City of Redondo Beach
Travel Demand Modelling Report

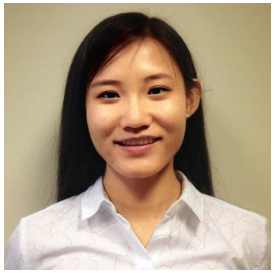
CE599 Transportation Modelling

Fawzan Saleh Alfawzan, MSCE 2019
Rui Zhang, MPL 2018

ACKNOWLEDGEMENT

We sincerely appreciate Dr. Fatemeh Ranaiefar›s guidance and instructions on this study

ABOUT US



RUI (RAE) ZHANG

Master of Planning 2018

USC Sol Price School of Public Policy

zhan305@usc.edu

Rui (Rae) Zhang is a second-year Master of Planning student at USC with transportation concentration. She has internship experience with transit finance and research experience with freight studies. She is interested in GIS applications as well as finance and environmental clearance for transit and freight projects. She plans to start her career as a transportation/ environmental planner in the private sector.

FAWZAN SALEH ALFAWZAN

Master of Science in Civil Engineering - Transportation Engineering 2019

USC Viterbi School of Engineering

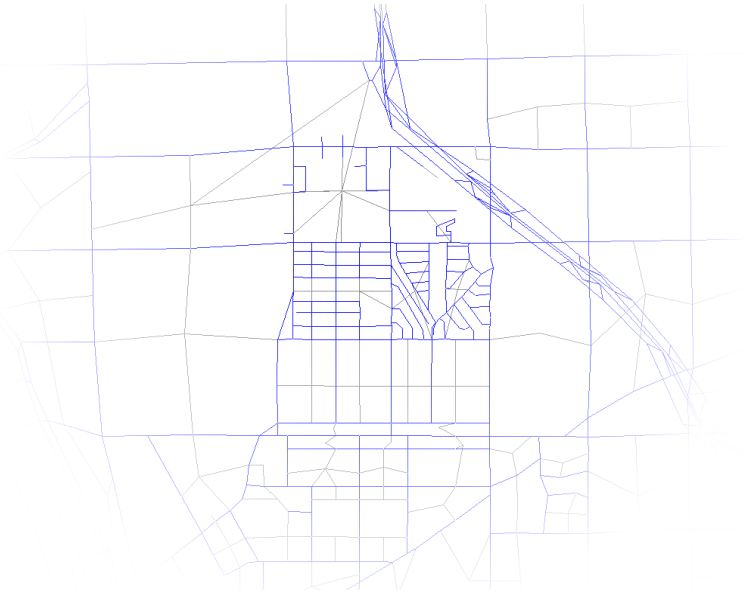
falfawza@usc.edu

Fawzan Alfawzan is a Civil Engineer with bachelor degree from Qassim University . He is pursuing his master's degree in transoprtation engineering at university of Southern California. He is interested in adding more values to the transportation industry and build new initiatives which utilize the transportation services.

TABLE OF CONTENTS

INTRODUCTION

The purpose of this report is to introduce the Travel Demand Forecasting (TDF) model built for the City of Redondo Beach with CUBE version 6.4. This report describes the model development and updating based on the source data originally validated in the year of 2008, provides forecasts of future travel demand in the year of 2028, and includes traffic impact analysis of an assumed comprehensive development project in Study Area 15. The citywide model contains 17 study areas (1-16, and 18) composed of 175 Traffic Analysis Zones (TAZ). Study Area 15 and 16 are the concentration of this report, which are made up of TAZ 5 – 8 and 1 – 4 respectively. Three scenarios are built to analyze traffic impacts, including base year (2008), future without project (2028) and future with project (2028).



Network Updating

The model networks are updated in Study Area 15 and 16 by adding new links with more detailed attributes of link speed, facility type, one/two-way direction toll cost. and zone ID.

Trip Generation

For the newly added project in Study Area 16, we used ITE Trip Generation Table to calculate the trips.

Trip Distribution

The model assigned the trips of the 2008 base scenario, 2028 future base scenario and 2008 future with project scenario to the study areas.

Trip Assignment

Following the trip distribution, the model assigns trips to links in the 17 study areas for impact evalution.

STUDY AREA

Boundary

Highway 405 intersects with Study Area 16 on Inglewood Avenue (the eastern border) and crosses above Marine Ave (the northern border). On the south, 2nd St – Robinson St – 166th St separate Study Area 15 from 14. North Aviation Blvd is the left border of the study area.

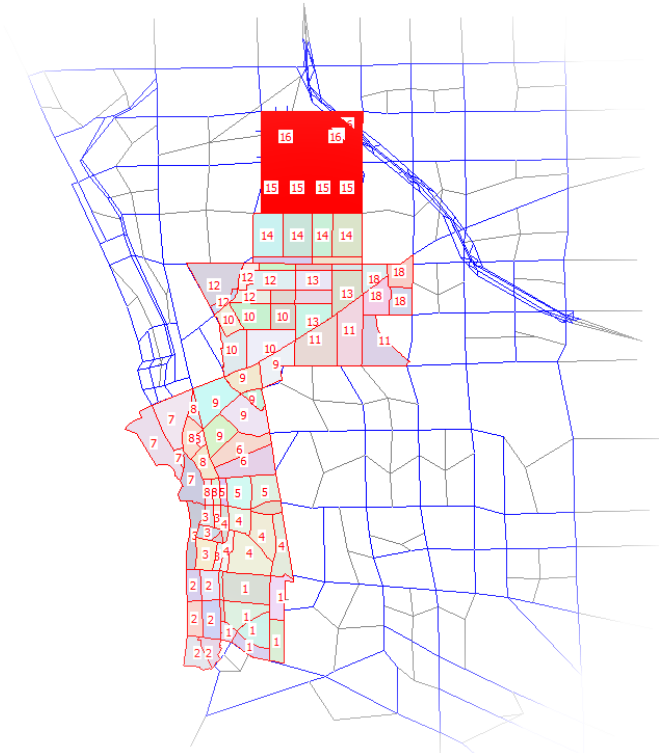


Figure 1.1 Study Area Distribution

Land Use

Study Area 16 is functional land use: industrial (light industrial and industrial-commercial) while 15 is basically all residential (single family and multi-family). They jointly constitute Census Tract 6205.01. Tt is hard to generate a solid modelling process if we only choose one of them with an estimate of half of the population for whole census tract. Therefore, we selected Study Area 15 and 16 as a unified area for the modelling study. Apart from light-industrial and residential land use, it is noteworthy that there is an aerospace museum and an arts center in Study Area 16, as well as a park and an elementary school in Study Area 15, which can be major traffic generators to be considered.

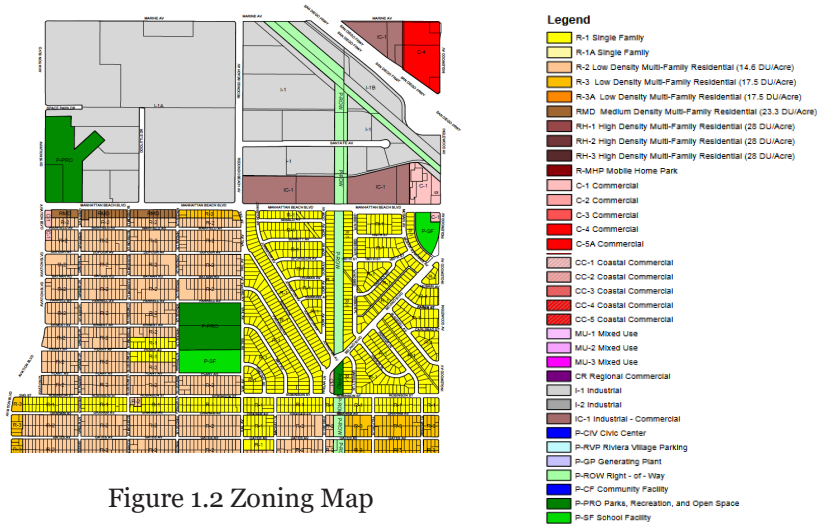


Figure 1.2 Zoning Map
Source: City of Redondo Beach

Population and Vehicle Ownership

According to the American Community Survey conducted in 2010 and related estimates, household of the census tract reached 2,094 with an average household size of 2.92. It was estimated that in 2016, the number increased to 2,142 and 2.81. Shown as Table 2.1 Household Size by Vehicle Available in 2016, there are totally about 4,574 vehicles available owned by 2,142 households. On average, every household owns 2.14 vehicles. Median household income was $124,296 measured in 2016 inflation-adjusted dollars, almost 10 times of California median household income level.

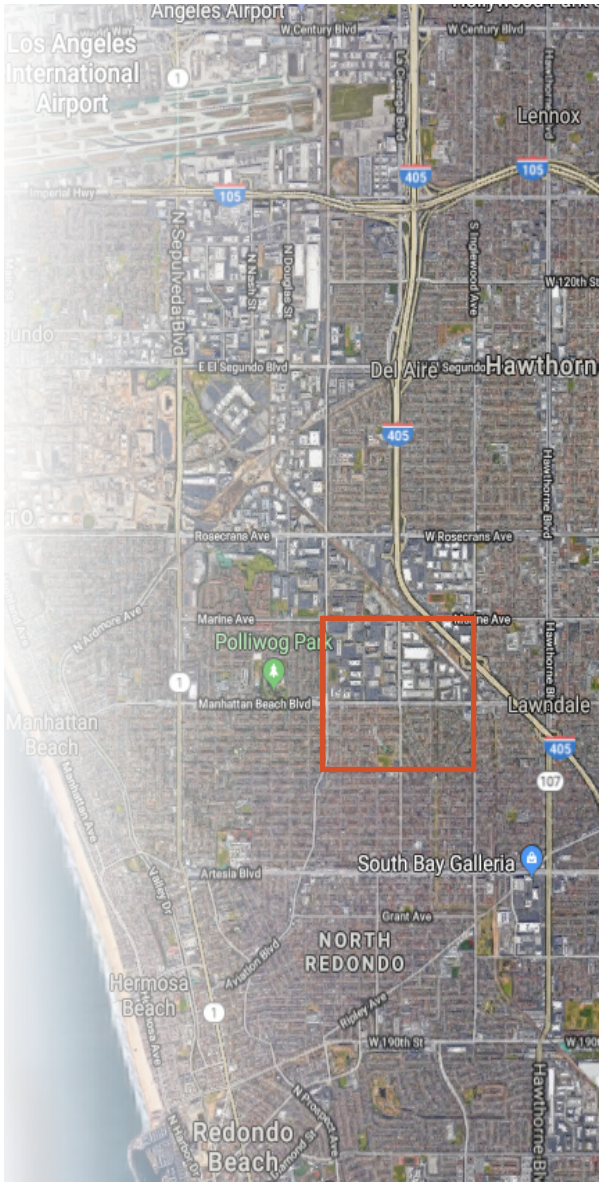
	Census Tract 6205.01, Los Angeles County, California	
	Estimate	Margin of Error
Total:	2,142	+/-50
No vehicle available	26	+/-31
1 vehicle available	488	+/-152
2 vehicles available	983	+/-175
3 vehicles available	460	+/-139
4 or more vehicles available	185	+/-79
1-person household:	305	+/-122
No vehicle available	0	+/-17
1 vehicle available	244	+/-106
2 vehicles available	61	+/-54
3 vehicles available	0	+/-17
4 or more vehicles available	0	+/-17
2-person household:	770	+/-181
No vehicle available	15	+/-24
1 vehicle available	106	+/-101
2 vehicles available	515	+/-141
3 vehicles available	80	+/-56
4 or more vehicles available	54	+/-60
3-person household:	446	+/-145
No vehicle available	11	+/-20
1 vehicle available	76	+/-65
2 vehicles available	195	+/-100
3 vehicles available	164	+/-91
4 or more vehicles available	0	+/-17
4-or-more-person household:	621	+/-178
No vehicle available	0	+/-17
1 vehicle available	62	+/-54
2 vehicles available	212	+/-122
3 vehicles available	216	+/-118
4 or more vehicles available	131	+/-72

	Census Tract 6205.01, Los Angeles County, California	
	Estimate	Margin of Erro
Total:	2,006	+/-1
No vehicle available	44	+/-
1 vehicle available	499	+/-1
2 vehicles available	883	+/-1
3 vehicles available	361	+/-1
4 or more vehicles available	219	+/-1
1-person household:	479	+/-1
No vehicle available	44	+/-
1 vehicle available	283	+/-
2 vehicles available	139	+/-
3 vehicles available	13	+/-
4 or more vehicles available	0	+/-1
2-person household:	618	+/-1
No vehicle available	0	+/-1
1 vehicle available	111	+/-
2 vehicles available	352	+/-1
3 vehicles available	124	+/-
4 or more vehicles available	31	+/-
3-person household:	423	+/-1
No vehicle available	0	+/-1
1 vehicle available	32	+/-
2 vehicles available	250	+/-1
3 vehicles available	125	+/-
4 or more vehicles available	16	+/-
4-or-more-person household:	486	+/-1
No vehicle available	0	+/-1
1 vehicle available	73	+/-
2 vehicles available	142	+/-
3 vehicles available	99	+/-
4 or more vehicles available	172	+/-

Table 2.1 Household Size by Vehicle Available in 2016 and 2010

Source: American FactFinder

2012-2016 American Community Survey 5-Year Estimates



2008 Base Year OD Matrix

Traffic volume of four time periods are compared in the table 2.2 for TAZ 1-8: AM peak hour, mid-day, PM peak hour and night time. PM peak hour shows the highest traffic volume of a day, more than 4.5 times of AM time, roughly 4 times of mid-day and 2.5 times of night time. Inbound and outbound trips generally remain equal, with slight differences throughout a whole day. Night time traffic is higher than AM and mid-day, reflecting more activities in the city during PM time. OD trip tables of the four time periods for the 175 TAZs are listed as Appendix A.

TAZ 1-8	AM	Mid-Day	PM	Night
Inbound	1301	1536	6067	2614
Outbound	1289	1601	5978	2472
Intrazonal	108	195	660	240
Total (not including intrazonal)	2590	3137	12045	5086

Table 2.2 Traffic Volume of Four Time Periods in Base Year 2008

Top three destinations from the study area are TAZ 152, 153 and 165, all of which are entrances/exits of highway 405. This reflects the study area's function as a traffic zone connecting arterials and highways, i.e., connecting the city with the SoCal region.

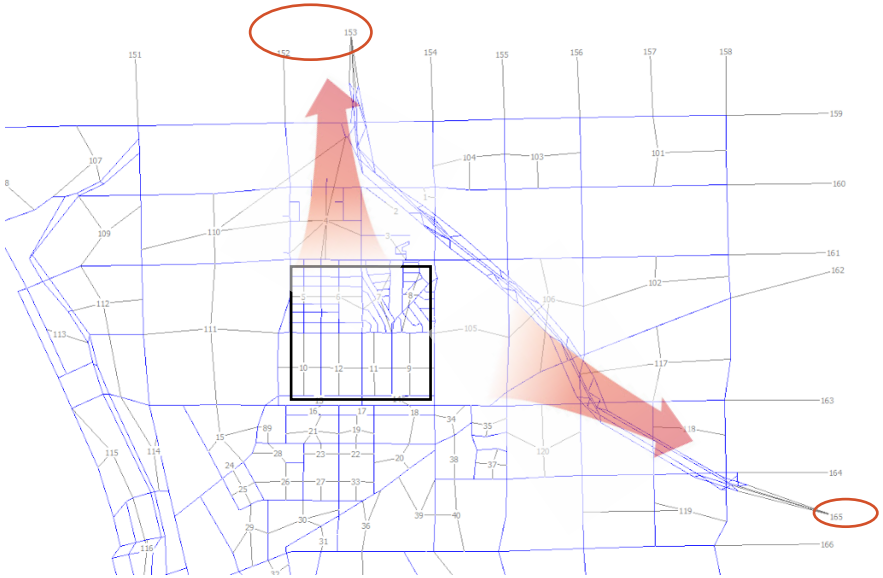


Figure 2.3 Top Destinations for Trips Starting in Study Area 15 and 16

MODIFICATION TO TRANSPORTATION NETWORK

We updated the road networks in this region with comparison to Google Maps. We firstly confirmed the speed limits for each segment of the road network, the capacity of the network, and location of the centroid connectors. In addition, we added several links and associated turn penalties.

Figure 3.1 and 3.2 reflect the revised networks and their characteristics. Links are color coded by facility type and other attributes.

We checked the turn penalty and added one setting for an intersection which is linked through Node 1990, 1989 and 1997 (value of -1 means prohibition). We assume that North Aviation Blvd is a toll road with unit cost $0.5/mile.

COLOR CODED BY ATTRIBUTES

Note: Due to the absence of GIS connection in CUBE education version, we cannot provide legends or scale bars for the maps.

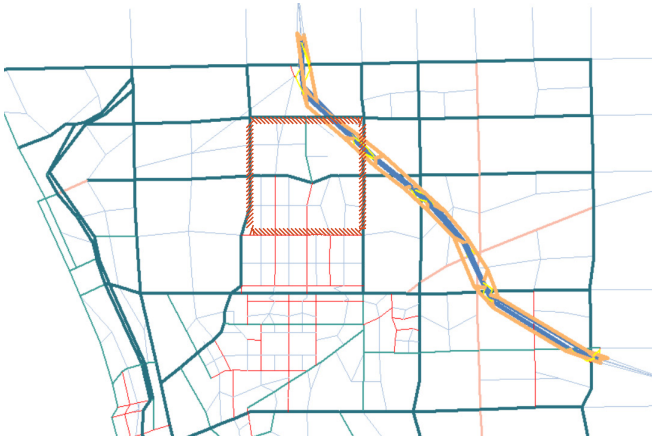


Figure 3.1 Original Network

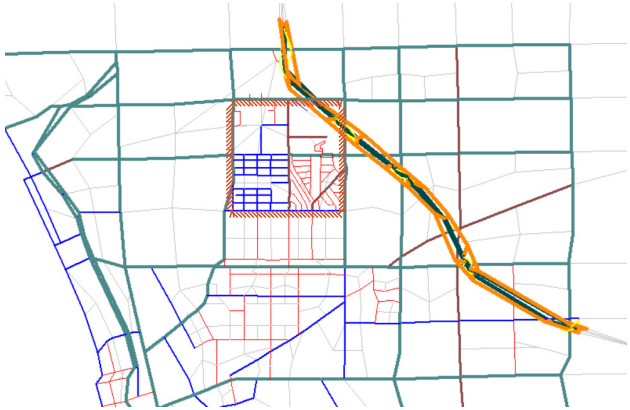


Figure 3.2 Modified Network
Links are added to Study Area 15 and 16.

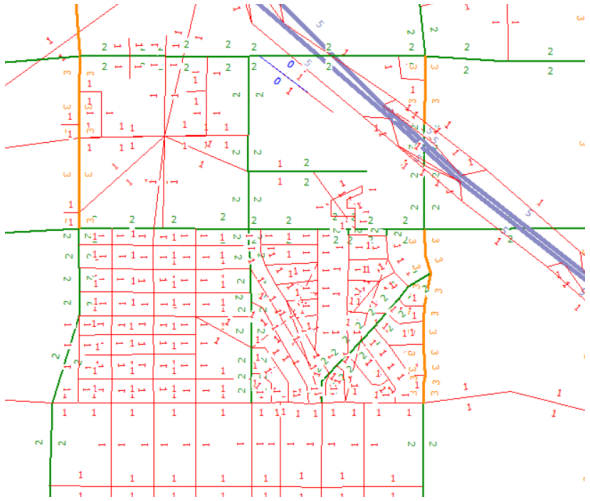


Figure 3.3 Network Coded by Number of Lanes

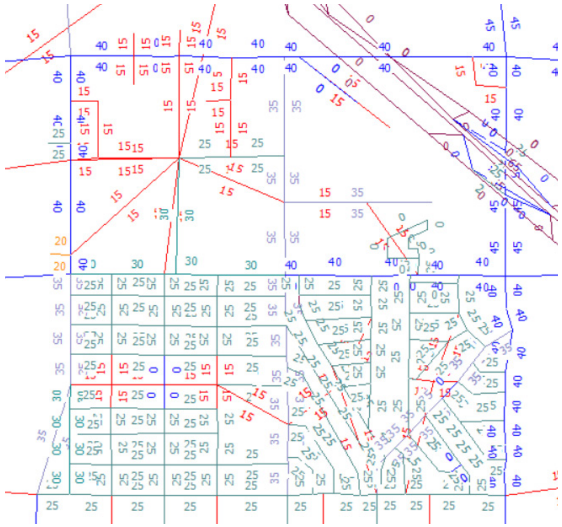


Figure 3.4 Network Coded by Calculated Speed

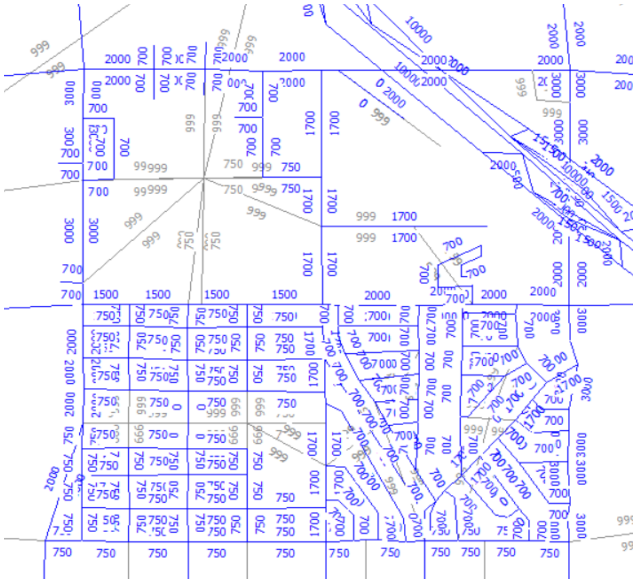


Figure 3.5 Network Coded by Link Capacity

TOLL SETTING ON MANHATTAN BEACH BLVD

After setting the toll with $0.5/mile unit cost to Manhattan Beach Bvld, the model stopped assigning trips to the toll segments.

TOLL SETTING ON NORTH AVIATION BLVD

We switched the toll settings to N Aviation Blvd to check the impacts and witnessed trips assigned to the toll segments.

TRNPEN_studyarea15-16 - Notepad

File Edit Format View Help

1955	1847	1174	0	15
1174	1281	1851	0	20
1851	1281	88	0	15
88	1281	1276	0	20
88	1281	1174	0	10
88	1281	1851	0	10
1276	1281	1174	0	20
1958	1175	1176	0	15
1958	1175	1851	0	10
1176	1175	1851	0	20
1366	1175	1851	0	25
1851	1175	1958	0	15
1851	1175	1176	0	30
1851	1175	1366	0	10
1794	1319	1433	0	25
1433	1319	1808	0	20
1433	1319	1812	0	20
1433	1319	1794	0	30
1808	1319	1812	0	20
1808	1319	1794	0	5
1808	1319	1433	0	5
1812	1319	1794	0	35
1812	1319	1433	0	35
1812	1319	1808	0	10
1485	1454	1455	0	-1
1990	1989	1997	0	-1

Figure 3.6 Turn Penalty

Figure 3.7-1 Ineffective Toll Road Setting

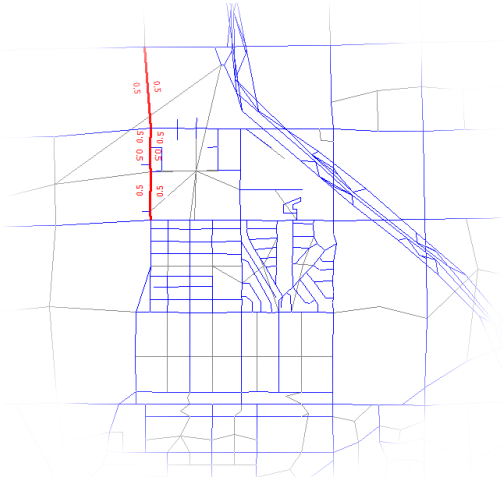


Figure 3.7-2 Effective Toll Road Setting

USER EQUILIBRIUM

No driver can unilaterally reduce his/her travel costs by shifting to another route. It is assumed that drivers have perfect knowledge about travel costs on a network and choose the best route according to Wardrop›s first principle, this behavioural assumption leads to deterministic user equilibrium.

UNLIMITEDLINKCAPACITY

ALL-OR-NOTHING

ALLTOSHORTESTPATH

SKIMMING

Figure 4.1 Base Year Cube Modelling App

To best understand the traffic flow of the network in the study area, we analyzed the shortest path between the 17 study areas of the Redondo Beach Network Model. This analysis compares the shortest path of User Equilibrium (UE) and All-or-Nothing (AON) modes based on distance, travel time, and generalized cost.

Cost= ($/mile)*(distance in (mile)) + (time value in $) + (Toll price)*(distance in mile) + (hour cost*time)pay and average gas cost per mile).

Modelling application of the base year includes three major parts: calculating actual speed by facility type, assign trips by UE and AON modes to generate OD trip distances, time and generalized cost, as well as export the link data to csv files. Based on the shortest path between centroids, we summarized the average distance, time and cost per trip between study areas. Raw shortest path tables are shown in Appendix B.

OD trip distances of two modes are compared under the generalized cost and time assignments.

2008 UE-AON Average Time

AON Average Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	0.05	0.05	0.06	0.09	0.10	0.10	0.15	0.11	0.12	0.15	0.19	0.16	0.19	0.21	0.21	0.23	0.22	0.13
2	0.05	0.02	0.04	0.07	0.08	0.08	0.13	0.10	0.11	0.14	0.18	0.15	0.17	0.19	0.19	0.21	0.22	0.12
3	0.07	0.04	0.02	0.05	0.06	0.06	0.10	0.07	0.08	0.11	0.16	0.12	0.15	0.17	0.17	0.19	0.20	0.10
4	0.08	0.06	0.04	0.04	0.05	0.07	0.11	0.08	0.09	0.12	0.17	0.13	0.16	0.18	0.18	0.20	0.20	0.11
5	0.09	0.07	0.05	0.04	0.03	0.05	0.09	0.06	0.07	0.10	0.14	0.11	0.14	0.16	0.16	0.18	0.18	0.10
6	0.09	0.07	0.05	0.05	0.04	0.01	0.07	0.05	0.05	0.08	0.12	0.09	0.11	0.14	0.14	0.17	0.16	0.09
7	0.10	0.09	0.06	0.07	0.07	0.06	0.05	0.05	0.08	0.11	0.15	0.12	0.14	0.16	0.16	0.19	0.19	0.11
8	0.10	0.08	0.05	0.06	0.05	0.04	0.06	0.04	0.06	0.08	0.13	0.09	0.12	0.14	0.14	0.16	0.17	0.09
9	0.12	0.10	0.07	0.07	0.06	0.05	0.09	0.06	0.03	0.06	0.09	0.07	0.08	0.11	0.11	0.14	0.16	0.09
10	0.15	0.13	0.11	0.11	0.09	0.08	0.10	0.09	0.05	0.02	0.06	0.04	0.05	0.07	0.08	0.11	0.14	0.09
11	0.17	0.16	0.13	0.12	0.10	0.10	0.13	0.12	0.08	0.08	0.04	0.09	0.08	0.11	0.12	0.15	0.12	0.11
12	0.18	0.16	0.13	0.13	0.12	0.11	0.12	0.12	0.07	0.04	0.07	0.03	0.05	0.06	0.07	0.10	0.13	0.10
13	0.18	0.17	0.14	0.13	0.12	0.11	0.13	0.13	0.08	0.05	0.05	0.04	0.03	0.05	0.06	0.09	0.11	0.10
14	0.20	0.19	0.16	0.15	0.14	0.13	0.15	0.15	0.10	0.07	0.06	0.05	0.04	0.03	0.03	0.07	0.09	0.11
15	0.21	0.20	0.17	0.16	0.15	0.14	0.15	0.15	0.11	0.08	0.07	0.06	0.06	0.04	0.02	0.04	0.08	0.12
16	0.23	0.22	0.19	0.19	0.17	0.16	0.17	0.18	0.14	0.10	0.08	0.09	0.08	0.06	0.04	0.03	0.08	0.14
18	0.18	0.18	0.15	0.14	0.12	0.12	0.16	0.14	0.11	0.12	0.06	0.12	0.11	0.13	0.14	0.15	0.07	0.13
Grand Total	0.13	0.11	0.09	0.10	0.09	0.09	0.12	0.10	0.09	0.09	0.11	0.09	0.11	0.12	0.12	0.14	0.15	0.11

Table 4.1 AON Time Assignment Average Travel Time between TAZs in the Year 2008

UE Average Time	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	0.19	0.18	0.24	0.42	0.61	0.63	0.96	0.72	0.78	1.01	1.16	1.07	1.24	1.42	1.45	1.63	1.33	0.82
2	0.17	0.06	0.14	0.37	0.55	0.56	0.89	0.65	0.71	0.94	1.14	1.00	1.17	1.35	1.38	1.56	1.31	0.76
3	0.26	0.17	0.03	0.23	0.40	0.41	0.70	0.48	0.57	0.79	1.08	0.85	1.03	1.20	1.24	1.42	1.41	0.67
4	0.33	0.27	0.12	0.16	0.29	0.40	0.73	0.49	0.55	0.78	1.06	0.84	1.01	1.19	1.22	1.40	1.41	0.67
5	0.38	0.32	0.16	0.11	0.11	0.22	0.55	0.35	0.37	0.61	0.84	0.68	0.79	0.99	1.04	1.23	1.19	0.56
6	0.44	0.36	0.19	0.20	0.13	0.01	0.42	0.24	0.21	0.48	0.70	0.55	0.65	0.86	0.92	1.12	1.04	0.49
7	0.47	0.39	0.22	0.31	0.31	0.27	0.29	0.23	0.39	0.66	0.91	0.72	0.86	1.04	1.08	1.27	1.29	0.60
8	0.42	0.35	0.17	0.22	0.17	0.13	0.31	0.16	0.26	0.42	0.72	0.48	0.66	0.83	0.86	1.05	1.13	0.47
9	0.61	0.53	0.37	0.32	0.25	0.22	0.45	0.35	0.12	0.25	0.45	0.34	0.40	0.59	0.64	0.84	1.03	0.45
10	0.89	0.82	0.65	0.58	0.52	0.46	0.52	0.56	0.21	0.05	0.27	0.12	0.20	0.37	0.41	0.62	0.93	0.49
11	0.93	0.90	0.76	0.66	0.60	0.59	0.81	0.76	0.42	0.45	0.18	0.53	0.48	0.69	0.76	0.98	0.78	0.68
12	1.02	0.95	0.78	0.71	0.64	0.59	0.60	0.68	0.31	0.11	0.28	0.09	0.16	0.29	0.33	0.54	0.85	0.54
13	1.00	0.92	0.76	0.67	0.61	0.57	0.68	0.70	0.32	0.16	0.18	0.13	0.06	0.20	0.27	0.49	0.76	0.52
14	1.12	1.05	0.89	0.80	0.73	0.69	0.76	0.81	0.44	0.26	0.25	0.18	0.13	0.07	0.10	0.30	0.60	0.57
15	1.19	1.13	0.97	0.88	0.82	0.77	0.78	0.87	0.52	0.34	0.31	0.26	0.22	0.10	0.05	0.24	0.57	0.63
16	1.30	1.25	1.09	1.00	0.93	0.89	0.87	0.98	0.63	0.46	0.42	0.38	0.33	0.21	0.14	0.10	0.58	0.72
18	0.96	1.00	0.91	0.82	0.77	0.80	1.05	0.97	0.67	0.75	0.30	0.65	0.53	0.59	0.66	0.87	0.36	0.77
Grand Total	0.65	0.59	0.47	0.49	0.50	0.49	0.68	0.59	0.46	0.52	0.64	0.54	0.61	0.74	0.77	0.96	1.01	0.62

Table 4.2 UE Time Assignment Average Travel Time between TAZs in the Year 2008

2008 UE-AON Average Cost

AON Average Cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	1.36	1.59	2.08	2.55	2.97	3.25	4.46	3.32	4.08	5.11	6.47	5.44	6.41	7.10	7.16	7.87	7.51	4.34
2	1.64	0.80	1.47	2.30	2.61	2.84	4.06	2.92	3.68	4.71	6.25	5.04	6.01	6.70	6.76	7.46	7.54	4.01
3	2.07	1.48	0.70	1.49	1.71	1.95	3.09	1.93	2.79	3.82	5.36	4.15	5.11	5.80	5.86	6.57	6.72	3.36
4	1.97	2.03	1.38	1.11	1.55	2.21	3.42	2.28	3.05	4.08	5.62	4.41	5.37	6.06	6.12	6.83	6.98	3.58
5	2.51	2.44	1.64	1.38	0.99	1.61	2.99	1.80	2.39	3.50	4.52	3.85	4.62	5.38	5.55	6.32	6.17	3.27
6	2.91	2.55	1.57	1.74	1.19	0.33	2.45	1.28	1.54	2.81	3.99	3.20	3.76	4.62	4.90	5.76	5.34	2.90
7	3.40	2.92	2.00	2.44	2.15	1.99	1.51	1.52	2.58	3.17	4.83	3.48	4.51	5.14	5.20	5.91	6.54	3.41
8	2.97	2.61	1.60	1.95	1.53	1.30	2.03	0.93	1.93	2.75	4.39	3.06	4.08	4.72	4.78	5.49	5.92	2.98
9	3.58	3.41	2.43	2.39	1.90	1.55	2.91	1.79	0.94	1.96	3.06	2.48	2.80	3.56	3.83	4.73	5.05	2.83
10	4.87	4.59	3.61	3.61	3.14	2.73	3.42	3.10	1.72	0.71	2.11	1.30	1.72	2.35	2.70	3.76	3.98	2.97
11	5.20	5.30	4.33	4.08	3.51	3.26	4.59	3.96	2.58	1.86	0.79	2.25	1.67	2.63	3.03	3.95	3.22	3.43
12	5.75	5.44	4.47	4.43	3.96	3.56	3.88	3.69	2.46	1.28	2.28	0.97	1.58	1.91	2.18	3.23	3.57	3.31
13	5.66	5.65	4.68	4.47	3.96	3.60	4.48	4.24	2.58	1.64	1.58	1.40	0.85	1.53	1.95	2.88	2.94	3.31
14	6.53	6.40	5.42	5.24	4.73	4.38	4.64	4.79	3.30	2.23	2.04	1.64	1.46	0.90	1.18	2.22	2.77	3.69
15	6.87	6.75	5.78	5.60	5.07	4.75	5.23	5.22	3.63	2.58	2.31	2.04	1.92	1.19	0.59	1.50	2.66	3.95
16	7.79	7.66	6.69	6.47	5.93	5.63	5.91	6.01	4.56	3.49	2.97	2.86	2.66	2.00	1.28	0.80	3.00	4.70
18	5.85	6.07	5.10	4.82	4.23	4.05	5.60	4.72	3.59	2.80	1.45	2.53	1.84	2.30	2.72	3.61	0.75	3.82
Grand Total	3.96	3.77	3.10	3.21	2.99	2.91	3.81	3.12	2.84	2.95	3.76	3.05	3.50	3.95	4.07	4.85	4.98	3.55

Table 4.3 AON Cost Assignment Average Travel Cost between TAZs in the Year 2008

UE Average cost	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	1.97	2.95	4.75	4.05	4.92	9.51	11.81	9.09	10.25	14.92	16.14	17.79	16.61	20.81	23.69	28.32	19.81	11.85
2	3.23	1.57	3.53	5.01	5.97	9.31	11.21	7.91	12.68	17.17	18.93	19.05	20.60	22.90	24.80	29.25	22.16	12.88
3	5.07	3.57	0.96	2.74	2.84	5.80	8.06	4.90	9.16	13.66	16.47	15.54	17.10	19.39	21.30	25.74	20.51	10.62
4	4.33	5.41	2.76	1.91	2.28	5.66	8.86	6.03	7.80	12.05	14.10	14.50	15.04	18.47	20.84	25.34	18.00	10.14
5	6.00	7.09	3.83	2.71	1.27	3.04	7.00	4.27	5.71	9.77	12.12	12.56	13.12	16.72	19.15	23.62	15.99	9.28
6	8.23	8.64	5.05	5.54	3.12	0.33	5.93	3.44	4.28	8.34	11.16	11.66	11.81	15.67	18.05	22.80	14.98	9.24
7	10.74	10.10	6.73	7.62	6.17	5.59	3.63	3.55	4.66	7.83	10.03	9.62	10.86	13.33	15.50	19.92	14.41	9.33
8	9.12	8.57	5.08	5.95	4.57	3.83	4.04	2.44	4.36	8.32	11.11	10.18	11.54	13.98	16.08	20.52	14.96	8.91
9	10.52	12.25	8.84	7.68	5.94	4.40	5.46	4.86	1.78	3.90	5.78	6.69	7.09	10.73	13.20	17.73	10.50	8.17
10	14.72	16.37	12.80	11.97	10.18	8.37	7.81	8.05	3.97	1.22	6.31	2.73	4.17	6.60	8.99	13.49	9.14	8.86
11	16.43	18.66	15.63	13.55	11.83	10.63	10.35	10.83	5.22	5.06	1.08	6.92	4.07	7.59	9.73	13.22	3.72	10.23
12	16.68	17.64	14.07	14.01	12.21	11.02	8.93	9.22	6.29	2.58	6.73	1.56	2.80	4.54	7.05	11.55	9.15	9.41
13	17.56	19.80	16.44	14.64	12.94	11.40	11.03	11.56	6.74	3.77	4.35	2.85	1.48	4.21	6.92	11.33	5.82	10.01
14	19.88	20.77	17.25	17.02	15.25	14.40	11.79	12.12	9.34	5.50	6.65	3.86	3.55	1.85	2.96	7.24	6.08	10.83
15	22.04	22.58	18.99	19.21	17.42	16.73	13.91	14.07	11.67	7.78	8.34	6.18	6.15	2.96	1.48	5.32	9.80	12.62
16	25.12	25.32	21.70	22.30	20.55	19.89	17.14	16.96	14.84	10.91	11.08	9.29	9.01	5.93	3.96	2.34	11.12	15.25
18	20.98	23.17	20.76	18.44	16.72	15.68	16.08	16.04	9.85	8.73	3.51	8.28	5.38	6.07	6.62	9.27	1.62	12.95
Grand Total	11.65	12.29	9.89	9.66	8.68	9.16	9.58	8.42	7.73	8.66	10.23	9.71	9.88	11.85	13.68	17.74	12.92	10.60

Table 4.4 UE Cost Assignment Average Travel Cost between TAZs in the Year 2008

2008 UE-AON Average Distance (Under Time Assignment)

AON Average Distance(time)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	1.22	1.12	1.60	2.34	2.65	2.64	4.25	3.06	3.42	4.55	5.66	4.91	5.52	6.20	7.08	7.55	6.84	3.88
2	1.18	0.49	1.06	1.89	2.18	2.18	3.79	2.59	2.95	4.09	5.35	4.45	5.06	5.73	6.61	7.09	6.75	3.46
3	1.69	1.05	0.40	1.14	1.35	1.34	2.78	1.68	2.12	3.25	4.44	3.61	4.22	4.90	5.78	6.25	5.79	2.85
4	2.00	1.47	0.91	0.96	1.22	1.58	3.19	2.00	2.36	3.50	4.68	3.85	4.46	5.14	6.02	6.49	6.03	3.10
5	2.39	1.84	1.13	0.91	0.68	1.09	2.55	1.61	1.86	3.02	4.10	3.37	3.80	4.47	5.36	5.90	5.32	2.80
6	2.61	2.05	1.14	1.27	0.74	0.23	1.95	1.13	1.09	2.36	3.17	2.66	2.91	3.55	4.38	5.55	4.56	2.39
7	3.11	2.52	1.65	2.03	1.73	1.52	1.52	1.31	2.05	3.31	4.38	3.63	4.12	4.68	5.45	6.00	5.83	3.15
8	2.70	2.14	1.21	1.48	1.05	0.84	1.67	0.91	1.45	2.40	3.68	2.69	3.44	3.98	4.86	5.33	5.19	2.57
9	3.36	2.80	1.89	1.89	1.45	1.06	2.33	1.62	0.78	1.51	2.39	1.92	2.13	2.70	3.28	3.96	4.64	2.33
10	4.32	3.76	2.85	2.86	2.42	2.02	2.79	2.44	1.22	0.41	1.48	0.83	1.16	1.64	2.07	2.90	4.06	2.37
11	4.97	4.48	3.57	3.36	2.83	2.55	3.78	3.22	1.99	2.09	0.90	2.49	2.07	2.75	3.19	3.92	3.36	3.16
12	5.03	4.47	3.57	3.50	3.05	2.66	3.25	3.08	1.79	0.81	1.66	0.69	1.11	1.42	1.86	2.77	3.91	2.71
13	5.06	4.43	3.52	3.43	3.01	2.59	3.62	3.17	1.74	1.12	1.05	1.05	0.53	1.01	1.49	2.22	3.29	2.60
14	5.89	5.28	4.37	4.22	3.74	3.32	4.34	3.89	2.39	1.62	1.48	1.34	0.97	0.55	0.81	1.73	2.71	3.03
15	6.57	5.93	5.03	4.83	4.29	3.87	4.71	4.39	2.89	2.09	1.92	1.78	1.49	0.79	0.46	1.15	2.44	3.43
16	7.57	7.00	6.09	5.96	5.45	4.88	5.35	5.17	3.61	2.81	2.79	2.62	2.18	1.63	1.05	0.70	2.97	4.23
18	5.64	5.39	4.44	4.18	3.59	3.42	4.80	4.16	3.14	3.52	1.56	3.65	3.20	3.68	4.39	4.91	2.08	4.02
Grand Total	3.62	3.09	2.48	2.64	2.42	2.23	3.36	2.66	2.21	2.55	3.15	2.73	2.96	3.36	3.94	4.54	4.67	3.07

Table 4.5 AON Time Assignment Average Travel Distance between TAZs in the Year 2008

UE Average Distance(time)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	1.23	1.12	1.64	2.38	2.73	2.63	4.32	3.07	3.53	4.59	5.99	4.91	5.65	6.31	6.99	7.75	7.16	3.95
2	1.19	0.49	1.11	1.90	2.18	2.18	3.86	2.61	3.08	4.14	5.87	4.46	5.19	5.86	6.53	7.29	7.63	3.56
3	1.75	1.13	0.42	1.16	1.35	1.35	2.86	1.71	2.25	3.31	4.55	3.63	4.37	5.03	5.71	6.47	6.93	2.97
4	2.04	1.53	0.93	0.96	1.21	1.57	3.26	2.01	2.47	3.53	4.77	3.86	4.59	5.26	5.94	6.69	6.34	3.16
5	2.41	1.86	1.14	0.92	0.68	1.11	2.63	1.63	1.94	3.03	4.02	3.36	3.81	4.50	5.26	6.13	5.51	2.82
6	2.61	2.05	1.14	1.29	0.76	0.23	2.06	1.18	1.14	2.40	3.17	2.69	2.95	3.62	4.37	5.53	4.58	2.41
7	3.14	2.54	1.67	2.05	1.75	1.56	1.57	1.33	2.11	3.34	4.45	3.65	4.21	4.82	5.50	6.32	6.39	3.23
8	2.71	2.15	1.21	1.49	1.05	0.86	1.74	0.93	1.53	2.42	3.75	2.71	3.52	4.11	4.78	5.54	5.30	2.62
9	3.51	2.96	2.04	2.00	1.48	1.11	2.52	1.76	0.80	1.53	2.40	1.95	2.18	2.81	3.49	4.40	4.74	2.45
10	4.49	3.95	2.96	2.99	2.53	2.05	2.86	2.50	1.30	0.42	1.50	0.89	1.19	1.74	2.40	3.27	4.35	2.49
11	5.15	4.80	3.98	3.73	2.98	2.59	3.92	3.33	2.12	2.09	0.89	2.46	2.10	2.81	3.45	4.30	3.45	3.32
12	5.20	4.66	3.71	3.65	3.14	2.70	3.36	3.16	1.85	0.84	1.66	0.69	1.14	1.52	2.13	3.07	4.04	2.82
13	5.26	4.71	3.78	3.60	3.04	2.68	3.78	3.35	1.97	1.13	1.06	1.05	0.54	1.06	1.72	2.50	3.35	2.74
14	5.90	5.36	4.43	4.26	3.68	3.33	4.71	4.09	2.59	1.65	1.47	1.36	0.97	0.57	0.87	1.70	2.79	3.09
15	6.47	5.92	4.99	4.83	4.24	3.87	4.91	4.52	3.12	2.12	1.96	1.85	1.52	0.81	0.48	1.16	2.53	3.46
16	7.32	6.63	5.70	5.53	4.95	4.60	5.46	5.19	3.89	2.97	2.72	2.71	2.20	1.64	1.13	0.68	2.99	4.14
18	5.79	5.87	5.42	4.83	3.90	3.53	4.99	4.31	3.25	3.51	1.55	3.17	2.55	2.66	3.31	4.10	1.74	3.98
Grand Total	3.67	3.18	2.58	2.72	2.44	2.24	3.48	2.73	2.33	2.58	3.24	2.73	3.00	3.40	3.95	4.71	4.94	3.14

Table 4.6 UE Time Assignment Average Travel Distance between TAZs in the Year 2008

2008 UE-AON Average Distance (Under Cost Assignment)

AON Average Distance (cost)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	Grand Total
1	1.00	1.10	1.58	2.25	2.58	2.58	3.78	2.69	3.35	4.44	5.35	4.71	5.11	5.76	6.19	6.95	6.59	3.62
2	1.16	0.49	1.05	1.85	2.13	2.13	3.33	2.24	2.90	3.99	4.94	4.26	4.66	5.31	5.74	6.50	6.39	3.23
3	1.62	1.05	0.40	1.13	1.33	1.33	2.47	1.36	2.10	3.19	4.14	3.46	3.86	4.51	4.94	5.70	5.59	2.66
4	1.60	1.46	0.91	0.82	1.14	1.56	2.76	1.67	2.34	3.42	4.37	3.69	4.09	4.74	5.17	5.93	5.82	2.85
5	2.06	1.84	1.13	0.91	0.67	1.08	2.44	1.29	1.85	2.97	3.81	3.24	3.53	4.18	4.61	5.37	5.17	2.61
6	2.32	2.05	1.14	1.26	0.74	0.23	1.95	0.83	1.09	2.34	3.03	2.59	2.75	3.40	3.83	4.59	4.52	2.24
7	2.85	2.48	1.61	1.98	1.69	1.48	1.25	1.12	2.02	2.76	4.00	3.02	3.70	4.25	4.67	5.47	5.67	2.87
8	2.42	2.14	1.21	1.47	1.05	0.84	1.60	0.63	1.42	2.37	3.54	2.63	3.24	3.82	4.25	5.04	5.09	2.44
9	3.07	2.80	1.89	1.88	1.44	1.06	2.33	1.28	0.69	1.44	2.15	1.87	1.98	2.64	3.07	3.85	4.02	2.20
10	4.02	3.74	2.83	2.85	2.42	2.01	2.78	2.43	1.21	0.41	1.46	0.82	1.10	1.61	2.03	2.87	3.16	2.28
11	4.56	4.34	3.43	3.29	2.81	2.52	3.75	3.07	1.87	1.22	0.55	1.55	1.02	1.69	2.12	2.88	2.67	2.67
12	4.67	4.39	3.48	3.46	3.02	2.62	3.21	3.00	1.73	0.79	1.62	0.67	1.06	1.41	1.83	2.68	3.00	2.59
13	4.70	4.42	3.51	3.42	2.97	2.58	3.60	3.15	1.73	1.07	1.03	1.01	0.50	0.96	1.41	2.17	2.32	2.50
14	5.33	5.05	4.14	4.06	3.62	3.22	4.18	3.77	2.36	1.60	1.43	1.25	0.92	0.55	0.78	1.64	2.08	2.85
15	5.77	5.50	4.59	4.51	4.07	3.67	4.55	4.19	2.81	2.03	1.87	1.69	1.40	0.78	0.45	1.13	2.43	3.20
16	6.48	6.20	5.30	5.20	4.76	4.36	5.12	4.85	3.51	2.78	2.58	2.50	2.08	1.54	1.04	0.67	2.86	3.84
18	5.27	5.18	4.27	4.07	3.54	3.37	4.61	3.90	2.85	2.01	1.03	1.93	1.22	1.59	2.02	2.78	0.49	3.11
Grand Total	3.27	3.00	2.38	2.55	2.35	2.17	3.16	2.42	2.15	2.38	2.94	2.50	2.64	3.04	3.38	4.11	4.19	2.83

Figure 4.7 AON/UE Cost Assignment Average Travel Distance between TAZs in the Year

Assignment Mode	Average Time	Average Cost	Average Distance
AON Time	0.11	-	3.07
UE Time	0.62	-	3.14
AON Cost	-	3.55	2.83
UE Cost	-	10.6	2.83

Figure 4.8 AON - UE Comprehensive Comparison

Note: We assume that the introzonal distance is half of the minimum value of all trips from this TAZ, while introzonal time is added in the AON/UE assignments. All colume heads of the tables above refer to the destinataions TAZs of all trips and row heads refer to origin TAZs.

Distance
Equal and Slight Difference

Average travel distances between TAZs are equal under AON and UE Cost assignment, while slightly smaller under AON time assignment than UE time assignment.

Time
6 Times

The average travel time between TAZs under UE time assignment is close to 6 times the time under AON time assignment.

Cost
3 Times

The average cost between TAZs under UE cost assignment is generally 3 times the cost under AON cost assignment.

FUTURE TRAVEL DEMAND FORECAST

Traffic growth rate is affected by demographic and economic incr Traffic growth rate is affected by demographic and economic increase. According to Redondo Beach demographic profiles, the city witnessed an increase of 5.1% and 5.5% for each decade from 1990 to 2010.

American Community Survey (ACS) 5-year-estimate from 2010 to 2016 shows that vehicle ownership increased by 8.3%, employment by 7%. From 2005-2009, the employment increased by about 4.4%. Taking all these factors into comprehensive consideration, we have assumed that the traffic growth factor is 5.2% from 2008 to 2018, 5.5% from 2018 to 2008, and 10.1% from 2008 to 2028.

Setting up the modelling shown as figure 5.2 using the assumed growth factors, we have generated OD tables for the four time periods in 2028 scenario shown in Appendix E.

Year	Population	% Change
1900	855	---
1910	2,935	243.3
1920	4,913	67.4
1930	9,347	90.3
1940	13,092	40.1
1950	25,226	92.7
1960	46,986	86.3
1970	56,075	19.3
1980	57,102	1.8
1990	60,167	5.4
2000	63,261	5.1
2010	66,748	5.5

Figure 5.1 Demographic Profile from 1990 to 2010
Source: City of Redondo Beach

GROWTH FACETOR: 10.1%

DEMOGRAPHIC

- *5.1% (1990-2000)*
- *5.5% (2000-2010)*

EMPLOYMENT

- *8.3% (2010-2016)*

VEHICLE OWNERSHIP

- *4.4% (2005-2009)*

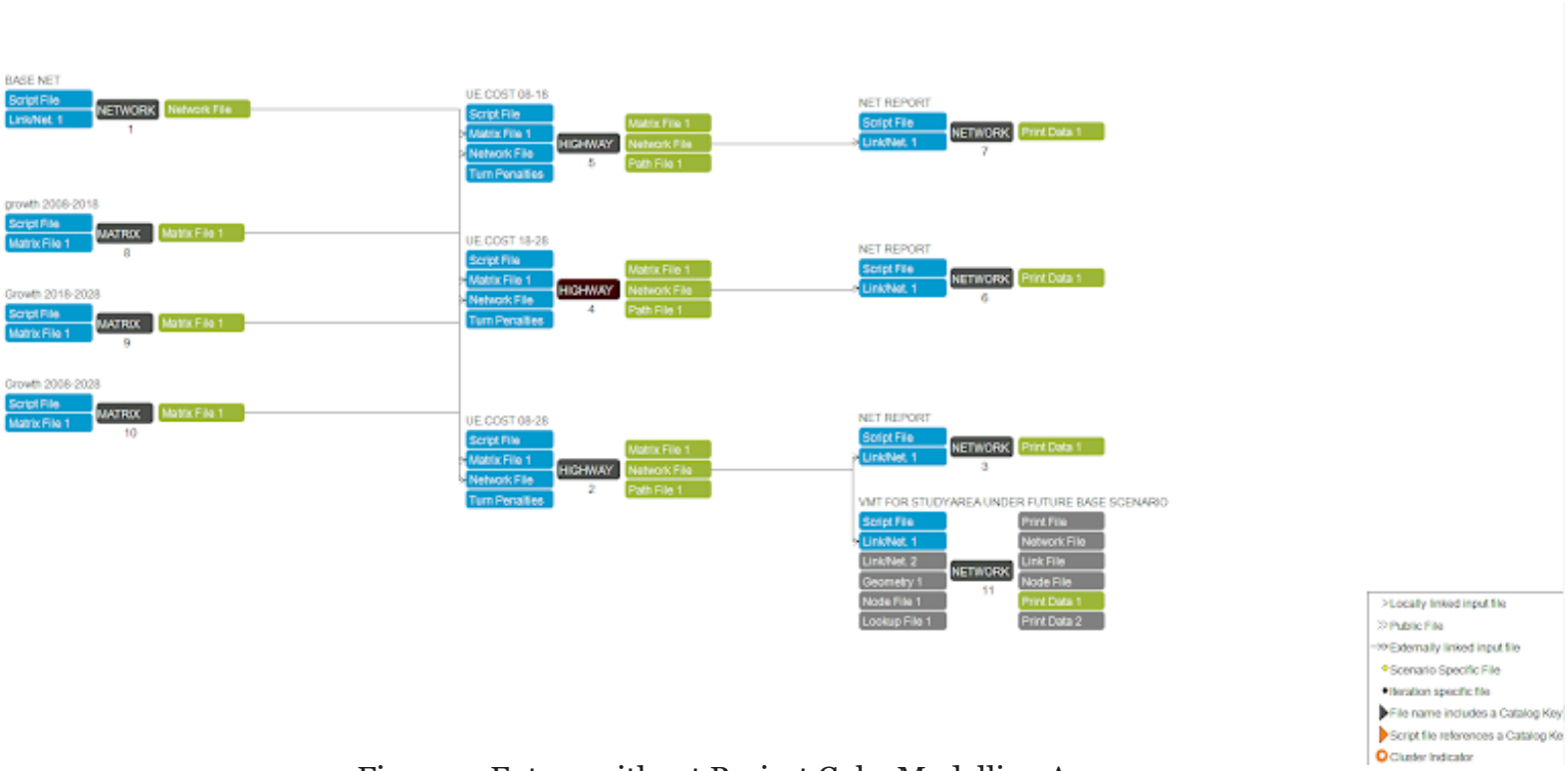


Figure .2 Future without Project Cube Modelling App

Comparing the link volumes in our study area between 2008 and 2028 scenarios under the UE general cost assignment mode, we have found that the average traffic volume attributes to the links in Study Area 15 and 16 will grow by 12.33%, average V/C by 12.48% and average travel time by 4.74%. Most increases take place during mid-day and night time, while the PM peak hour has lower increases than the daily average. Appendix D spreadsheets illustrates the specific analysis of the link attributes comparison.

Average	Daily Volume	V/C	Congestion Speed	Travel Time
2008StudyArea	4557	3.35	11.50	1.06
2028StudyArea	4984	3.68	11.17	1.10
%Change	12.33%	12.48%	-3.12%	4.74%

Figure 5.3 Future without Project Growth

Average	Daily Volume	AM Volume	Mid-day Volume	PM Volume	Night Volume
2008StudyArea	4557	546	621	2262	1128
2028StudyArea	4984	598	679	2475	1233
%Change	12.33%	12.43%	12.90%	12.35%	12.55%

Figure 5.4 Future without Project Traffic Volume Growth

IMPACTS OF A NEW PROJECT

A new comprehensive project is proposed in Study Area 16, including 200 units of low-rise apartments, a 20,000-square feet (sf) supermarket, a 16,000-sf office complex, and 8,000-sf restaurants. Currently the zoning for the Project site is light industrial. There is going to be a request of zoning change to mixed-land use to accommodate the proposed residential and commercial land use.

Figure 6.1 Location of Proposed Project

Using ITE Trip Generation Manual 9th Edition, we have calculated the generated trips from the project shown as table 6.1. ITE Trip Generation Manual only provides trip generation rates for AM peak hour, PM peak hour and daily as total. Therefore, we assumed the trip generation rates for mid-day and night time for the modelling shown as Appendix E.

Land Use Type	Peak Hour AM Inbound	Peak Hour AM Outbound	Peak Hour PM Inbound	Peak Hour PM Outbound	Mid-day Inbound	Mid-day Outbound	Night inbound	Night Outbound	Daily Inbound	Daily Outbound
200 dwelling unit of low-rise departments	26.68	65.32	75.40	40.60	32.68	43.32	12.64	3.36	665.00	665.00
A 20,000-sf supermarket	43.80	28.00	107.10	102.90	75.00	75.00	12.48	13.52	1022.40	1022.40
A 16,000-sf office complex	50.41	6.87	11.20	12.64	20.88	25.52	0.08	0.72	88.24	88.24
8,000-sf restaurants	36.54	8.02	44.74	27.42	59.83	50.97	6.29	10.27	359.80	359.80
Total	157.42	108.22	238.44	183.56	188.39	194.81	31.49	27.87	2135.44	2135.44

Table 6.1 Project Trip Generation

The Project is located in TAZ 3. To make it simple, we assume all trips generated from the project only go to and leave from TAZ 3. After assigning trips of different time periods to the six general directions shown as figure 6.2, we have further divided the trips of each direction in alignment with TAZs shown as table 6.2. The future with project scenario app in CUBE is illustrated as figure 6.3. With the newly generated trips added to the row and column of Study Area 16, we get the new OD matrix using UE assignment method with general cost function shown as Appendix F.

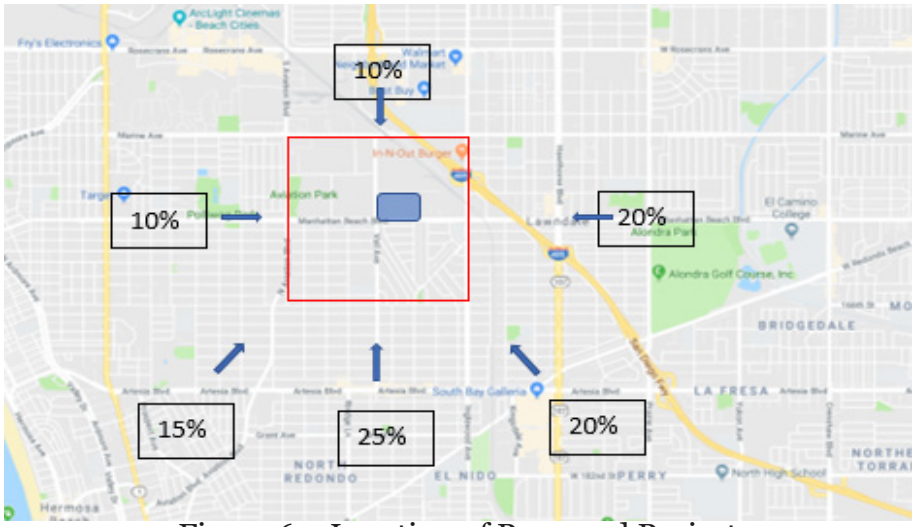


Figure 6.2 Location of Proposed Project

TAZ 3	North	South		West	East	Southeast		Southwest	
Percentage	10%	25%		10%	20%	15%		20%	
To Each TAZ	1%	0.5%	1.1%	1.43%	1%	1.66%	0.38%	0.3%	0.63%
Centroids	151-156	5-14		107-113	157-165	121		114-116	
	103, 104	16-19			101	122		42-54	10%
	1, 2	20-23			102	124	10%	69-85	
		26-28	15%		117	125		87	
		89			118	127		56	
		33			105	129		58-68	10%
		30,31,36,39			120	131		88	
		25,29,32			34	133		135	
		41,123,126			35	130	5%	175	
		86			37	134			
		128			38	166-174			
		57	10%		40				
		132							
		55							
		136							

Table 6.2 Project Trip Assignment to TAZs

The general cost between study areas for the future with project scenario is summarized as table 6.3, while the cost generated from the project is summarized as table 6.4. Compared with the 2008 scenario, we can find that the cost of the project-generated trips are basically same as the 2008 level. Appendix G shows the raw data and related analysis for only project-generated trips.

Link Attributes Comparison

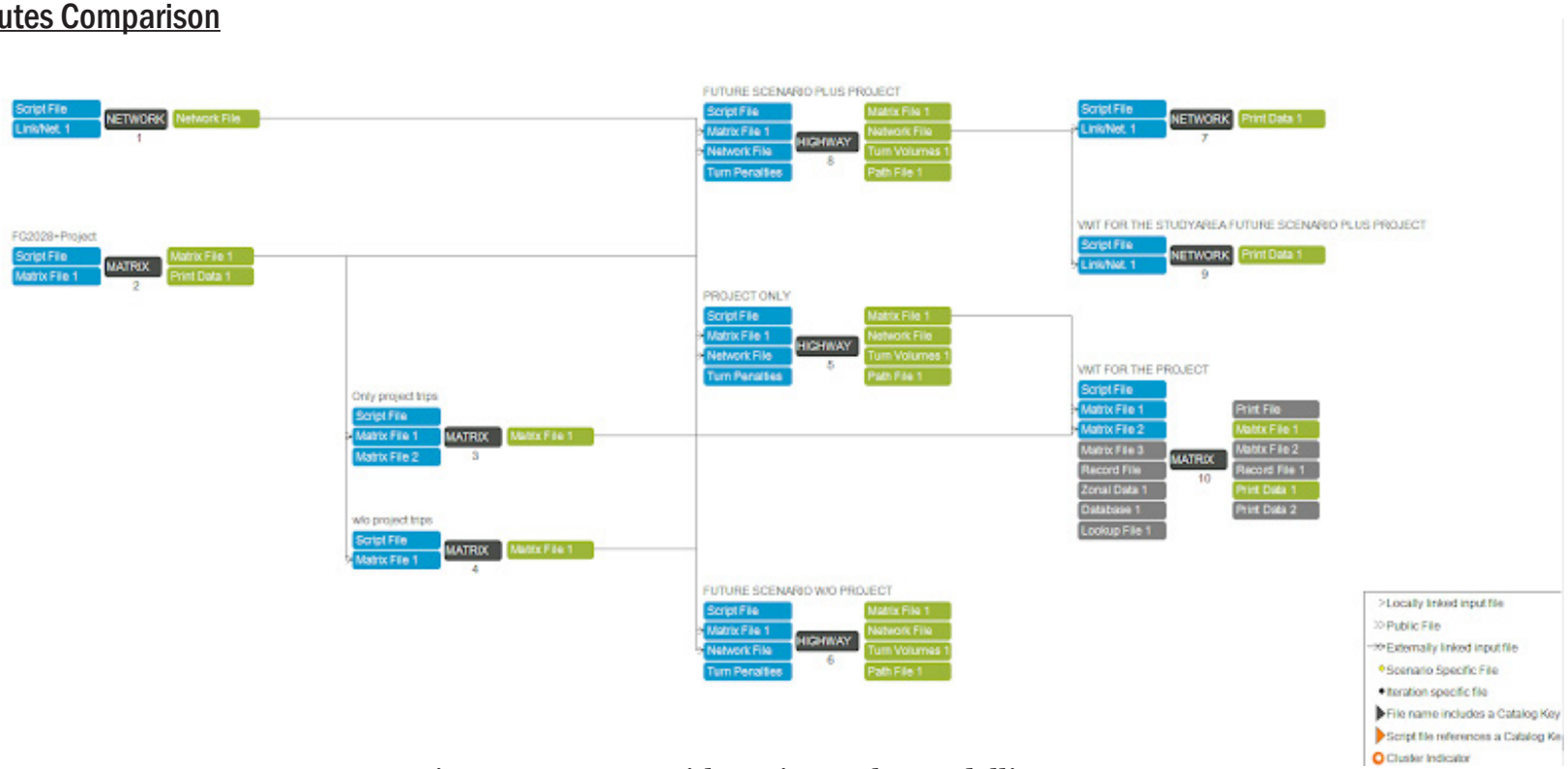


Figure 6.3 Future with Project Cube Modelling App

Comparing the link volumes in our study area between 2028 without project and with project scenarios under the UE general cost assignment mode, we have found that the average traffic volume attributed to the links in Study Area 15 and 16 will grow by 1% in total, with most increase in AM peak hour and Mid-day peak hour. The average V/C of all links is estimated to increase by 2% and average travel time by 1%. Appendix D spreadsheets illustrates the specific analysis of the link attributes comparison.

Sum	Daily Volume	AM Volume	Mid-day Volume	PM Volume	Night Volume
without	2462370	295411	335378	1222573	609008
with	2486961	300727	340426	1233777	612032
%change	1.00%	1.80%	1.51%	0.92%	0.50%

Table 6.3 Future with Project Traffic Volume Growth

Average	Daily Volume	V/C	CongestedSpeed	Time
without	2462370	3.67	11.17	1.1
without	2486961	3.74	11.1	1.11
%change	1.00%	1.91%	-0.63%	0.91%

Table 6.4 Future with Project Traffic Impacts

Links with Most Delay

To identify the links in the study areas with greatest impact from the project, we selected the top 20 links with the highest percentage of change in travel time, added a new field Impact Level to the attribute table of the identified links, and color coded the links by the field value in CUBE. Shown as Figure 6.5, the links with most delays from the project cluster at the surrounding residential areas close to the project site.

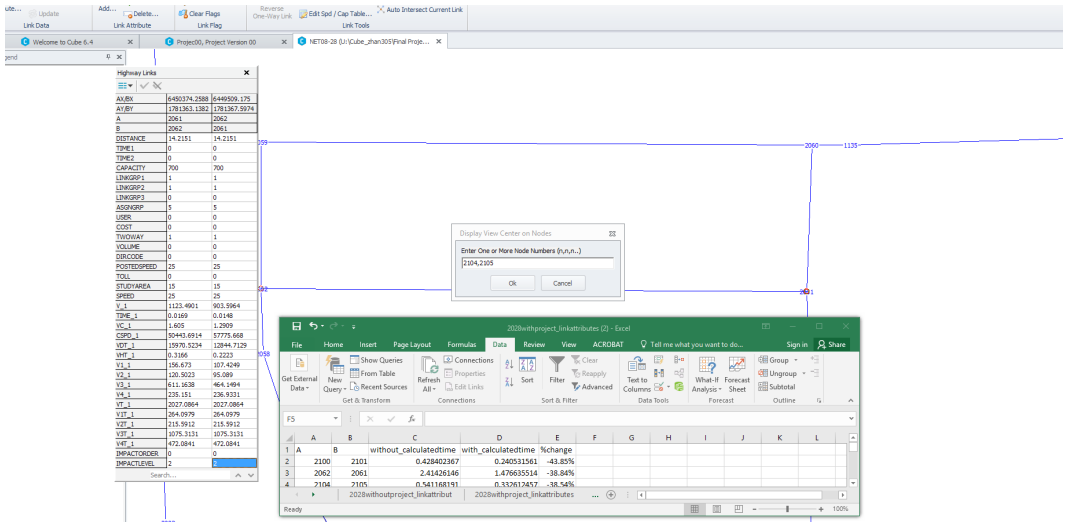


Figure 6.4 Identify Links with Most Delay

A	B	without_calculatedtime	with_calculatedtime	%change
2100	2101	0.428402367	0.240531561	-43.85%
2062	2061	2.41426146	1.476635514	-38.84%
2104	2105	0.541168191	0.332612457	-38.54%
2107	2104	0.651143099	0.414778857	-36.30%
2061	2060	0.647959184	0.421460177	-34.96%
2092	2091	0.264380531	0.190742219	-27.85%
2093	2092	0.540929204	0.390263368	-27.85%
2063	2064	0.27244582	0.199185152	-26.89%
1131	2005	0.514457831	0.389243391	-24.34%
2105	2106	1.464128843	1.109877913	-24.20%
2057	2063	0.7920434	0.602475928	-23.93%
2065	2064	0.347664937	0.264822134	-23.83%
1973	1972	0.567484663	0.439429929	-22.57%
1974	1973	1.148261759	0.889152811	-22.57%
2002	2001	2.961538462	2.294701987	-22.52%
1107	1974	0.998168498	0.77746077	-22.11%
2101	2114	0.420269313	0.333333333	-20.69%
2101	2103	1.037974684	0.827586207	-20.27%
2101	2100	0.612521151	0.489189189	-20.14%
2092	2093	0.591293833	0.476144109	-19.47%

Table 6.5 Links with Most Delay

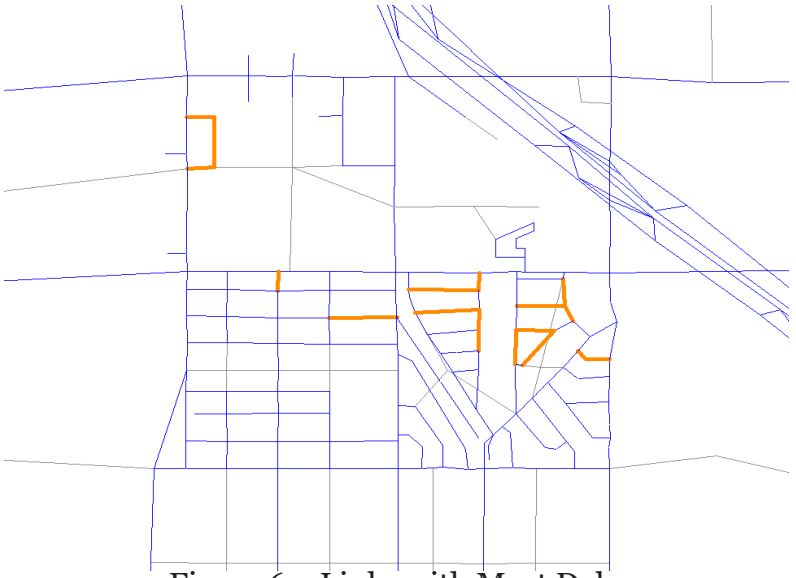


Figure 6.5 Links with Most Delay

Turning Movement Analysis

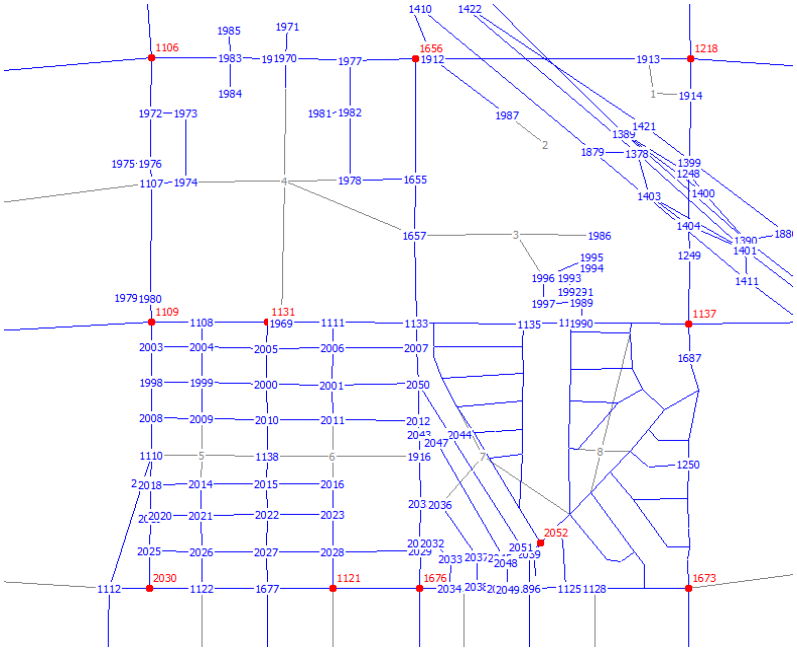


Figure 6.6 Identified Intersections

Turn volumes will generally grow from lower level of facilities to higher level, for example, from secondary arterials to arterials. The volumes moving to Marine Ave, Inglewood ave and Manhattan Beach Blvd will growth by the largest share.

We identified 11 intersections in the study area shown as figure 6.6. The turning movements for both future without project and future with project scenarios were exported to analyze the traffic impacts on the key intersections.

The intersections of arterials are estimated to witness larger increase including N Aviation Blvd/Marine Ave and Manhattan Beach Blvd. Intersections of local and collectors facilities are going to see a decrease.

No.	Intersection Name	%volume_change
1106	N Aviation Blvd/Marine Ave	10.23%
1109	N Aviation Blvd/Manhattan Beach Blvd	-0.67%
1121	Robinson St/Rindge Ln	-17.50%
1131	Manhanttan Beach Blvd/Blossom Ln	-10.87%
1137	Manhanttan Beach Blvd/Inglewood Ave	7.74%
1218	Marine Ave/Inglewood Ave	-0.62%
1656	Marin Ave/Redondo Beach Ave	-7.22%
1673	Robinson St/Inglewood Ave	4.88%
1676	Robinson St/Vail Ave	1.04%
2030	Robinson St/Aviation Pl	-12.80%
2052	Johnston Ave/Beland Blvd	0.62%

Table 6.6 Identified Intersections

VMT Analysis

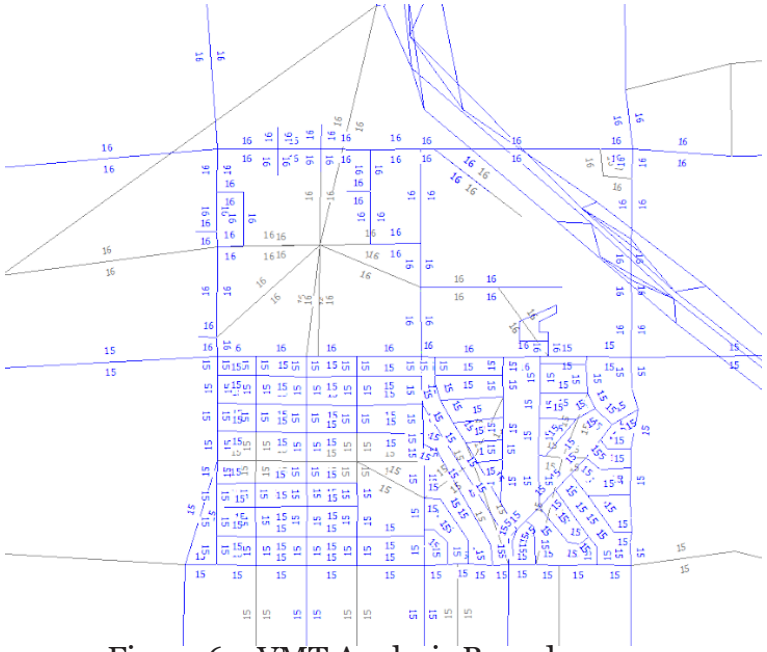


Figure 6.7 VMT Analysis Boundary

AssignedGroup	FacilityType	Sum of without_VMT	Sum of with_VMT	Difference	%change
1	HOV lane	31.28	37.76	6.48	20.72%
2	Major Arterial	161207.62	159782	-1425.62	-0.88%
3	Secondary Arterial	31118.87	32451.66	1332.79	4.28%
4	Minor Arterial	39829.04	40775.01	945.97	2.38%
5	Local Road	15093.17	15492.24	399.07	2.64%
6	centroid Connector	15713.18	15822.71	109.53	0.70%
Grand Total		262993.16	264361.38	1368.22	0.52%

Table 6.7 VMT Increase by Facility Type

AssignedGroup	FacilityType	without_speed	with_speed	Difference	%change
1	HOV lane	36.58	29.12	-7.46	-20.39%
2	Major Arterial	12.06	12.08	0.02	0.18%
3	Secondary Arterial	9.46	9.46	0.01	0.07%
4	Minor Arterial	8.05	7.92	-0.14	-1.70%
5	Local Road	11.83	11.75	-0.08	-0.68%
6	centroid Connector	15.00	15.00	0.00	0.00%
Grand Total		10.83	14.22	3.39	31.28%

Table 6.8 Speed Change by Facility Type

Define the Boundary

We set a buffer of the study boundary by including the links directly connecting with the study area network.

Compare VMT

The total VMT for base future without project and future with project scenarios are compared. The VMT increase for the study area is 0.52%.

Classify

The VMT values are classifed by facility types. Most increases take place on secondary arterials, which are the major facility type in the area.

The most significant change to the VMT happen at secondary arterials (by values), with an increase of 4.28%, while the biggest change to speed take place in the HOV lane group, reflecting a considerable growth of traffic volumes to highways.

CONCLUSION

TRAVEL PATTERN

Trips starting from the study area mainly go to areas out of the city by taking the highway.

AON-UE ASSIGNMENT

UE has the average travel time and cost between TAZs 3 and 6 times of the associated metrics for AON.

FUTURE GROWTH

10.1% growth factor generates more than 12% increase in traffic volume in the study area.

PROJECT IMPACT

Generated trips are mainly assigned to arterials instead of lower level of facilities.

Travel Pattern

The top destinations of trips starting from the study area are all connection points to the highway 405. This reflects the insufficient supply of resources in the city to meet people's need. Considering the City of Redondo Beach is a small city with a high concentration of rich population, the travel pattern is implies further researches on people's life need, in order to lower the number of such trips to boost the local economy while reducing traffic impacts.

AON-UE Assignment

UE assignment considers the delay on the transportation network. The average travel time and cost between TAZs under UE assignment are generally 6 times and 3 times the metrics of the AON mode. This reflects the delay factors.

Future Growth Forecast

Comprehensively considering the economic, employment and population growth, we eventually identified the growth factor from 2008 to 2028 as 10.1%, which generates an increase of traffic volume by 12%. AM and Mid-day peak hours will have the largest shares of the growth, while PM and night lower than the daily level. Shown by figure 7.1 and 7.2, traffic is more likely to go wtih higher level of facilities like arterials, instead of lower level, which will cause more serious congestion on arterials, particuarly those in proximity to highways.

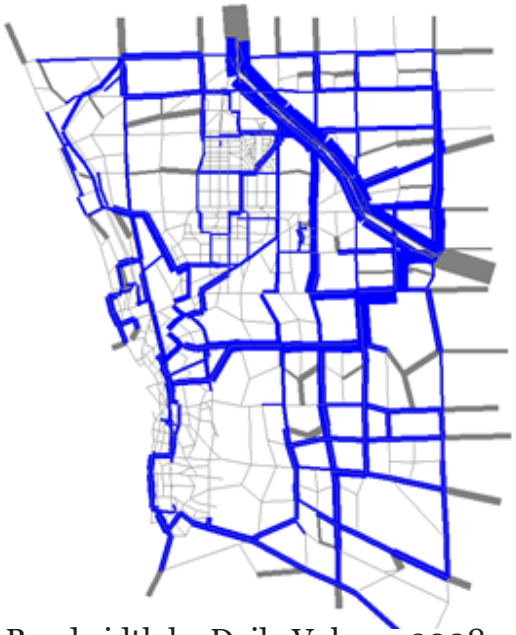


Figure 7.1 Bandwidth by Daily Volume 2008

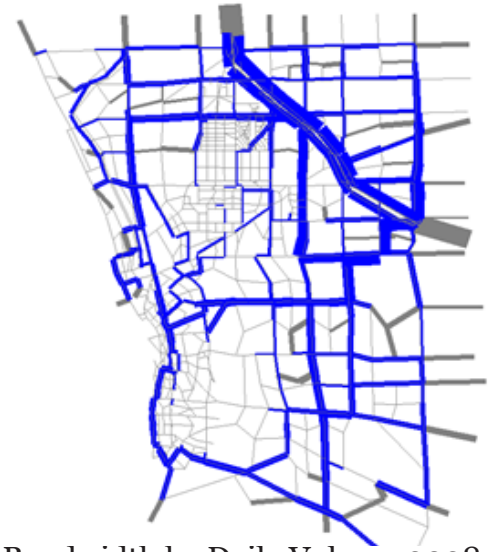


Figure 7.2 Bandwidth by Daily Volume 2028

Impacts of the Project

The proposed project will contribute to a 0.5% increase on the total traffic volume in the study area. The links close the proposed project site in TAZ 3 will witness the largest increase of volume, V/C ratio and delay time in the residential area south of TAZ 3.

Highly affected intersections are those of arterials or other higher level of facilities in this system, which corresponds to the assignment of trips to arterials instead of local/collectors.

Figure 7.3 Bandwidth by Daily Volume 2028 with Project

Proposed Solution

Due to the considerable impact on the arterials and associated intersections, we suggest widening the Inglewood Ave and Manhattan Beach Blvd and the surrounding arterials intersections to accommodate the forecasted traffic growth.

Additionally, bike share programs might be considered for this area to provide sustainble travel modes as well as reduce VMT.

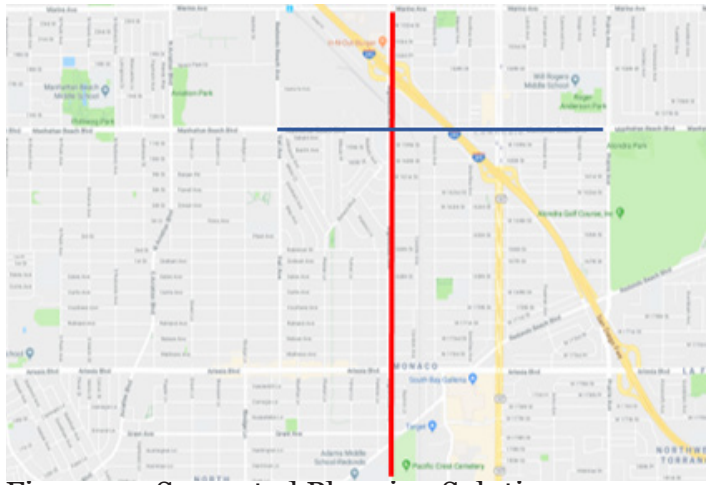


Figure 7.4 Suggested Planning Solution