo! 543 which would be discontinued under this alternative.

[16] See footnote 9 for potential ROW implications.

Figure 3.11. Alternative L-4: Anaheim-Lemon Bus Rapid Transit



Source: STV, 2016

3.3.5. Katella Ave

3.3.5.1. K-1: Harbor-Katella Streetcar

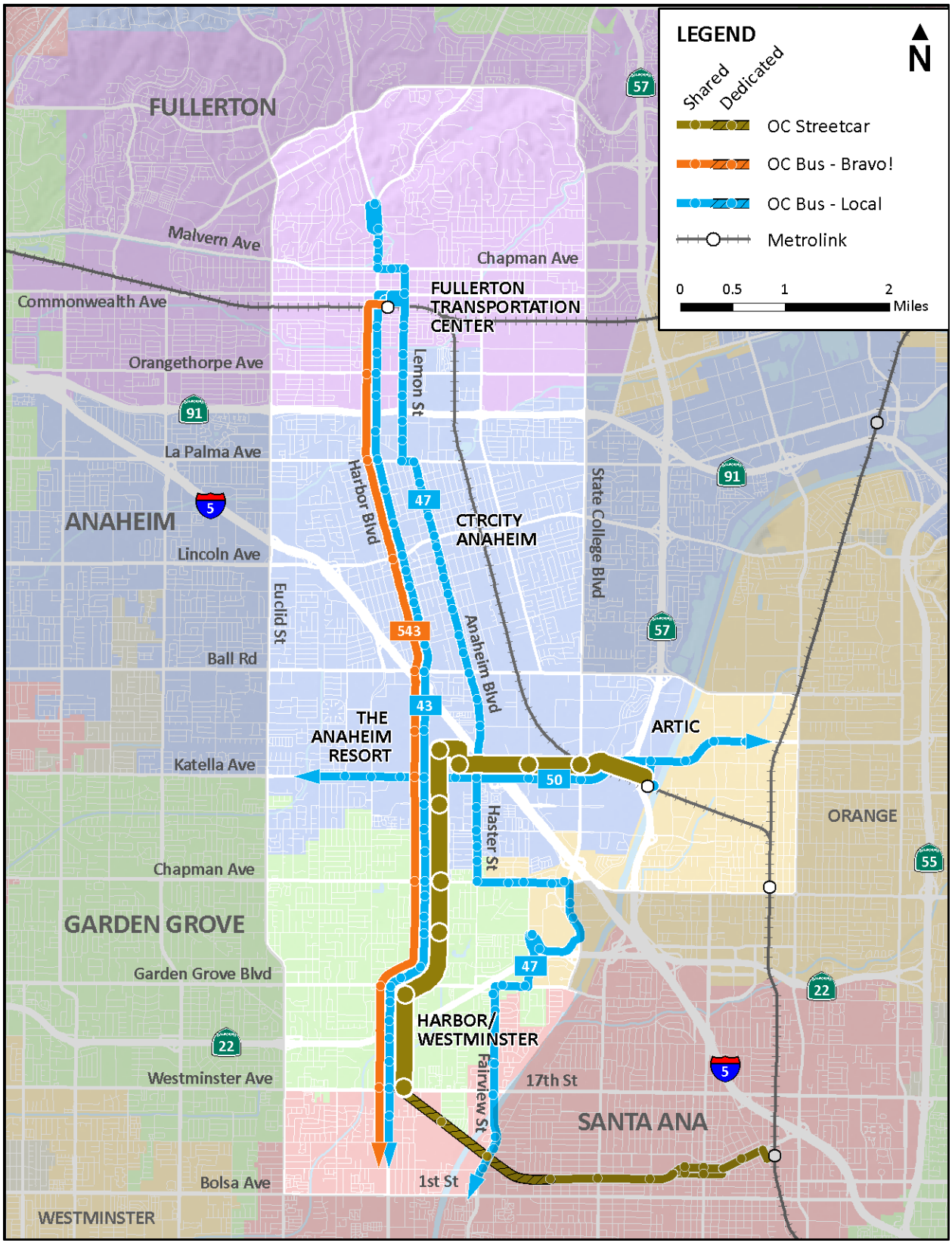
Alternative K-1: *Harbor-Katella Streetcar* would travel north to south along Harbor Boulevard between Westminster Avenue in Garden Grove and The Anaheim Resort, and then east to west along Katella Avenue (via Disney Way and Clementine Street) and the LOSSAN rail corridor into ARTIC. The approximately 5.9-mile streetcar alignment would operate in a shared traffic lane with stops at major arterials generally spaced 0.75-1.0 miles apart.

This alternative would function as a northward extension of the future OC Streetcar and provide a direct connection between SARTC, key activity centers at The Anaheim Resort, a future transit center at Disney Way and Clementine Street, and ARTIC. This alternative would operate in a shared traffic lane within the existing ROW.[17] [18] Consequently, existing OCTA transit service along Harbor Boulevard (Bravo! 543 and local route 43) would remain unchanged.

[17] This alternative deviates from Katella Avenue and operates along/adjacent to an existing rail corridor as it enters ARTIC.

[18] See footnote7 potential ROW implications.

Figure 3.12. Alternative K-1: Harbor-Katella Streetcar



Source: STV, 2016

3.3.5.2. K-2: Katella + Anaheim-Lemon Enhanced Bus

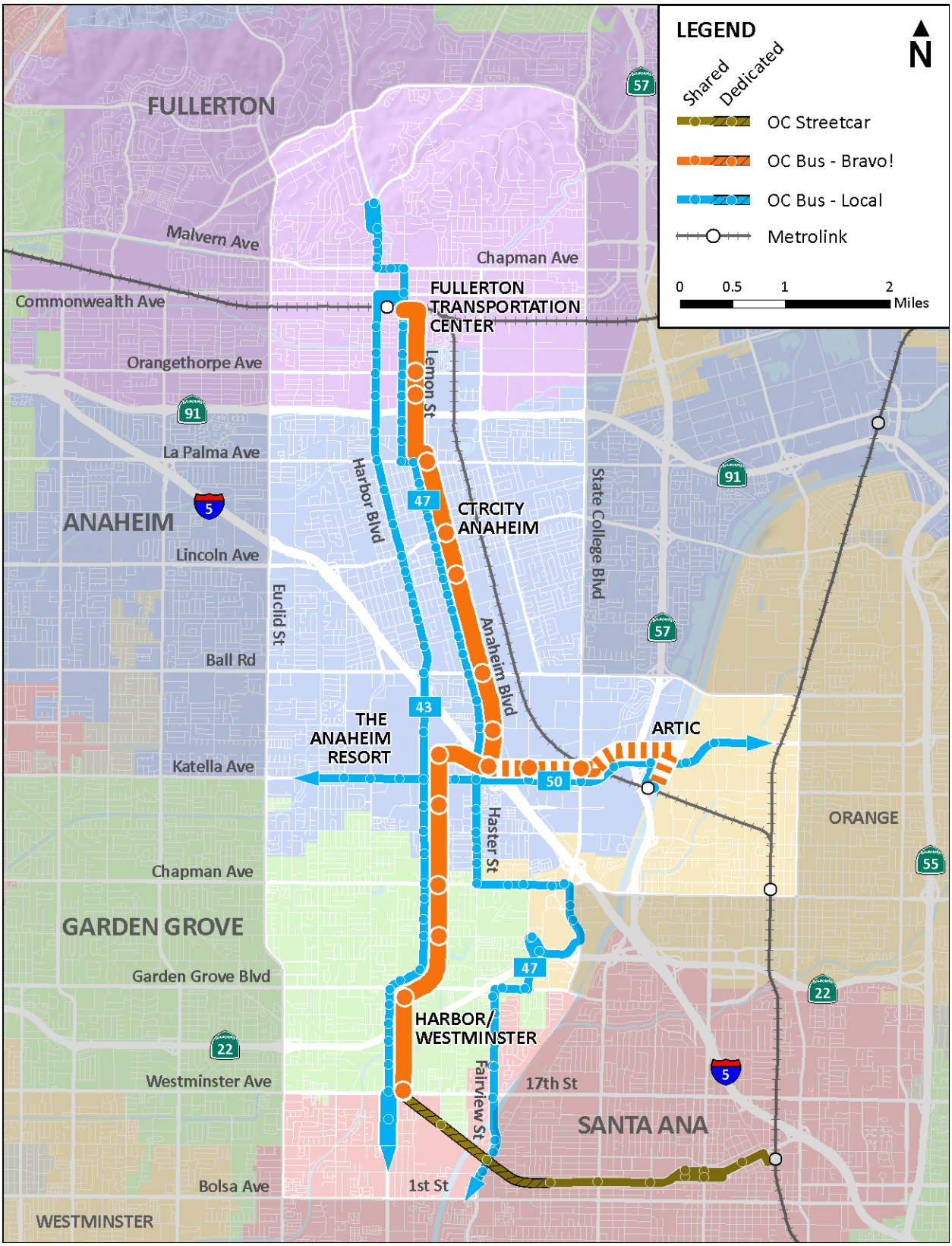
Alternative K-2: *Katella + Anaheim-Lemon Enhanced Bus* would travel primarily north to south along Lemon Street and Anaheim Boulevard (transitioning between Lemon Street and Anaheim Boulevard via La Palma Avenue) and Harbor Boulevard (transitioning between Anaheim Boulevard and Harbor Boulevard via Disney Way) between the FTC in Fullerton and Westminster Avenue in Garden Grove. Additionally, every other trip would travel along Katella Avenue (via Disney Way-Manchester Avenue or Anaheim Way) to ARTIC before returning west on Katella Avenue and north on Anaheim Boulevard/Lemon Street and terminating at the FTC.

The approximately 10.5-mile bus alignment would operate in a shared traffic lane with stops at major east-west arterials generally spaced 0.75-1.0 miles apart. This alternative would provide a connection to the future OC Streetcar and provide a direct connection between a future OC Streetcar transfer point at Harbor Boulevard and Westminster Avenue, key activity centers at The Anaheim Resort, a new transit center on Disney Way, CtrCity Anaheim, the FTC, and ARTIC. This alternative would operate in a shared traffic lane within the existing ROW. [19]

This alternative would also function as an enhanced Bravo! 543 and thus would not affect existing transit service south of The Anaheim Resort. Service along Harbor Boulevard north of The Anaheim Resort, however, would shift east onto Anaheim Boulevard and Lemon Street. Similar to Alternative L-2: *Anaheim-Lemon Rapid Streetcar*, OCTA would offer enhanced service south of Westminster Avenue on Route 43 in lieu of Bravo! 543 which would be discontinued south of Westminster Avenue under this alternative.

[19] See footnote 7 for potential ROW implications.

Figure 3.13. Alternative K-2: Katella + Anaheim-Lemon Enhanced Bus



Source: STV, 2016

3.3.5.3. K-3: Katella + Harbor Hybrid

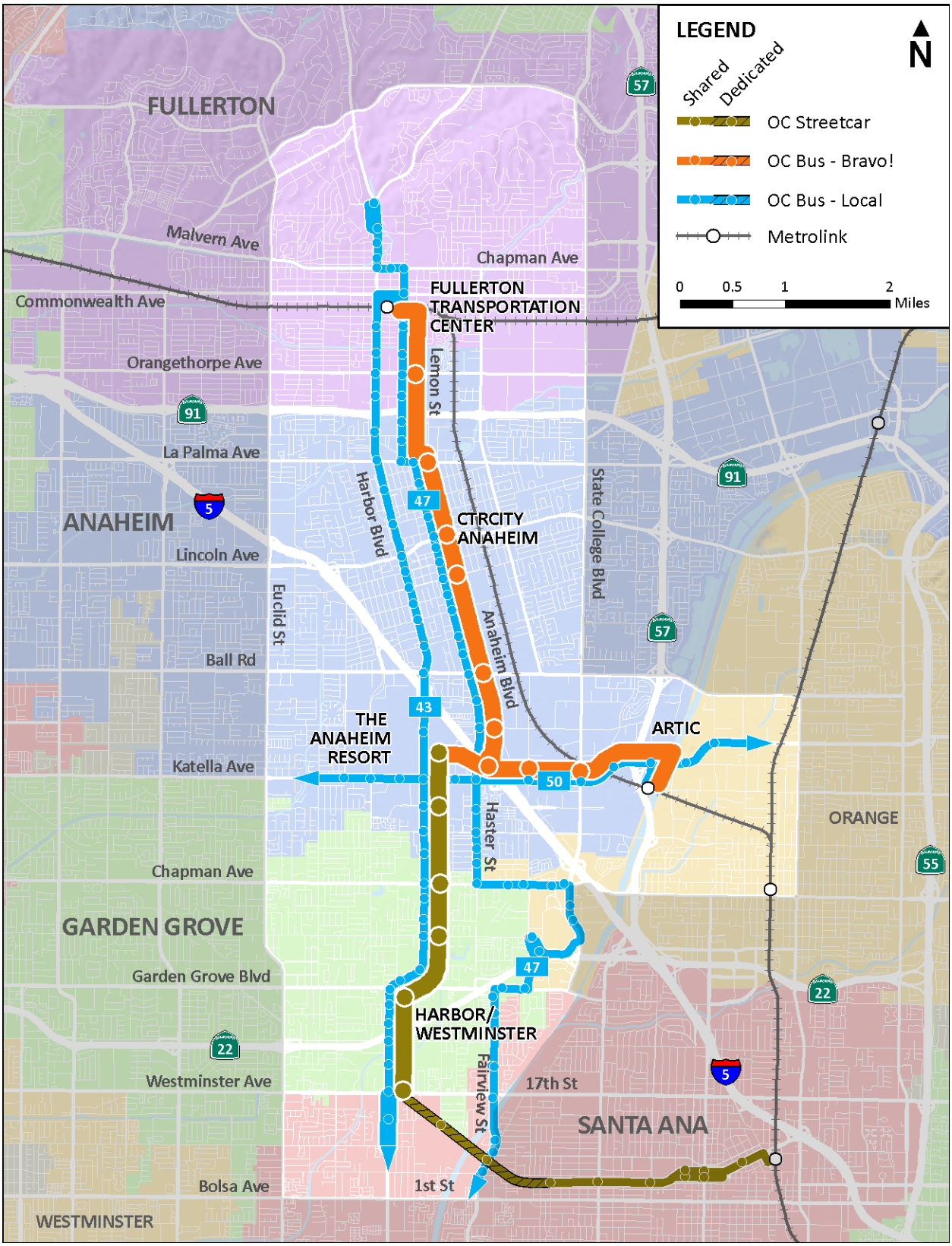
Alternative K-3, "Katella + Harbor Hybrid, would consist of both enhanced bus and streetcar modes. The enhanced bus portion would travel primarily north to south along Lemon Street and Anaheim Boulevard (via La Palma Avenue) and east to west along Disney Way-Manchester Avenue and Katella Avenue between the FTC, The Anaheim Resort, and ARTIC. Northbound buses traveling from ARTIC to the FTC would travel west along Katella Avenue to Harbor Boulevard, north on Harbor Boulevard, and east on Disney Way before continuing north on Anaheim Boulevard. Similarly, southbound buses traveling from the FTC to ARTIC on Anaheim Boulevard, would deviate clock-wise via Katella Avenue and Harbor Boulevard to the proposed streetcar terminus on Disney Way before continuing east to ARTIC.

The streetcar portion of this alternative would be identical to Alternative H-1: *Harbor Short Streetcar* which travels north to south along Harbor Boulevard between Disney Way in Anaheim and Westminster Avenue in Garden Grove. See section 3.3.2.1 of this report for information on Alternative H-1.

The approximately 7.1-mile bus alignment and 3.4-mile streetcar alignment would operate in shared traffic lanes with stops at major arterials generally spaced 0.75-1.0 miles apart. This alternative would function as a northward extension of the future OC Streetcar, providing a direct connection between SARTC, Harbor Boulevard and Westminster Avenue, and key activity centers at The Anaheim Resort. It would also provide a one-transfer connection to a new transit center on Disney Way, CtrCity Anaheim, the FTC, and ARTIC. This alternative would operate in shared traffic lanes within the existing ROW.[20] OCTA would offer enhanced service south of Westminster Avenue on Route 43 in lieu of Bravo! 543 which would be discontinued south of The Anaheim Resort under this alternative.

[20] See footnote 7 for potential ROW implications.

Figure 3.14. Alternative K-3: Katella + Harbor Hybrid



Source: STV, 2016

3.4. STOPS

3.4.1. Stop Locations

Proposed stops are mostly located at major east-west arterials and generally align with existing Bravo! 543 stops (for alternatives along Harbor Boulevard). Notable exceptions include Lampson Avenue and Disney Way, which were designated to serve a key activity center or, in the case of Disney Way, as a potential streetcar terminus or major transfer location.

With the exception of Disney Way, all stops are assumed to be located adjacent to the curb lane and constructed on public property. Table 3.2 below lists all proposed stop locations by alternative. Explanatory notes are listed below.

Table 3.2. Proposed Stop Locations by Alternative

	H-1	H-2	H-3	H-4	H-5	L-1	L-2	L-3	L-4	K-1	K-2	K-3
Fullerton Transportation Center		●	●	●	●	●	●	●	●		●	●
Anaheim/Lemon												
Orangethorpe Ave						●	●	●	●		●	●
La Palma Ave						●	●	●	●		●	●
Lincoln Ave						●	●	●	●		●	●
Santa Ana St						●	●	●	●		●	●
Ball Rd						●	●	●	●		●	●
Cerritos Ave						●	●	●	●		●	●
Katella												
Clementine St										●		
Anaheim Blvd-Haster St											●	●
Lewis St										●	●	●
State College Blvd										●	●	●
ARTIC										●	●	●
Harbor												
Orangethorpe Ave		●	●	●	●							
La Palma Ave		●	●	●	●							
Lincoln Ave		●	●	●	●							
Ball Rd		●	●	●	●							
Disney Way	●	●	●	●	●	●	●	●	●	●	●	●
Katella Ave	●	●	●	●	●	●	●	●	●	●	●	●
Convention Way												
Chapman Ave	●	●	●	●	●	●	●	●	●	●	●	●
Lampson Ave	●	●	●	●	●	●	●	●	●	●	●	●
Garden Grove Blvd	●	●	●	●	●	●	●	●	●	●	●	●
Westminster Ave	●	●	●	●	●	●	●	●	●	●	●	●
Harbor (South of Westminster Ave)												
First St				●	●			●	●			
McFadden Ave				●	●			●	●			
Edinger Ave				●	●			●	●			
Warner Ave				●	●			●	●			
MacArthur Blvd				●	●			●	●			
OC Streetcar												
SARTC	●	●	●			●	●			●		●
Santa Ana Blvd & Lacy St	●	●	●			●	●			●		●
Santa Ana Blvd & French St	●	●	●			●	●			●		●
Santa Ana Blvd & Sycamore St	●	●	●			●	●			●		●
Santa Blvd & Ross St	●	●	●			●	●			●		●
Santa Ana Blvd & Flower St	●	●	●			●	●			●		●
Santa Ana Blvd & Bristol St	●	●	●			●	●			●		●
Santa Ana Blvd & Raitt St	●	●	●			●	●			●		●
Fairview St	●	●	●			●	●			●		●
Willowick	●	●	●			●	●			●		●
TOTAL	**16**	**21**	**21**	**16**	**16**	**23**	**23**	**18**	**18**	**20**	**17**	**27**

Notes:

1. Alternative H-1: *Harbor Short Streetcar*
   a) Alternative stops in median on Disney Way, close to proposed Disneyland Resort parking facility;
   b) Alternative makes one stop between Katella Avenue and Convention Way.

2. Alternative H-2: *Harbor Long Streetcar* to Alternative H-5: *Harbor BRT*
   a) Stop labeled "Orangethorpe Avenue" are located between Orangethorpe Avenue and Orangefair Avenue;
   b) Alternative H-2 and Alternative H-3: *Harbor Rapid Streetcar* stops at "Disney Way" located between Disney Way and East Shuttle Area;

c) Alternatives H-2 and H-3 make one stop between Katella Avenue and Convention Way;

d) Alternative H-4: *Harbor Enhanced Bus* and Alternative H-5 stops labeled "Disney Way" located north of Disney Way at existing Bravo! stop by East Shuttle Area.

3. Alternative L-1: *Anaheim-Lemon Streetcar* to Alternative L-4: *Anaheim-Lemon BRT*
   a) Stops labeled "Orangethorpe Avenue" are located between Orangethorpe Avenue and Orangefair Avenue;

   b) Stops labeled "Santa Ana Street" are located between Santa Ana Street and Broadway;

   c) Alternatives L-1 and L-2: Anaheim-Lemon Rapid Streetcar stop in median on Disney Way, close to proposed Disneyland Resort parking facility;

   d) Alternatives L-1 and L-2 make one stop between Katella Avenue and Convention Way.

4. Alternative K-1: *Harbor-Katella Streetcar* to Alternative K-3: *Katella + Harbor Hybrid*
   a) Stops labeled "Orangethorpe Avenue" are located between Orangethorpe Avenue and Orangefair Avenue;

   b) Stops labeled "Santa Ana Street" are located between Santa Ana Street and Broadway;

   c) Alternatives K-1 and K-3 stop in median on Disney Way, close to proposed Disneyland Resort parking facility;

   d) Alternatives K-1 and K-3 make one stop between Katella Avenue and Convention Way.

3.4.2. Stop Design

OCTA proposes a standard "kit of parts" design for all proposed stops. Common elements to be included in a potential stop design include:

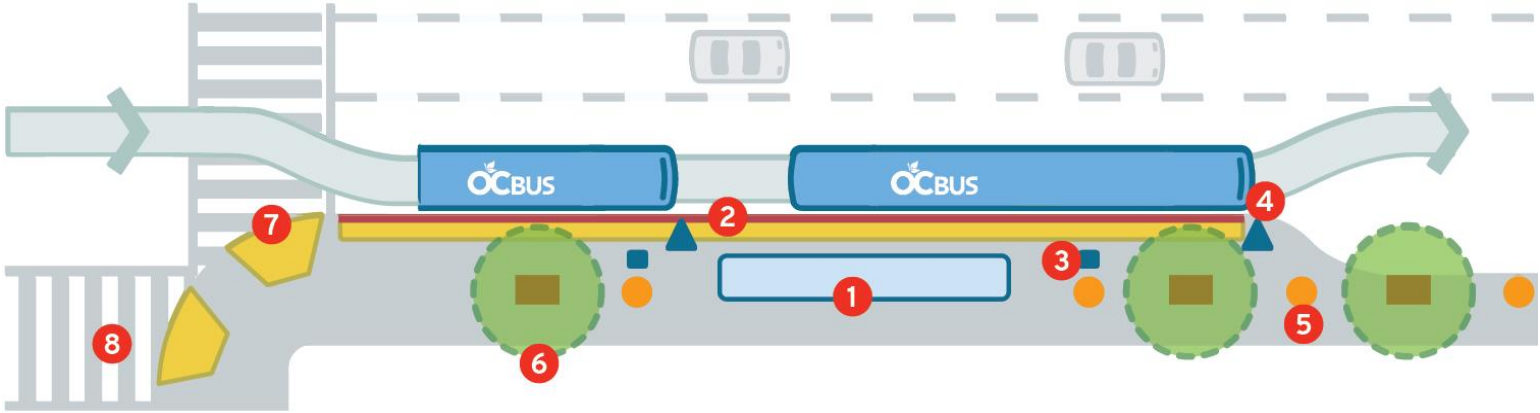
1) Transit Shelters
2) Tactile Edge Treatments
3) Payment Kiosks
4) Real-Time Transit Information
5) Pedestrian Lighting
6) Shade Trees
7) Dual Curb Ramps
8) Enhanced Crosswalks

These elements provide riders with a safe and comfortable experience by offering protection from inclement weather, off-board fare payment, and real-time arrival information. Enhanced coordination with cities may help distribute maintenance costs while coordination with local law enforcement agencies and introduction of an optional paid fare zone at designated stops may help distribute security costs and deter loitering or nuisance activity.

A prototypical station layout along with images and descriptions of common stop elements is shown in Figure 3.15. The actual size, location (i.e., near-side versus far-side of an intersection), and presence of certain elements would vary according to site-specific conditions (i.e., traffic/pedestrian circulation patterns, existence of pedestrian amenities, availability of space) and may be subject to requirements from the local city and/or nearby property owners.

Determination of the precise location of all stops would take place during subsequent phases of this project.

Figure 3.15. Prototypical Far-Side Station Layout and Common Elements



1 TRANSIT SHELTER

Transit shelters provide comfort for waiting passengers through seating or lean bars, and offer protection from the elements (rain, sun, and wind).

2 TACTILE EDGE TREATMENT

Highly visible colored and raised domes clearly delineate the outer edge of the boarding area.

3 PAYMENT KIOSK

Ticket vending machines shorten boarding times by allowing riders to pay fares before their transit vehicle arrives.

4 TRANSIT INFORMATION

Real-time information and maps of the system and station area help users navigate smoothly to their destination.

5 PEDESTRIAN LIGHTING

Pedestrian-scaled sidewalk and station area lighting can serve as wayfinding and improve security after dark.

6 SHADE TREES

Trees provide additional shade beyond, or in place of, a shelter. Trees should be spaced to define the curbside boarding and leave primary walking paths clear.

7 DUAL CURB RAMPS

Bi-directional access ramps align with each crosswalk, providing a safer path for pedestrians.

8 CROSSWALK

Marked crosswalks improve safety for pedestrians by increasing their visibility by motorists. Adding a stop bar can reduce vehicle encroachment into the crossing area.

Bottom Images via Fickr.com

4. RESULTS

4.1. INTRODUCTION

This section provides a detailed overview of the results of the analysis performed on each of the 12 alternatives. This analysis informs the scoring and ranking of each alternative.

This section is organized into three parts: Part one defines the methodology used to evaluate each alternative by listing goals and defining the objectives, performance measures, and scoring approach to evaluating each alternative. Part two summarizes the results of the evaluation of the six evaluation criteria by which each alternative was analyzed. Part two also lists projected capital and operations and maintenance (O&M) costs, ridership, and travel time savings per alternative. Part three provides a summary of results and overall scores for each alternative.

4.2. EVALUATION METHODOLOGY

This report defines six goals, 24 objectives (four per goal), and various performance measures under each objective to evaluate each alternative and address the six mobility problems listed in section 2.8 of this report.

4.2.1. Goals

Goals are high-level themes, which were arrived at by reversing the mobility problem statements. For example, if the mobility problem statement refers to poor connectivity between activity centers, the corresponding goal is to improve connectivity between activity centers. Each of the 12 alternatives was evaluated across the following goals:

1) Enhance Transit Performance.
2) Encourage Transit Compatible Land Uses.
3) Improve Local and Regional Connectivity.
4) Optimally Allocate Infrastructure within Corridor Constraints.
5) Enhance User Experience/Mode Choices.
6) Pursue a Project that is Cost-Effective.

These goals were first defined in the *Alternative Evaluation Methodology Report* (February 2017). Community Support is also included as a goal of the study, but is evaluated in a qualitative manner based on feedback from outreach and stakeholder events.

4.2.2. Objectives

Objectives are more defined items for each goal which are more easily measured. For example, if the goal is to improve transit performance, objectives include improving transit speed, reliability, and overall roadway throughput.

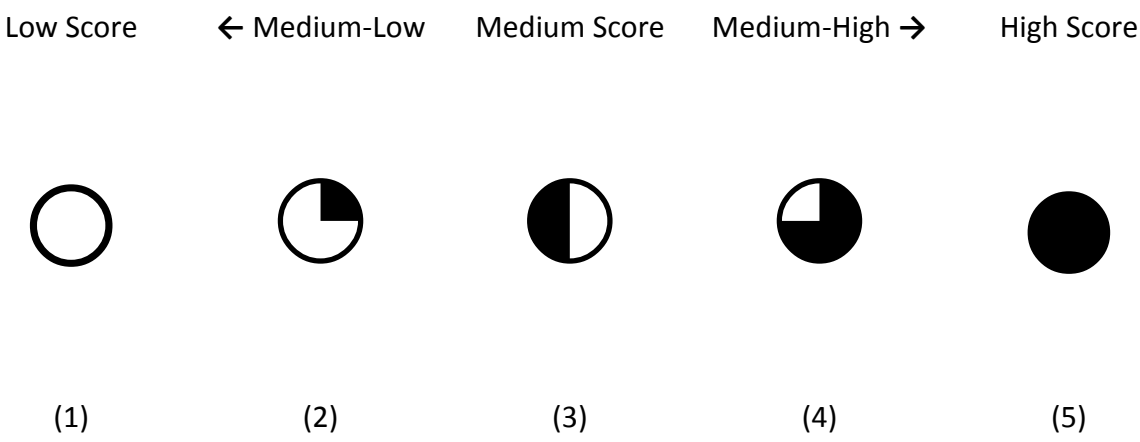
4.2.3. Performance Measures

Performance Measures are specific criteria for each objective to measure how well alternatives perform. For example, if the objective is to improve transit reliability, the performance measure is projected on-time performance of transit service in a corridor. Each table also describes methods (i.e., qualitative versus quantitative), sources considered during data collection and analysis (e.g., outputs from travel demand model [TDM], geographic information systems [GIS], site visits, public input) and whether the performance measure matches evaluation criteria for FTA New Starts funding.[21]

4.2.4. Scoring/Weighting

A five-point scale using Harvey Balls is proposed for scoring all criteria objectives as shown in Figure 4.1 below. The exact scoring method and parameters for classification for each objective varies per results. Nevertheless, this approach is intended to provide a range of scores for each alternative under each criteria goal and criteria objective.

Figure 4.1 Scoring System Using Harvey Balls



Weighting of each overall goal was determined in collaboration with the study's project development team, which is largely comprised of OCTA staff, staff from the four corridor cities, and staff from stakeholder agencies including ART. The respective weights for each goal are listed below in Table 4.1.

[21] New Starts projects are funded under the FTA's discretionary Capital Investment Grant (CIG) program. Under the current funding and authorization bill to govern U.S. surface transportation spending, *Fixing America's Surface Transportation* (FAST) Act, New Starts projects are defined as projects with a total estimated capital cost of $300 million or more or seeking $100 million or more in CIG program funds.

Table 4.1. Weighted Evaluation Criteria

Criteria	PDT Weight
1. Transit Performance	20%
2. Land Use	15%
3. Connectivity	18%
4. Corridor Constraints	15%
5. Mode Choices/User Experience	17%
6. Cost-Effectiveness	15%
7. Community Input	*Qualitative*

Weights were applied to each criteria goal after the individual scores for each of the 24 objectives have been totaled. Thus, while the maximum unweighted total score an evaluation criteria goal can receive is 20 (5 points per objective), application of weighting made the maximum total score per goal equal to the weights in the chart above, and equal to 100 overall. Rather than assigning a numerical value to the feedback received during outreach activities that took place over the course of this study, this report considered community input separately and in a qualitative manner.

The 12 alternatives were evaluated through each of the goals and objectives listed in Table 4.2.[22] This section provides a summary of the scoring results for each alternative. A detailed overview of methodology, assumptions, and scoring is provided in Appendix B.

[22] As noted previously, Community Input was considered separately and in a qualitative manner.

Table 4.2. Evaluation Criteria Goals and Objectives Summary Table

Criteria		PDT Weight
1. Transit Performance		
a	Average Transit Operating Speed	**20%**
b	Person Throughput	
c	Travel Time Reliability / On-Time Performance	
d*	Congestion Relief - New Linked Project Trips	
2. Land Use		
a*	Transit-Compatible Land Uses - Station Area Population / Employment Density	**15%**
b*	Economic Development - Transit Supportive Plans and Policies	
c*	Environmental Benefits and Impacts - VMT-Related	
d*	Other Environmental Benefits and Impacts (Title VI, Environmental Justice)	
3. Connectivity		
a	Activity Center Connectivity	**18%**
b	Zero and One Transfer Rides	
c*	Compliance with Long Range Regional Mobility Goals	
d*	First/Last Mile Connections - Bike/Ped Amenities and Linkages	
4. Corridor Constraints		
a	Optimally Allocate Roadway Infrastructure	**15%**
b	Roadway Incidents and Collisions	
c	Optimize Traffic Operations	
d	Physical Corridor Constraints (Bridges, Rail Crossings, etc.)	
5. Mode Choices / User Experience		
a	New Riders (System-Wide)	**17%**
b	Mode Share	
c*	Mobility Improvement - Linked Trips on Project	
d	Station/Stop User Experience / Level of Amenities	
6. Cost-Effectiveness		
a*	Cost Effectiveness - Capital + O&M Costs / Project Trips	**15%**
b	Incremental Cost per New Transit Trip	
c	Farebox Recovery	
d	Financial Feasibility (Cost, Suitability for Funding, etc.)	
Community Input		
a*	Outreach Plan (Activities, Dates and Times, #Attendees, etc.)	-
b	Comments Received / Key Themes	

*Matches FTA New Starts funding evaluation criteria

4.3. SUMMARY OF RESULTS

4.3.1. Overview of Results for all Alternatives

As seen in Table 4.3 and Table 4.4, Alternative H-3: *Harbor Rapid Streetcar*, received the highest overall score out of all alternatives with 74 out of 100 points. Also shown on Table 4.4, Alternative H-3 received a "high" average score for all criteria under Transit Performance, "medium-high" across all criteria under Land Use, Connectivity, Mode Choice/User Experience, and Cost, respectively, and "medium-low" under Constraints.

Despite sharing the same corridor as Alternative H-3, Alternative H-4: *Harbor Enhanced Bus* received the lowest overall score out of all alternatives with 55 out of 100 points. As the least impactful alternative, Alternative H-4 would operate very similarly to existing OCTA *Bravo!* service and include a limited amount of premium features. Alternative H-4 received a "low" average score for all criteria under Mode Choice/User Experience, "medium-low" across all criteria under Transit Performance, "medium" under Land Use, Connectivity, and Cost, and "medium-high" under Constraints.

Table 4.5 summarizes overall capital costs, net annual operations and maintenance costs, net ridership, and cost-effectiveness per alternative.

Finally, Table 4.6 groups all alternatives according to mode.

Table 4.3. Evaluation Results

Alternative	Mode	Description	Transit Performance (20 Max)	Land Use (15 Max)	Connectivity (18 Max)	Constraints (15 Max)	Mode Choice/User Experience (17 Max)	Cost (15 Max)	Weighted Total
H-3	**Rapid Streetcar**	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	18	11	14	7	14	11	***74***
H-2	**Streetcar**	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	17	11	12	10	14	10	***73***
H-5	**BRT**	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	17	11	12	8	11	14	***73***
L-1	**Streetcar**	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	17	10	12	8	13	8	***68***
L-4	**BRT**	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	14	11	12	6	12	12	***66***
L-2	**Rapid Streetcar**	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	15	10	14	5	14	8	***65***
K-1	**Streetcar**	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	15	11	10	11	12	6	***65***
H-1	**Streetcar**	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	16	9	8	13	10	8	***64***
K-2	**Bus**	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	8	11	11	11	7	11	***57***
L-3	**Bus**	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	10	10	9	11	5	11	***56***
K-3	**Hybrid**	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	10	11	11	10	9	7	***56***
H-4	**Bus**	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	9	10	10	13	4	9	***55***

Notes:

1. Numbers may not add up correctly due to rounding.

2. Row colors represent the different corridors: Green = Harbor “Short,” Blue = Harbor “Long,” Yellow = Anaheim/Lemon, Orange = Katella.

Table 4.4. Average Evaluation Results

ALTERNATIVE	DESCRIPTION	Transit Performance	Land Use	Connectivity	Constraints	Mode Choice/User Experience	Cost	Weighted Total
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	● 4.5	◕ 3.8	◕ 3.8	◔ 2.3	◕ 4.3	◕ 3.5	***74***
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	◕ 4.3	◕ 3.8	◑ 3.3	◑ 3.3	◕ 4.0	◑ 3.3	***73***
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕ 4.3	◕ 3.8	◑ 3.3	◑ 2.8	◑ 3.3	● 4.5	***73***
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	◕ 4.3	◑ 3.3	◑ 3.3	◑ 2.8	◕ 3.8	◑ 2.8	***68***
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕ 3.5	◕ 3.5	◑ 3.3	◔ 2.0	◕ 3.5	◕ 4.0	***66***
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◕ 3.8	◑ 3.3	◕ 3.8	◔ 1.5	◕ 4.0	◑ 2.8	***65***
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	◕ 3.8	◕ 3.5	◑ 2.8	◕ 3.8	◕ 3.5	◔ 2.0	***65***
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	◕ 4.0	◑ 3.0	◔ 2.3	◕ 4.3	◑ 3.0	◑ 2.8	***64***
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	◔ 2.0	◕ 3.5	◑ 3.0	◕ 3.5	◔ 2.0	◕ 3.5	***57***
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◑ 2.5	◑ 3.3	◑ 2.5	◕ 3.8	◔ 1.5	◕ 3.5	***56***
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	◑ 2.5	◕ 3.5	◑ 3.0	◑ 3.3	◑ 2.5	◔ 2.3	***56***
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◔ 2.3	◑ 3.3	◑ 2.8	◕ 4.3	○ 1.3	◑ 3.0	***55***

Notes:

1. Row colors represent the different corridors: Green = Harbor "Short," Blue = Harbor "Long," Yellow = Anaheim/Lemon, Orange = Katella.

2. Average scores rounded to the nearest whole number: Low (○) = 1; Medium-Low (◔) = 2; Medium (◐) = 3; Medium-High (◕) = 4; High (●) = 5.

Table 4.5 Costs, Ridership, and Cost-Effectiveness

Alternative	Mode	Description	Total	Capital Cost*	Net Annual O&M Cost	(Weekday) Project Boardings	New Systemwide Boardings**	Cost-Effectiveness***
H-3	**Rapid Streetcar**	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	***74***	$ 690,000,000	$ 1,900,000	15,200	15,500	$ 5.54
H-2	**Streetcar**	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	***73***	$ 610,000,000	$ 3,000,000	14,700	15,200	$ 5.58
H-5	**BRT**	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	***73***	$ 230,000,000	$ 1,100,000	14,600	15,500	$ 2.72
L-1	**Streetcar**	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	***68***	$ 660,000,000	$ 4,000,000	11,300	10,300	$ 8.18
L-4	**BRT**	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	***66***	$ 250,000,000	$ 1,800,000	12,000	11,500	$ 3.78
L-2	**Rapid Streetcar**	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	***65***	$ 740,000,000	$ 3,000,000	12,500	12,000	$ 7.60
K-1	**Streetcar**	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	***65***	$ 450,000,000	$ 5,200,000	5,500	7,500	$ 13.69
H-1	**Streetcar**	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	***64***	$ 260,000,000	$ 3,100,000	3,700	7,500	$ 11.73
K-2	**Bus**	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	***57***	$ 60,000,000	$ 1,700,000	4,900	400	$ 3.40
L-3	**Bus**	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	***56***	$ 67,000,000	$ 1,000,000	5,400	410	$ 2.62
K-3	**Hybrid**	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	***56***	$ 300,000,000	$ 3,000,000	7,000	3,100	$ 6.89
H-4	**Bus**	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	***55***	$ 64,000,000	$ 1,000,000	5,200	490	$ 2.68

* 2025 assumed Year of Expenditure

** Net ridership estimates derived from OCTAM and calculated as the difference between baseline (2035) ridership estimates on OCTA routes 543, 43, 47, 50, and OC Streetcar, and modeled ridership on same routes plus additional ridership from a project alternative. In cases where a project alternative obviates service on Bravo! 543, ridership from the 543 was removed. See Appendices B and C for more information.

***Per the FTA, Cost-Effectiveness is calculated as Incremental Cost per Hour of Transportation System User Benefit between the baseline and build alternatives (see Objective 6A details on methodology)

Table 4.6. Evaluation Results by Mode

Alternative	Mode	Description	Transit Performance (20 Max)	Land Use (15 Max)	Connectivity (18 Max)	Constraints (15 Max)	Mode Choice/User Experience (17 Max)	Cost (15 Max)	Weighted Total
K-2	**Bus**	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	8	11	11	11	7	11	***57***
L-3	**Bus**	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	10	10	9	11	5	11	***56***
H-4	**Bus**	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	9	10	10	13	4	9	***55***
H-5	**BRT**	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	17	11	12	8	11	14	***73***
L-4	**BRT**	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	14	11	12	6	12	12	***66***
H-2	**Streetcar**	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	17	11	12	10	14	10	***73***
L-1	**Streetcar**	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	17	10	12	8	13	8	***68***
K-1	**Streetcar**	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	15	11	10	11	12	6	***65***
H-1	**Streetcar**	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	16	9	8	13	10	8	***64***
K-3	**Hybrid**	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	10	11	11	10	9	7	***56***
H-3	**Rapid Streetcar**	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	18	11	14	7	14	11	***74***
L-2	**Rapid Streetcar**	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	15	10	14	5	14	8	***65***

Note: Numbers may not add up correctly due to rounding.

Criteria 1: Transit Performance

Mobility Problem: Traffic conditions limit the speed and reliability of transit service.

Goal: Improve the speed and reliability of transit service by removing bottlenecks and minimizing interactions with auto traffic.

Table 4.7. Objectives and Performance Measures – Transit Performance

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
ENHANCE TRANSIT PERFORMANCE	1A: Increase average overall transit operating speed	Improvement in average transit operating speed (Greater than 20% is target)	Quantitative	Travel Demand Model (TDM)	
	1B: Improve transit service by reducing conflicts with auto traffic	Increase person throughput	Quantitative	TDM (with post-processing)	
	1C: Improve travel time reliability/On-time performance by ensuring better on-time performance	Measure the travel time reliability for each alternative (and per alternative segment as needed). The following factors may be considered to measure variability: • Minimize connections or transfer times • Provide accurate real-time arrival information • Improve bottlenecks • Dedicated lane miles • Traffic Signal Priority	Quantitative/ Qualitative	TDM; Alternative Description/ Information	
	1D: Congestion relief – New linked project trips	Number of new weekday linked trips resulting from implementation of the project	Quantitative	TDM; Simplified Trips-on-Project Software (STOPS)	X

FTA = Federal Transit Administration; STOPS = Simplified Trips-on-Project (Software)*; TDM= Travel Demand Model*

4.3.1.1. Transit Performance Summary

As shown in Table 4.8, Alternative H-3: *Harbor Rapid Streetcar* scored the highest in Transit Performance among all alternatives, receiving 18 out of a possible 20 overall points while Alternative K-2: *Katella + Anaheim/Lemon Enhanced Bus* scored the lowest with 8 out of 20 points.

Alternative H-3 scored "high" in 1A: *Average Transit Operating Speed* and 1D: *Congestion Relief - New Linked Project Trips* because of significant projected improvements in net speed and the highest projected ridership per mile. Alternative H-3 also benefitted from a "medium-high" score in 1B: *Person Throughput* and 1C: *Travel Time Reliability/On-Time Performance* due in part to its proposed dedicated transitway.

Alternative K-2 scored "medium" in 1C (in this case, due largely to the lack of proposed a proposed dedicated transitway), and "medium-low" in 1A and 1B with minimal projected speed and person throughput improvements. Finally, Alternative K-2, was hindered by a "low" score in 1D with the second to lowest projected new linked trips per mile among all alternatives.

Table 4.8. Transit Performance Summary Table

Alternative	Description	Transit Performance				Rating	Score out of 20
		1A	1B	1C	1D		
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	◕	◕	◑	●	◕	16.0
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	●	●	◔	●	◕	17.0
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	●	◕	◕	●	●	***18.0***
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◔	◕	◔	○	◔	9.0
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	●	◕	◕	◕	◕	17.0
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	●	●	◑	◕	◕	17.0
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	●	◔	◕	◕	◕	15.0
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◔	◕	◑	○	◑	10.0
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕	◑	◕	◑	◕	14.0
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	◕	◕	◑	◕	◕	15.0
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	◔	◔	◑	○	◔	***8.0***
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	◔	◑	◑	◔	◑	10.0

Criteria 2: Land Use

Mobility Problem: There are some land uses within the study area that are not easily or efficiently served by transit.

Goal: Allow cities to leverage improved transit service in the study area to support transit-compatible land uses and minimize secondary effects to surrounding communities.

Table 4.9. Objectives and Performance Measures – Land Use

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
ENCOURAGE TRANSIT COMPATIBLE LAND USE	2A: Encourage transit-compatible land uses by locating transit improvements in areas with either supportive uses currently or good potential for future transit-supportive uses	• Station/stop area population densities ("station area" is defined as the area within a 0.5-mile radius of a station) • Total employment and employment density served by the Project. (e.g., estimate employees throughout project area per standards) • Quality of pedestrian facilities including access for persons with disabilities • Existing corridor and station/stop area parking supply	Quantitative / Qualitative	Corridor Cities Zoning and Land Use data, Site Visits	X
	2B: Economic Development	Examination of existing transit supportive plans and policies; the demonstrated performance of those policies and tools in place to preserve or increase the amount of affordable housing in the project corridor	Qualitative	City zoning; Land use data	X
	2C: Reduce VMT-related impacts to environment	Rate primary (type of mode alternative) and secondary (e.g., vehicle miles traveled (VMT) offset and impact on congestion, air quality, greenhouse gases (GHG)) emissions from various mode alternatives and through different alignment alternatives	Quantitative	TDM, STOPS	X

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
ENCOURAGE TRANSIT COMPATIBLE LAND USE	2D: Reduce/minimize environmental impacts	These are computed based on the change in VMT resulting from the project: • Noise and Vibration • Historic and Cultural Resources • Parks and Open Space • Traffic/Transportation • Community Disruption/Displacement • Title VI/Environmental Justice • Utilities • CalEnviroScreen score	Quantitative / Qualitative	TDM; Alternative Description/ Information; GIS Analysis; STOPS	

FTA = Federal Transit Administration; GHG = Greenhouse Gas Emissions; GIS = Geographic Information Systems; STOPS = Simplified Trips-on-Project TDM= Travel Demand Model; VMT = Vehicle Miles Traveled

4.3.1.2. Land Use Summary

As shown in Table 4.10, Alternative H-3: *Harbor Rapid Streetcar* and Alternative H-5: *Harbor Bus Rapid Transit*, scored highest in Land Use among all alternatives, receiving 11.3 out of a possible 15 overall points apiece. Alternative H-1: *Harbor Short Streetcar* scored the lowest with 9 out of 15 points.

Alternatives H-3 and H-5 both scored "high" in 2C: *Reduce VMT-Related Environmental Benefits and Impacts* by contributing to a greater overall potential decrease in countywide VMT. Both alternatives, like all alternatives with a proposed alignment along Harbor Boulevard, also benefited from "medium-high" scores in 2A: *Encourage Transit Compatible Land Uses* because of current and future potential land use conditions along the corridor.

Alternative H-3 also scored "medium-high" in 2B: *Economic Development* due to potential integration with the OC Streetcar project in Santa Ana, and "medium-low" in 2D: *Reduce/Minimize Environmental Impacts* due to higher potential impacts from streetcar operations. Consequently, Alternative H-5 scored "medium" in 2B and 2D due to the lack of direct integration with the OC Streetcar project and the typically less impactful nature of BRT.

Alternative H-1 scored "high" in 2D due to its short alignment length, "medium" in 2A and 2B due largely, again, to its limited length, which constrains it from contributing to transit-compatible land uses and economic development. Finally, Alternative H-1 scored "low" in 2C due to its limited length which may constrain it from impacting regional VMT significantly.

Table 4.10. Land Use Summary Table

Alternative	Description	Land Use				Rating	Score out of 15
		2A	2B	2C	2D		
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	◑	◑	○	●	◑	***9.0***
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◕	●	◔	◕	11.3
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◕	●	◔	◕	***11.3***
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◕	◑	◑	◑	◑	9.8
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕	◑	●	◑	◕	***11.3***
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	◑	◕	●	○	◑	9.8
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◑	◕	●	○	◑	9.8
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◑	◑	◕	◑	◑	9.8
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◑	◑	●	◑	◕	10.5
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	◑	◕	◔	●	◕	10.5
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	◕	◑	◕	◑	◕	10.5
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	◕	◑	◕	◑	◕	10.5

Criteria 3: Connectivity

Mobility Problem: Connections to/from major activity centers are difficult for many transit users.

Goal: Ensure that major destinations for core transit ridership are reachable via one-seat transit rides or easy transfers.

Table 4.11. Objectives and Performance Measures – Connectivity

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
IMPROVE LOCAL & REGIONAL CONNECTIVITY	3A: Ensure major activity centers in the region can be reached within a reasonable amount of time	Determine the percentage of activity centers that can be reached within fifteen minutes, thirty minutes, forty-five minutes, one hour, greater than one hour, per alternative using isochrone mapping. Transfer times will be adjusted based on improvements in transfer areas.	Quantitative	TDM; GIS Analysis	
	3B: Ensure zero and one-transfer rides to all major regional activity centers	Identify all major activity centers in study area and adjacent region and determine number that can be reached with a one-seat ride per alternative and determine which mode alternative is better for select connections. Level of Stress measures similar to what is used for Active Transportation/Bike commutes will be analyzed to support this objective.	Quantitative/ Qualitative	TDM; GIS Analysis	
	3C: Compliance with Long Range Regional Mobility Goals	Ensure project complies and helps agency meet long-term regional goals.	Qualitative	2016 Southern California Association of Governments (SCAG) Draft Regional Transportation Plan (RTP)	X
	3D: Improve first and last mile connections to major hubs and seek opportunities to link to bike and pedestrian amenities	Evaluate existing connections to major hubs (FTC, SARTC, ARTIC) and activity centers (Downtown Fullerton, CtrCity Anaheim, The Anaheim Resort, Grove District) and compare travel time with alternatives. This measure will mainly focus on walk and bike sheds, although other first/last mile connections will be considered as applicable.	Quantitative	TDM, Bicycle and Pedestrian Plans	X

ARTIC = Anaheim Regional Transportation Intermodal Center; FTA = Federal Transit Administration; FTC = Fullerton Transportation Center
GIS = Geographic Information Systems; SARTC = Santa Ana Regional Transportation Intermodal Center; TDM = Travel Demand Model

4.3.1.3. Connectivity Summary

As shown on Table 4.12, Alternative H-3: *Harbor Rapid Streetcar* and Alternative L-2: *Anaheim/Lemon Rapid Streetcar* scored highest in Connectivity among all alternatives, receiving 13.5 out of a possible 18 overall points apiece. Alternative H-1: *Harbor Short Streetcar* scored the lowest with 8.1 out of 18 points.

Alternative H-3 scored "high" in both 3A: *Enhance Connectivity between Activity Centers* and 3C: *Comply with Long-Range Mobility Goals* due to its direct alignment along Harbor Boulevard and factors related to projected costs which would align it more closely with SCAG-defined regional mobility goals. Alternative H-3 scored "medium" in 3B: *Ensure Zero and One-Transfer Rides to Activity Centers* due in part, to its limited length (in comparison to longer alternatives which offer more zero-transfer rides) and "medium-low" in 3D: *Improve First/Last Mile Connections to Regional Transit Hubs and Connect to Bike/Pedestrian Amenities* because of limited bicycle and pedestrian amenities along Harbor Boulevard, and its lack of a connection to Anaheim's CtrCity District.

Consequently, Alternative L-2 scored "medium-high" in 3A, 3C, and 3D, due to its less direct and longer route, and its connections to a greater number of transit nodes. Alternative L-2 also scored "medium" in 3B due to its less direct route, requiring riders to potentially make additional transfers to reach activity centers.

Alternative H-1 scored "medium" in 3B and 3C, offering one additional zero-transfer ride, and making a marginal contribution toward the achievement of regional goals (due, in part, to improvements in regional economic development). Alternative H-1 also scored "medium-low" in 3A and "low" in 3D due its limited proposed length.

Table 4.12. Connectivity Summary Table

Alternative	Description	Connectivity				Rating	Score out of 18
		3A	3B	3C	3D		
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	◔	◑	◑	○	◔	***8.1***
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◑	●	○	◑	11.7
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	●	◑	●	◔	◕	***13.5***
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	●	◔	◑	○	◑	9.9
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	●	◔	●	○	◑	11.7
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	◔	◑	◕	◕	◑	11.7
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◑	◕	◕	◕	***13.5***
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◑	◔	◑	◔	◑	9.0
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	●	◔	◕	◔	◑	11.7
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	◔	◕	◑	◔	◑	9.9
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	◑	◑	◑	◑	◑	10.8
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	○	◑	◑	●	◑	10.8

Criteria 4: Constraints

Mobility Problem: Constrained corridor infrastructure is mainly allocated to personal automobiles.

Goal: Ensure roadway space is allocated equitably for travel modes to allow residents, workers and visitors to travel freely and safely through a variety of mode choices within the study area.

Table 4.13. Objectives and Performance Measures – Infrastructure Constraints

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
OPTIMALLY ALLOCATE INFRASTRUCTURE WITHIN CORRIDOR CONSTRAINTS	**4A: Optimally allocate roadway infrastructure** between auto movement, parking, and transit, bicycle, and pedestrian uses	Measure proposed roadway right-of-way (ROW) allocation by mode and compare to projected volumes by mode. Consider improvements as needed such as: • Queue jumpers • Lane reconfiguration • Lane restriping • Bus bays • Bulb-outs • Peak-hour travel lanes • Bicycle and pedestrian improvements	Quantitative/ Qualitative	TDM; Alternative Description/ Information	
	4B: Improve overall safety in corridor for all modes and identify collision hot spots	Identify hotspots for vehicle and pedestrian collisions and recommended improvements (e.g., crosswalks, striping, and signage) in areas of concern. The following are safety factors to be considered: • Decrease in modal conflict • Pedestrian safety elements (striping, crossing beacons, etc.) • Decrease in fatal and/or severe injury crashes	Qualitative/ Quantitative	TDM; Statewide Integrated Traffic Records System (SWITRS), Alternative Description/ Information	
	4C: Optimize traffic operations	Measure vehicular travel time impact on auto and other roadway modes	Quantitative	TDM	
	4D: Develop a project that compliments local neighborhoods and communities and minimizes constraints with physical corridor constraints	Assess project impact to physical environment—does project divide or segregate neighborhoods or communities? Does project require enhanced coordination with regional, state, and federal agencies?	Qualitative	Orange County, State of California, U.S. Federal Agencies	

FTA = Federal Transit Administration; TDM = Travel Demand Model

4.3.1.4. Constraints Summary

As shown in Table 4.14, Alternative H-1: *Harbor Short Streetcar* and Alternative H-4: *Harbor Enhanced Bus* scored highest in Constraints among all alternatives, receiving 12.8 out of a possible 15 overall points apiece. Alternative L-2: *Anaheim/Lemon Rapid Streetcar* scored the lowest with 4.5 out of 15 points.

Alternatives H-1 and H-4 both scored "high" in 4D: *Minimizing Conflicts with Structures and Utilities* due to the short length of the H-1 alignment and the assumed low impacts typically associated with a bus alternative.

Additionally, Alternative H-4 scored "high" in 4C: *Optimize Traffic Operations* and 4A: *Optimally Allocate Roadway Infrastructure* due to its minimal impact on existing roadway and traffic conditions. H-4 scored "medium" in 4B: *Roadway Incident and Collisions* based on incident/collision data on Harbor Boulevard and the assumed low impact of a bus on existing safety.

Similarly, Alternative H-1, scored "medium-high" in 4A, 4B, and 4C due to largely to its short length and direct route. Although impacts for H-1 would be on par with other streetcar alternatives, its short length minimizes the total area that would be affected.

Alternative L-2 scored "medium" in 4B due to the potential safety benefits of dedicated transit lanes and a medium number of required turns along its route. Consequently, L-2 scored "low" in 4A, 4C, and 4D largely because of its mode and route length (i.e., streetcars are generally more impactful than buses and longer routes carry a greater number of potential conflicts), and impacts typically associated with dedicated lanes.

Table 4.14. Constraints Summary Table

Alternative	Description	Constraints				Rating	Score out 15
		4A	4B	4C	4D		
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	◕	◕	◕	●	◕	**12.8**
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◑	●	○	◑	9.8
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◔	◕	◔	○	◔	6.8
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◕	◑	●	●	◕	***12.8***
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◔	◕	◔	◑	◑	8.3
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◔	◕	○	◑	8.3
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	○	◑	○	○	◔	***4.5***
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◕	◔	◕	●	◕	11.3
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	○	◑	○	◑	◔	6.0
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	◕	◕	◕	◑	◕	11.3
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	◕	◔	◑	●	◕	10.5
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	◕	◔	◑	◕	◑	9.8

Criteria 5: Mode Choice/User Experience

Mobility Problem: Inconsistent user experience at transit stops can be confusing; for many study area trips, mode choices are limited.

Goal: Enable transit-dependent riders, choice riders, and tourists to easily access transit options and improve perceptions of transit service.

Table 4.15. Objectives and Performance Measures – User Experience

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
ENHANCED USER EXPERIENCE/MODE CHOICES5	**5A: Attract new riders**	Increase ridership and ensure annual system-wide new riders exceed baseline average hourly boardings	Quantitative	TDM; ACS	
	5B: Reduce auto dependence/ auto trips and promote mode shift to transit (primarily focus on choice riders)	Measure before and after mode share for each alternative. Alternatives with larger non-auto mode shares will score better.	Quantitative	TDM; National Household Travel Survey (NHTS)	
	5C: Improve mobility for all households (primarily focus on zero-car households)	Increased ridership/capacity, including: • Annual study area transit ridership • Annual study area VMT Mobility Improvement: Estimated number of linked trips on the project by non-transit dependent persons + (Estimated number of linked trips taken by transit dependent)*2	Quantitative	TDM; ACS; STOPS	X
	5D: Improve user experience by evaluating level of amenities per stop	Evaluate stops by amenity level (e.g., informational materials, seating, shade, sidewalk conditions) and offer recommendations for improvements to suit ridership needs. Criteria will consider the following stop amenities and the quality/level of amenity: • Defined stops • Bench (basic, premium, ad) • Shelter (ad shelter, barrel vaulted roof shelter, high capacity, etc.) • Bus Service Information • Off-Board ticketing • Adequate lighting (hard-wired shelters, pole mounted) • Trash Cans	Qualitative	Alternative Description/ Information	

ACS = American Community Survey; FTA = Federal Transit Administration; STOPS = Simplified-Trips-on-Project; TDM = Travel Demand Model

4.3.1.5. Mode Choice/User Experience Summary

As shown in Table 4.16, Alternative H-3: *Harbor Rapid Streetcar* scored highest in Mode Choice/User Experience among all alternatives, receiving 14.5 out of a possible 17 overall points. Alternative H-4: *Harbor Enhanced Bus* scored the lowest with 4.3 out of 17 points.

Alternative H-3 scored "high" in 5A: *Attract New Riders,* 5B: *Promote Mode Shift to Transit, and* 5C: *Improve Mobility for all Households (Emphasis on Zero-Car Households).* However, H-3 scored "low" in *5D: Improve User Experience/Level of Amenities at Stops.* Alternative H-3's high rating in three out of four objectives underscores the primacy of Harbor Boulevard as the busiest transit corridor in Orange County and the substantial ridership benefits typically associated with streetcars and a dedicated transit lanes. Thus, substantial improvements to mobility on Harbor Boulevard would likely resonate more than improvements along other corridors. H-3 received a low score in 5D primarily because the net total improvement in station stop amenities and user experience would be marginal due to the existing level of stop amenities serving Bravo! 543 and Local Route 43 on the busy Harbor Boulevard corridor.

Alternative H-4 received a "low" rating for the very reasons that H-3 was rated so high in three of four objectives. The enhanced bus mode option, while potentially least impactful among all alternatives, also likely contributes a minimal amount to attracting new riders, promoting mode shift to transit, and improving mobility for all households. For reasons mentioned above, H-4 also scored low in 5D as it shares the same corridor as Alternative H-3.

Table 4.16. Mode Choice/User Experience Summary Table

Alternative	Description	Mode Choice / User Experience				Rating	Score out of 17
		5A	5B	5C	5D		
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	●	◑	◑	○	◑	10.2
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	●	◕	●	◔	◕	13.6
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	●	●	●	◔	◕	***14.5***
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	○	○	○	◔	○	***4.3***
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕	◕	◑	◔	◑	11.1
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	◕	◕	◑	◕	12.8
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◕	●	◕	◑	◕	13.6
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	○	○	○	◑	◔	5.1
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◑	●	◑	◑	◕	11.9
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	◕	●	◑	◔	◕	11.9
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	○	○	○	●	◔	6.8
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	◔	○	◔	●	◑	8.5

Criteria 6: Cost

Mobility Problem: Limited availability of transportation funding imposes a significant constraint on the design and extent of the final project.

Goal: Pursue cost-effective and financially feasible projects to balance mobility benefits and best use of public funds.

Table 4.17. Objectives and Performance Measures – Cost Effectiveness

GOAL	OBJECTIVE	PERFORMANCE MEASURE	METHOD	SOURCE	FTA
PURSUE PROJECTS THAT ARE COST EFFECTIVE	**6A: Design a cost-effective project while minimizing Capital and required Operations and Maintenance (O&M) costs**	Annualized capital cost plus annual O&M cost of the project divided by the annual number of forecasted trips on the project (Trips on the Project are the number of linked trips using the project, with no extra weight given to trips taken by transit dependent persons. Trips can be calculated using STOPS or the local travel model).	Quantitative/ Qualitative	Capital and O&M Cost Estimates; TDM	X
	6B: Operate the Project while minimizing O&M Costs	Incremental cost per new transit trip	Quantitative/ Qualitative	O&M Cost Estimate	
	6C: Build and operate a cost effective Project that balances costs and benefits	Farebox recovery—exceed systemwide average farebox recovery within three years of opening	Quantitative	TDM	
	6D: Financial Feasibility	Assess overall project cost and competitiveness for outside funding	Quantitative/ Qualitative	Capital and O&M Cost Estimates	

FTA = Federal Transit Administration; TDM = Travel Demand Model

4.3.1.6. Cost Summary

As shown in Table 4.18, Alternative H-5: *Harbor Bus Rapid Transit* scored highest in Cost among all alternatives, receiving 13.5 out of a possible 15 overall points. Alternative K-1: *Katella Streetcar* scored the lowest with 6 out of 15 possible points.

Alternative H-5 scored "high" in 6B: *Design a Project with Minimal Operations Costs* and 6D: *Design a Project that is Financially Feasible* due primarily to its low projected marginal annual operations and maintenance costs (on par with regular bus service), medium projected annual capital costs (halfway between streetcar and regular bus service), and as mentioned in Section 4.2.3 at the beginning of this section, the presence of dedicated lanes which are a requirement under federal funding guidelines. H-5 also scored "medium-high" in 6A: *Cost-Effectiveness* and 6C: *Balances Overall Project Costs* due, again, to its strong potential for enhanced ridership along with the cost-effectiveness of its mode in comparison to costlier modes like streetcar.

Alternative K-1 scored "medium" in 6D, "medium-low" in 6B and 6C, and "low" in 6A. In 6D, the high projected capital and operations and maintenance cost of the alternative is moderated by its connections to the Anaheim Resort, which may in turn enhance its attractiveness for outside funding. However, in 6B, 6C, and 6D, the high projected capital and operations and maintenance cost is not offset by strong projected ridership gains due to the project alignment which misses key ridership gains north of Katella Avenue.

Table 4.18. Cost-Effectiveness Summary Table

Alternative	Description	Cost				Rating	Score out of 15
		6A	6B	6C	6D		
H-1	Harbor Short Streetcar from Harbor Blvd/Westminster Ave to Anaheim Resort	○	◑	◑	◕	◑	8.3
H-2	Harbor Long Streetcar from Harbor Blvd/Westminster Ave to FTC	◑	◕	◑	◑	◑	9.8
H-3	Harbor Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◑	◕	◕	◑	◕	10.5
H-4	Harbor Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◕	○	◔	●	◑	9.0
H-5	Harbor Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕	●	◕	●	●	***13.5***
L-1	Anaheim/Lemon Streetcar from Harbor Blvd/Westminster Ave to FTC	◔	◑	◑	◑	◑	8.3
L-2	Anaheim/Lemon Rapid Streetcar from Harbor Blvd/Westminster Ave to FTC	◔	◑	◑	◑	◑	8.3
L-3	Anaheim/Lemon Enhanced Bus from Harbor Blvd/MacArthur Blvd to FTC	◕	◔	◑	●	◕	10.5
L-4	Anaheim/Lemon Bus Rapid Transit from Harbor Blvd/MacArthur Blvd to FTC	◕	◕	◑	●	◕	12.0
K-1	Katella Streetcar from Harbor Blvd/Westminster Ave to ARTIC	○	◔	◔	◑	◔	***6.0***
K-2	Katella + Anaheim/Lemon Enhanced Bus from Harbor Blvd/Westminster Ave to FTC, every other trip to ARTIC	◕	◔	◑	●	◕	10.5
K-3	Harbor Short Streetcar from Harbor Blvd/Westminter Ave to Anaheim Resort + Enhanced Bus from FTC to ARTIC via Anaheim/Lemon	◔	○	◔	◕	◔	6.8

Criteria 7: Community Input

Industry best practices suggest that OCTA pursue projects with broad support from stakeholders. To achieve this, OCTA considered input received during outreach activities and throughout project development. An overview of outreach activities in provided in Section 4. Outreach. Comments received and key themes developed throughout activity helped inform the project throughout the life of the study.

Table 4.19. Objectives and Performance Measures – Community Support

OBJECTIVE	PERFORMANCE MEASURE	SOURCE
Define a project with widespread support from Corridor Cities, Stakeholders, and Public	Measure support for alignment and mode alternatives from corridor cities (they can define how they want to provide this measure, such as staff or Council preferences), key stakeholders, and general public	Project Development Team meetings; Key Stakeholder Workshops; Public Open Houses; Project website

4.3.1.7. Community Input Summary

Community input and public support were considered separately and qualitatively throughout the course of this study. Due to the simultaneous nature of gathering public feedback while evaluating the alternatives proposed in this study, it was determined that the best course of action at this stage of project development was to consider feedback gathered from online surveys and public outreach events as broadly as possible, but to avoid restricting a particular alternative, mode, or corridor, given their preliminary status and ongoing refinement.

Moreover, community input gathered throughout the development of this study is considered part of a comprehensive and ongoing outreach program, consisting of input from a wide variety of public and private stakeholders, leading up to the preparation of an environmental document and the selection of one of the alternatives proposed in this study or any combination thereof.

Since the study began in 2015, OCTA has worked in close coordination with the cities of Anaheim, Fullerton, Garden Grove, and Santa Ana, in addition to major stakeholders such as Anaheim Resort Transportation, the California Department of Transportation, local residents, representatives from numerous local businesses/business associations, and community organizations. The following section contains an overview of the outreach program and a summary of activities, feedback gathered during these activities, and online survey results.

As mentioned above, the activities that have taken place to date form part of a comprehensive outreach program that will continue throughout subsequent phases of project development. The results in the following section thus supplement and inform the evaluation of corridor and mode technology but do not preclude any alternative (or combination thereof) from proceeding into a subsequent phase of project development.

5. OUTREACH

5.1. OVERVIEW

Over the course of the study, traditional outreach was supplemented with online and social media outreach to solicit input from a variety of stakeholders. Outreach was conducted in two phases, based upon technical milestones; Phase 1: Introducing and defining the study and its evaluation criteria; and Phase 2: Presenting draft alternatives, including alignment and mode options. Key stakeholder workshops (KSW), open house meetings, and online surveys were offered during each outreach phase. Stakeholder feedback was then used to help shape and further develop the alternatives being considered.

Key themes that emerged during both phases of outreach consisted of improving connectivity of transit services locally and regionally, providing better service to key destinations during key times (i.e., Disneyland Resort and sporting events at Honda Center and Angel Stadium of Anaheim), signal synchronization and enhanced cross-jurisdictional coordination, reducing congestion during peak times on Harbor Boulevard, balancing enhanced stop amenities with the presence of a growing homeless population, and developing a high-quality project that will benefit residents, visitors, workers, and employers alike.

As mentioned previously, the outreach activities summarized in this section are part of a larger, comprehensive outreach program that will continue throughout subsequent phases of project development. A final round of outreach is proposed after the completion of this report. That input will be used to inform the study recommendations future project phases.

The following section provides an overview of activities and feedback gathered during both phases of outreach, and a summary of online survey results. See Appendix D for exhibits used during this initial stage of outreach.

5.2. OUTREACH PHASE 1

Public outreach efforts supporting the first phase of this study focused on introducing stakeholders to the study and the following information and messages:

1. *Study Overview*
   a) OCTA is committed to improving transit along the Harbor Boulevard corridor.
   b) As Central Orange County continues to grow, enhanced mobility options will need to be considered.
   c) This study is the first step in determining a future vision for transit in the corridor; alternatives will be developed for further study and environmental review.

2. *Introducing the Central Harbor Boulevard Transit Corridor Study*
   a) Defining the Corridor:
      i. Harbor Boulevard is the busiest bus corridor in Orange County, connecting a uniquely jobs- and population-dense corridor through the cities of Fullerton, Anaheim, Garden Grove, and Santa Ana.
      ii. Harbor Boulevard reflects the demographic and physical diversity of Orange County, traversing neighborhoods consisting of multi-family units, single family homes, historic properties, small businesses, and resort properties.

   b) Study Goals and Objectives:
      i. The study will develop a set of alternatives to improve transit on Harbor Boulevard.

   c) Purpose and Need:
      i. Harbor Boulevard is an important north-south transit spine.
      ii. Harbor Boulevard offers the highest-frequency transit service in Orange County.
      iii. Harbor Boulevard is important to the Resorts, Tourism, and Jobs in the area.
      iv. Harbor Boulevard is home to the highest residential and employment densities in Orange County.
      v. Harbor Boulevard connects to numerous planned and proposed transit projects.
      vi. Investment in the Harbor Boulevard corridor supports the goals of voter-approved Measure M1/M2.
      vii. Investment in the Harbor Boulevard corridor supports transit rider demographics and needs.
      viii. Investment in the Harbor Boulevard corridor helps OCTA meet the challenge of growing transit ridership.
      ix. Investment in the Harbor Boulevard corridor carries out the OC Bus 360 plan.
      x. Investment in the Harbor Boulevard corridor enhances connections to regional rail.
   d) Route Options and Transit Modes:

i. Identifying possible connections Harbor adjacent for the alternatives to consider, including Anaheim Boulevard/Lemon Street, and Katella Avenue.

e) Public Participation:
   i. Stakeholder feedback from study corridor cities, key stakeholder organizations, and the public is important in shaping the alternatives to improve transit and mobility in the study area.

To support the dissemination of the study's messages a fact sheet and website were developed (see Appendix D).

5.2.1. Key Stakeholder Workshops

In an effort to engage a diverse group of stakeholders in the study process, OCTA hosted a Key Stakeholder Workshop on January 28, 2016. The KSW provides an opportunity for community leaders to receive information in advance of the general public and provide early feedback. This helps the study team confirm assumptions, identify possible areas of concern, and reach deeper into the community by asking participants to share information with their constituents. Specifically, participants are asked to assist OCTA by sharing information about upcoming public meetings and online survey opportunities, and are encouraged to schedule speaker's bureau-style presentations with their constituents.

OCTA invited more than 75 leaders from business, tourism, education, faith, neighborhood/homeowner, community, health, and ethnic associations to participate in the KSW. Invitees received both a letter via mail and email, as well as follow up phone calls. Approximately 19 stakeholders participated in the KSWs.

During the meeting, the study was introduced and information supporting the messages outlined in this this report were shared. A presentation was provided and stakeholders were encouraged to ask questions and provide feedback.

The KSW invitee list, invitation letter, meeting agenda, presentation slides and meeting notes can be found in Appendix D.

5.2.2. Public Open Houses

OCTA hosted two open houses in February 2016 to provide the public with an opportunity to learn about the study, ask questions, and provide feedback. Both open houses were held from 5:00 to 8:00 p.m. and featured information stations staffed by project team members. Each meeting provided Spanish language support by having a bilingual technical and outreach team member available. Presentation slides were displayed on a loop throughout the meeting. Approximately 25 stakeholders attended each meeting.

A virtual meeting was made available following the meetings via the OCTA website and featured the full complement of information boards and presentation slides. Open House location information is shown in Table 5.1.

Table 5.1. Phase 1 Open Houses

Community	Date	Location/Address
Fullerton	Wednesday, February 24	Fullerton Community Center 340 W. Commonwealth Fullerton, CA
Garden Grove	Thursday, February 25	Garden Grove High School 11271 Stanford Ave. Garden Grove, CA

5.2.3. Summary of Feedback from Phase 1 Activities

Feedback from the abovementioned open houses yielded the following themes:

a) Improve connectivity of transit services locally and regionally, first/last mile connection particularly important.

b) Maintain or improve pedestrian and bicycle access in the corridor.

c) Provide efficient linkages to key destinations.

d) Make sure service is expanded/synchronized to serve Disneyland and sporting events.

e) Signal synchronization between jurisdictions to improve traffic flow for all vehicles.

f) Address congestion during peak times on Harbor Boulevard, including long waits at intersections and behind buses.

5.2.4. Online Survey

An online survey was developed for the convenience of stakeholders to gather additional information from the website, and provide their thoughts on transit improvements on Harbor Boulevard.

A link to the online survey was shared via the study website, email blasts, on tablets at the open house meetings, distributed by ride share coordinators for large employers, and via Facebook ads.

The online survey, was provided in English, Spanish, and Vietnamese. The survey garnered 603 unique visits and 413 responses for a 68.5 percent total completion rate. The majority of respondents identified themselves as commuters, employees, and/or residents within the study

area. More than 60 percent of respondents reported using transit on a daily, weekly, or monthly basis. Of these individuals, 69 percent were between the ages of 25 and 54. Table 5.2 is a summary of the feedback received via the online survey. A copy of the online survey is provided in Appendix D.

Table 5.2. Online Survey (Spring 2016) Results

Topic	Responses		
Biggest challenges for transit in the study area	Transit/roadway performance (27%)	Mode choices (25%)	Connectivity (17%)
Average rating for mode option preferences (Out of 10)	7.07 for streetcar	6.60 for BRT	6.10 for limited-stop bus
Most important transit characteristics (Able to choose multiple)	Frequency of service (59%)	Travel time compared to other modes (54%)	Convenient service hours (52%)
Most important connection within the study area	Disneyland Resort (39%)	Downtown Anaheim (17%)	Fullerton Transportation Center (13%)
Major activities participated within the study area (Able to choose multiple)	Working (64%)	Dining (54%)	Shopping (38%)

5.3. OUTREACH PHASE 2

Public outreach efforts supporting the second phase of this study focused on sharing and receiving feedback on the 12 draft alternatives defined in section 3.3 of this report. To help stakeholders differentiate and select their alternative preference, messaging is focused on the two main differentiating factors: corridor option and mode technology.

1. *Study Overview*
   a) Messaging remained consistent with those identified in section 2.1 of this document.

2. *12 Alternatives*
   a) Corridor Options:
      i. Harbor "Long": From Westminster Avenue in the south to Chapman Avenue (in Fullerton) in the north.
      ii. Harbor "Short": From Westminster Avenue in the south to the Anaheim Resort in the north.
      iii. Anaheim/Lemon: From Westminster Avenue to the FTC via Anaheim Boulevard and Lemon Street.
      iv. Katella: From Westminster to to ARTIC via Harbor Boulevard and Katella Avenue.

3. *Transit Modes*
   a) Enhanced Bus
   b) Bus Rapid Transit
   c) Streetcar
   d) Rapid Streetcar

4. *Public Participation*

Stakeholder feedback from partner cities, key stakeholder organizations and the public was collected as part of this outreach phase. This information is important in shaping the alternatives to improve transit and mobility in the study area.

To support the dissemination of the study's messages, the study fact sheet and website are provided in Appendix D.

5.3.1. Key Stakeholder Workshops

The second Key Stakeholder Workshop (KSW) was convened on March 9, 2017. Approximately 100 key stakeholders were invited to participate in the KSW, including stakeholders invited to participate in the first meeting and additional stakeholders identified as representing the Katella Avenue study area that was added to the study area in fall 2016. In all, 21 stakeholders participated.

To share the 12 Alternatives, presentation slides were prepared and stakeholders were encouraged to review a roll plot of the study area and information boards on the corridor and mode options. Stakeholders were also encouraged to ask questions and provide feedback throughout the workshop. The KSW invitee list, invitation email, meeting agenda, presentation slides, information boards, sign-in sheet and meeting notes can be found in Appendix D.

5.3.2. Public Open Houses

OCTA hosted two open houses on March 30 and April 5, 2017 to provide the public with an update on the study and an opportunity to ask questions and provide feedback. The two open houses were held from 5:00 to 7:00 p.m. and featured a large roll plot of recent satellite imagery of the corridor, boards focusing on corridor and mode options were displayed, and a comment station offering stakeholders the opportunity to complete the online survey, and/or a paper/electronic comment form. A digital presentation was provided and a brief question and answer session took place. Team members were available to engage with stakeholders one-on-one throughout the meeting. Additionally, attendees were encouraged to indicate corridor, mode, and origin/destination preferences using colored dot stickers. Attendees were also invited to leave notes on the roll plot to identify any location-specific issues the study team should consider.

Since a presentation was provided, a Spanish language translator was available to assist non-English speakers. Approximately 25 stakeholders attended the meetings. A virtual meeting was made available following the meetings via the OCTA website and featured the full complement of information boards and presentation slides. Open House location information is shown in Table 5.3.

A copy of the 2017 Anaheim City Council resolution (Res-2017-009) opposing a streetcar alternative within city limits was made available for stakeholders to review during the Anaheim open house event.

Table 5.3. Open House Locations

Community	Date	Location/Address
Garden Grove	Thursday, March 30	Garden Grove Community Center 11300 Stanford Ave Garden Grove, CA
Anaheim	Wednesday, April 5	Anaheim City Hall West Gordon Hoyt Conference Room 201 S. Anaheim Blvd Anaheim, CA

5.3.3. Summary of Feedback from Phase 2 Activities

Feedback from the abovementioned activities yielded the themes listed below. In some cases, these themes reiterated themes from the first phase of outreach activity.

a) Improve connectivity of transit services locally and regionally, in addition to first/last mile connections.
b) Maintain or improve pedestrian and bicycle access in the corridor.
c) Provide efficient linkages to key destinations.
d) Expand hours of service.
e) Balance enhanced stop amenities with challenge of homeless population.
f) Improve traffic flow for all vehicle through signal synchronization between jurisdictions.
g) Address congestion during peak times on Harbor Boulevard, including long waits at intersections and behind buses, and east-west traffic flow.
h) Consider both streetcar and bus options.
i) Focus on north-south connections.

5.3.4. Online Survey

Given the levels of response received during Phase 1 to the online survey, two new surveys were developed to share information about corridor and mode option, and solicit feedback. Two surveys were offered: a short and long version which stakeholders could self-select based on their level of interest, time, etc.

A link to the online survey was shared via open house notification materials, the study website, email blasts, on tablets at the open house meetings, distributed by ride share coordinators for large employers, and Facebook ads. Additional in person outreach was conducted at select bus stops on Harbor Boulevard, Metrolink Station(s) providing commuters the opportunity to complete the survey while they waited for their trains. Additionally, online survey information was shared with OCTA's Citizens Advisory Committee.

The survey garnered 683 responses, with 518 completing the short survey and 165 completing the long survey. The overwhelming majority of survey respondents were in favor of improving transit and were evenly split between streetcar and bus options (when both streetcar and bus modes were combined). When controlling for specific mode, survey respondents favored the Rapid Streetcar mode option and the "Harbor Long" corridor option. A copy of the online survey is provided in Appendix D.

Table 5.4. Online Survey (Spring 2017) Results

Topic	Responses					
Transit Improvements Desired:	Yes **92%**			No **8%**		
Bus versus Rail:	Bus **37%**			Rail **37%**		
Mode	Rapid Streetcar	Enhanced Bus	BRT	Streetcar	Hybrid	N/A
Preference:	**24%**	**20%**	**17%**	**13%**	**10%**	**15%**
Among Current Riders:	**29%**	**29%**	**19%**	**15%**	**8%**	**-**
Among Non-Riders:	**41%**	**10%**	**19%**	**19%**	**11%**	**-**
Corridor	Harbor "Long"	Katella	Anaheim/ Lemon	Harbor "Short"	N/A	
Preference:	**37%**	**23%**	**20%**	**2%**	**19%**	
Among Current Riders:	**58%**	**20%**	**12%**	**10%**	**-**	
Among Non-Riders:	**40%**	**40%**	**14%**	**6%**	**-**	
Activities (multiple):	Dining **73%**	Working **63%**	Recreation **58%**	Shopping **58%**	Tourism **39%**	Education **19%**
Most Important Transit Service Characteristics:	Frequency **68%**	Hours **49%**	Trip Time **41%**	Stop Location **29%**	Cost **28%**	Real-Time Info. **24%**
Transit Usage Frequency:	Never but would consider: **38%**	Daily **20%**	Weekly **9%**	Would never consider: **2%**		
Evaluation Criteria Ratings:	Connectivity rated highest		Land Use rated lowest			

5.4. OTHER OUTREACH ACTIVITIES

The OCTA Board of Directors provided input on the study during five regular monthly board meetings: July 2015, January 2016, October 2016, February 2017, and March 2017.

6. PRELIMINARY FINDINGS AND PROPOSED NEXT STEPS

The results presented in this study will help inform the development of a long-term transit improvement strategy in this corridor. This report summarizes the findings of an initial planning study. OCTA acknowledges that more discussion and feedback is needed before final recommendations can be made.

6.1. KEY ISSUES

Some of the key issues identified by the cities that would require additional analysis in the next study phase or would need to be addressed prior to more study include:

a) *Dedicated Transit Lanes*
A thorough analysis of the benefits and impacts of dedicated transit lanes, as well as identification of performance measures for evaluating appropriate locations, is needed before city staff can consider these.

b) *Master Plan of Arterials and Highways* (MPAH) *Guidelines*
The path and process for amending the MPAH[23] Guidelines to allow for a change in transit corridor status will need to be outlined and made available to city staff considering any changes to existing traffic operations.

c) *Center-Running Alignments and Median Stops*
There is limited support among the jurisdictions for center-running alignments with median stops due to the likelihood that this configuration would require additional right-of-way and reconfiguration of left-turn pockets to accommodate stops.

d) Harbor Boulevard Constraints
A portion of Harbor Boulevard in northern Anaheim has not been built out to full capacity and is limited to four traffic lanes in width. This is a potential physical constraint that must be considered with various improvement strategies. Additionally, the proximity of residents in the Anaheim Colony Historic District to Harbor Boulevard make this an area of increased community sensitivity which must be taken into consideration. For these reasons, further evaluation of both the Harbor and Anaheim/Lemon alignments is recommended.

[23] The Orange County Master Plan of Arterial Highways (MPAH) is a countywide transportation plan that defines the ultimate number of through lanes of arterial streets, and designates the traffic signal synchronization street routes in Orange County. OCTA administers the MPAH through coordination with cities and the County to develop a consensus-based, consistent, and inter-community arterial highway system that effectively balances regional mobility and local access for existing and future land uses.

e) *Service South of Westminster Avenue*
With the implementation of some streetcar and bus alternatives, a corresponding reduction in bus service frequencies on Harbor Boulevard south of Westminster Avenue is assumed. Staff from the City of Santa Ana have indicated that this would be an issue of concern.

f) *Evaluation of the Streetcar Mode Option*
The Anaheim City Council adopted a resolution in January 2017 stating opposition to a streetcar in the city of Anaheim. Among the reasons stated in the resolution were concerns over the expense of a streetcar, disruptions to traffic and potential added congestion, and lack of flexibility of such a system. The city of Anaheim accounts for a considerable part of the project study area, and all 12 of the study alternatives travel into or through the city.

6.2. NEXT STEPS

A final round of outreach is proposed in early 2018 to present the evaluation results to the cities in the study area, key stakeholders, and the general public. The reports prepared for this study will also be available on the study webpage for public review and comment. The input received from the cities, the public, and stakeholders will be incorporated into a revised Final Report and, as mentioned, inform the study's recommendations.

The top ranked alternatives have the potential to provide significant transportation benefits and compete well in state and federal funding programs. As the county transit agency, OCTA will continue to work with the corridor cities to move alternatives forward. With Board approval, OCTA staff will be presenting the study results to local city councils and the stakeholder working group for feedback. If sufficient support develops around a few alternatives, OCTA could recommend those be advanced to the next step of the process, which would be a detailed environmental review.

If consensus is not developed, OCTA may spend additional time discussing project concerns with cities and refining alternatives to develop sufficient support. OCTA may also consider making lower cost, lower impact transit improvements in the study area which are more under OCTA's direct control.

7. APPENDICES

Appendix A: *Corridor Diagrams*
Appendix B: *Detailed Evaluation Criteria Results Worksheets*
Appendix C: *Performance Metric Descriptions and Methodologies*
Appendix D: *Outreach Attachments*

7.1. APPENDIX A: CORRIDOR DIAGRAMS

7.2. APPENDIX B: DETAILED EVALUATION CRITERIA RESULTS WORKSHEETS

7.3. APPENDIX C: PERFORMANCE METRIC DESCRIPTIONS AND METHODOLOGIES

7.4. APPENDIX D: OUTREACH ATTACHMENTS