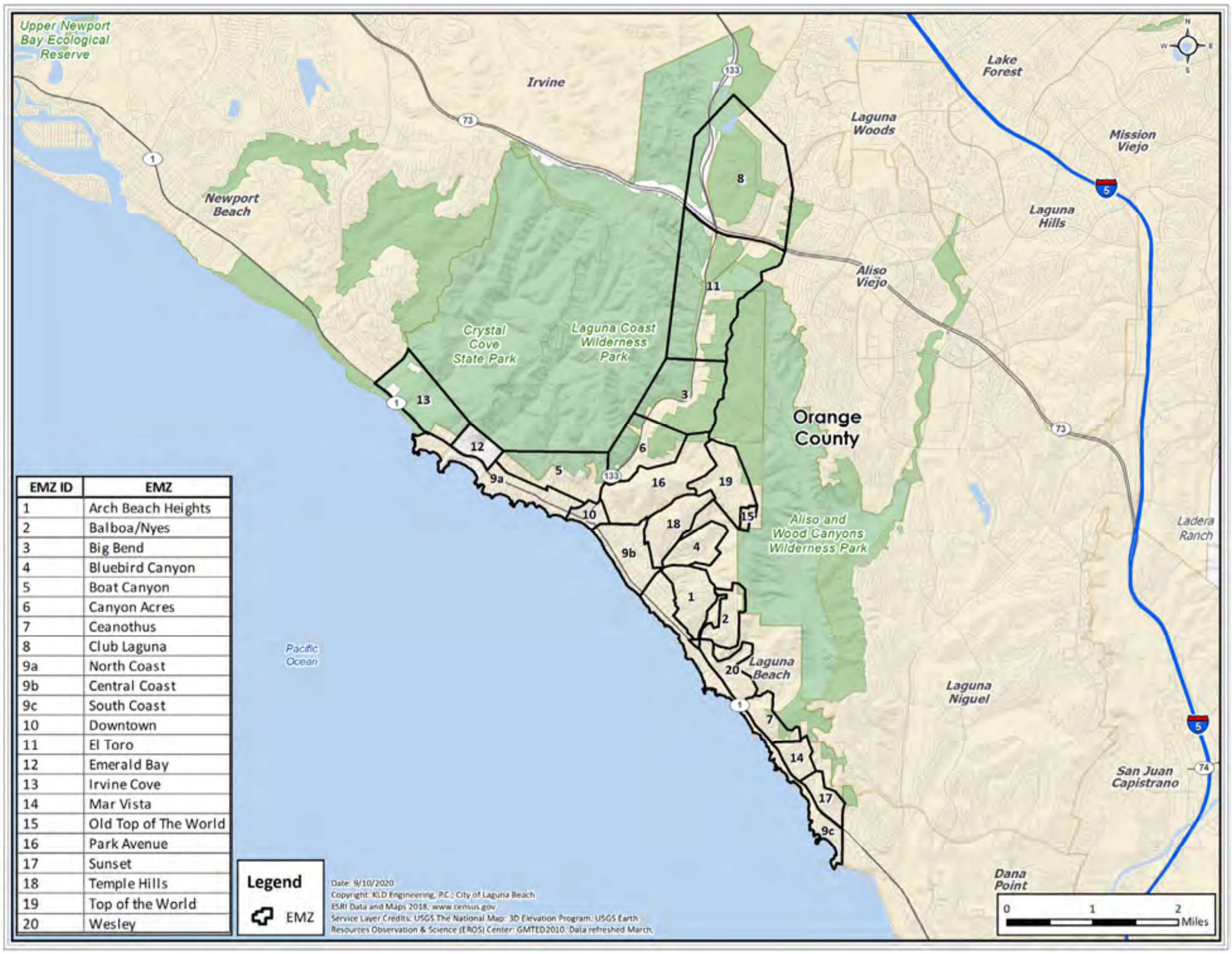
City of Laguna Beach

Wildfire Egress Study



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EXECUTIVE SUMMARY

The City of Laguna Beach is a well-known beach community that has a very unique topography which consists of canyons, hills and eight miles of coastline. Due to its topography, the City has limited ingress/egress routes and over 88% of the city is within the Very High Fire Sensitivity Zone designated by CAL FIRE. Due to climate and land use changes, wildfires are occurring more frequently in the State of California. The Camp Fire in November 2018 was the deadliest and most destructive wildfire in California history to date. The devastation caused by this wildfire highlights the need for an effective evacuation plan to move people away from impacted areas as expeditiously as possible given the roadway system.

As part of this study, three field visits were made: one to gather all of the roadway data, one to examine the access impaired neighborhoods, and one to conduct a demographic survey of the residents of the City (409 completed survey forms were obtained, yielding results with a sampling error of approximately ±4.81 at the 95% confidence level – see Appendix F). This study analyzed traffic conditions and evacuation times for a variety of evacuation scenarios of the City of Laguna Beach. Alternative emergency management strategies that could be used in response to an evacuation of the City were also examined. This study, and the results contained within this report, will further inform the City's emergency planning and protective action decision making.

A traffic/evacuation simulation model (Dynamic Evacuation Simulation Model, or DYNEV-II) is used to compute evacuation time estimates (ETE) using the procedures described in Appendix D. The supply (see Appendix H) and demand (see Section 3 and Appendix E) are input to DYNEV-II. The two main outputs of the DYNEV-II model are ETE for general population (evacuees with personal vehicles) and route-specific evacuation speeds, which are used to compute the ETE for special facilities (schools and medical facilities) and the transit-dependent population. These times are critical for developing an effective plan to protect the health and safety of the public.

City officials have divided the City of Laguna Beach into Emergency Management Zones (EMZs), see Figure 6-1. The boundaries of the EMZs follow political or geographical boundaries, which helps the City communicate evacuation orders to the public. Given the large wilderness areas surrounding the City of Laguna Beach – Aliso and Wood Canyons Wilderness Park and Laguna Coast Wilderness Park – it is highly unlikely that a wildfire would only impact Laguna Beach. Rather, neighboring communities which are also along the ridgelines of these wildnerness areas are likely to evacuate at the same time as Laguna Beach. The vehicles evacuating from these neighboring communities could delay egress from Laguna Beach; this phenomenon is referred to as a "shadow evacuation." Figure G-29 shows the EMZs that comprise the City of Laguna Beach, as well as the shadow evacuation region along the ridgeline surrounding the City.

The general population ETE are presented in Tables 7-1 and 7-2. These data are the times needed to clear the indicated regions (individual EMZs or groupings of EMZs) of 90 and 100 percent of the population occupying these regions, respectively. For definitions of scenarios (demand changes due to temporal variations) and regions (area to be evacuated varies by wildfire situation), see Section 6 and Appendix G, respectively.

Critical findings of the study include:

- The 100th percentile ETE for the evacuation of individual EMZs are entirely dictated by the time needed to mobilize rather than by traffic congestion. As such, it is recommended that the 90th

percentile is used when making protective action decisions for evacuation of individual EMZs. See Section 7.4). It is highly unlikely that an individual EMZ would be evacuated for a wildfire. Thus, the ETE for individual EMZs presented in this study can be used for smaller hazards such as a gas leak or a HAZMAT spill.

- People evacuating from areas that are not at risk could prolong the evacuation time of those people most at risk. Congestion dictates ETE for cases wherein groupings of EMZs are evacuated in conjunction with a Shadow evacuation along the ridge line. These Shadow evacuees consume much of the available roadway capacity along the major evacuation routes for the City of Laguna Beach and significantly increase the ETE. See Tables 7-1 and 7-2. It is imperative to educate the public to only evacuate if they are advised to do so.
- Emergency plans should include plans to address common events that reduce roadway capacity, such as disabled vehicles or traffic accidents. Events that reduce roadway capacity, such as thick smoke causing limited sight distance, traffic accidents, or vehicles blocking roads because they have run out of gas, can significantly impact the evacuation of the city. See Scenario 5 in Tables 7-1 and 7-2.
- Three access impaired neighborhoods have been identified: Canyon Acres Drive, Bluebird Canyon, and Diamond St & Crestview Drive. These neighborhoods would require early notification during an approaching wildfire as they may be unable to evacuate if a fire were present. See Figure 8-2.
- Available transportation resources were provided by city emergency management representatives. Table 9-1 summarizes the information received. These numbers indicate there are not sufficient resources available to evacuate everyone in a single wave. See Section 9.
- No additional traffic control points (TCPs) have been recommended as a result of the findings of this study. The existing City emergency plan has several traffic control points (TCPs) identified wherein a police officer would control traffic at an intersection during an emergency. These TCPs were modeled explicitly in the ETE simulations. See Section 10.
- The entire City takes 4 hours and 20 minutes, on average under normal roadway conditions (no roadways hazards like stalled vehicles, trees/debris and/or power lines blocking the road, thick smoke limiting sight distance, etc.), to evacuate with no roadway closures.
    - If a wildfire renders SR-133 (Laguna Canyon Rd) unavailable, the time to evacuate 100% of the entire City increases by as much as 40 minutes. See Section J.4.1 and Table ES-1.
    - If a wildfire renders SR-133 and SR-73 unavailable, the time to evacuate 100% of the entire City increases by as much as 1 hour and 20 minutes. See Section J.4.2 and Table ES-1.
    - If a wildfire renders SR-1 (Pacific Coast Highway) northbound and SR-133 unavailable, the time to evacuate 100% of the entire City increases by as much as 4 hours. See Section J.4.3 and Table ES-1.
    - If a wildfire renders SR-1 southbound and SR-133 unavailable, the time to evacuate 100% of the entire City increases by as much as 3 hours and 45 minutes. See Section J.4.4 and Table ES-1.

- The ETE benefit gained by implementing contraflow (20 minutes or less) does not outweigh the danger and effort required to implement it. See Section J.5. Implementing contraflow is dangerous – potential for head-on collisions – and resource intensive – requires extensive equipment and personnel to block all roadways that could potentially turn into oncoming traffic.
- A sensitivity study was performed to determine the impact of an additional 400 housing units being built along SR-1 in the City of Laguna Beach. The increased number of evacuating vehicles from these additional housing units increases congestion and delays along SR-1 thereby increasing the 90th and 100th percentile ETE by 25 minutes and 40 minutes, respectively. See Section J.6.

The City of Laguna Beach should consider revising their emergency plans to incorporate the lessons learned from this study. Once revised, the new procedures developed should be practiced through exercises and drills. Lessons learned from these exercises and drills should then be used to improve the emergency plans further. Emergency planning is an iterative process!

City residents and visitors should be informed, through public outreach, of the emergency plan contents, including how they will be notified, which evacuation routes to use, what to do if they need transportation assistance, how long it might take to evacuate, and what would happen if critical evacuation routes are unavailable. Citizen participation in evacuation drills is recommended. Education is key in protecting public health and safety!

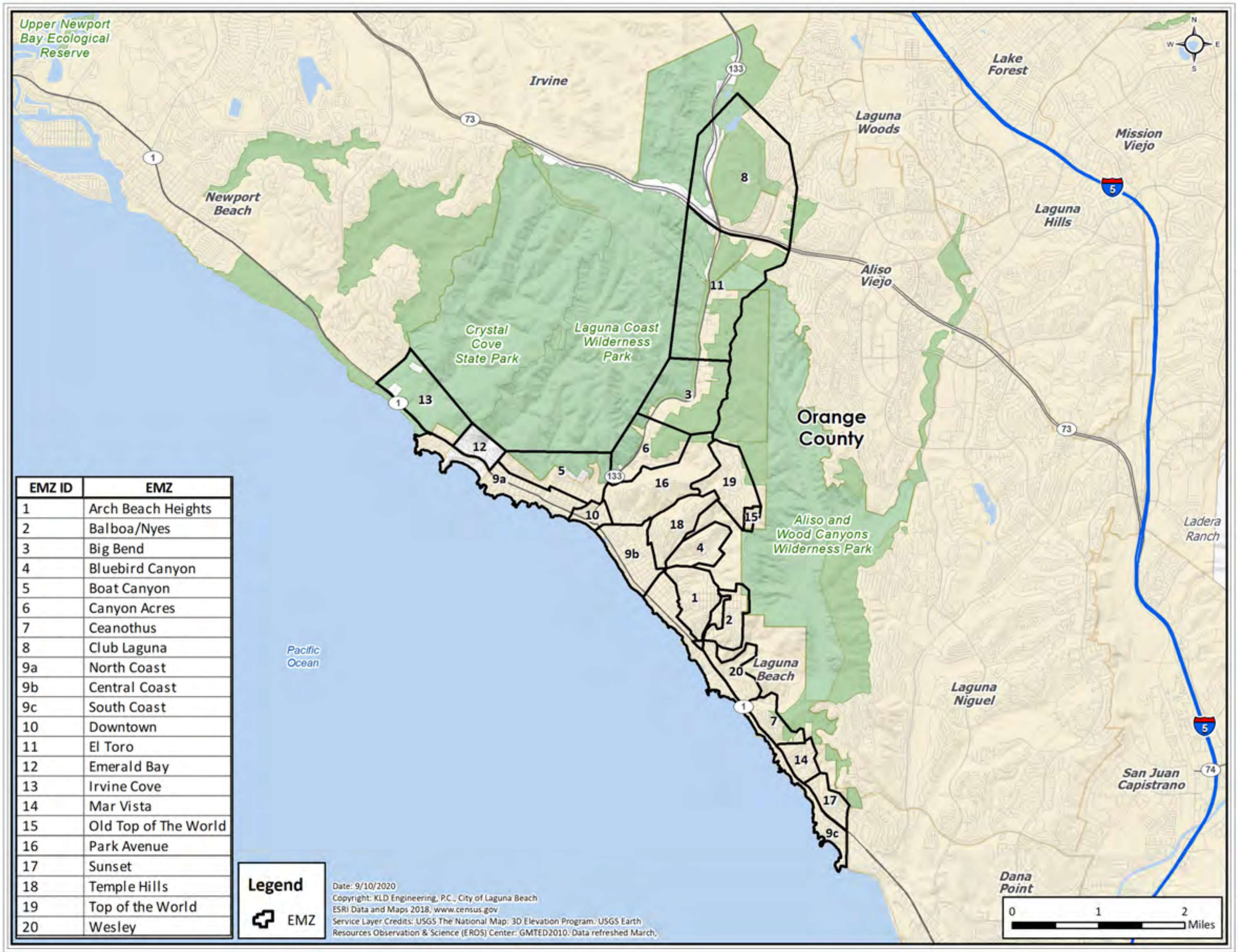

Figure 6-1. EMZ Boundaries

Table 7-1. Time to Clear the Indicated Area of *90* Percent of the Affected Population

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal	Normal	Normal	Normal	Reduced Roadway Capacity[1]	Normal	Normal
R01 - Arch Beach Heights	1:35	1:25	1:25	1:35	1:35	1:25	1:25
R02 - Balboa/Nyes	1:35	1:30	1:30	1:35	1:40	1:30	1:30
R03 - Big Bend	1:10	1:10	1:10	1:15	1:15	1:10	1:10
R04 - Bluebird Canyon	1:35	1:25	1:25	1:35	1:35	1:25	1:25
R05 - Boat Canyon	1:50	2:00	1:30	1:30	1:40	1:20	1:10
R06 - Canyon Acres	1:00	0:55	1:00	1:05	1:05	1:05	1:05
R07 - Ceanothus	1:25	1:20	1:20	1:30	1:30	1:25	1:25
R08 - Club Laguna	1:50	1:45	1:45	1:50	1:50	1:45	1:45
R09 - North Coast	1:50	1:45	1:35	1:55	2:00	1:55	1:40
R10 - Central Coast	1:45	1:40	1:30	1:45	1:55	1:45	1:35
R11 - South Coast	1:45	1:45	1:35	1:45	1:50	1:45	1:35
R12 - Downtown	1:40	1:40	1:35	1:45	1:50	1:45	1:40
R13 - El Toro	1:50	1:50	1:55	1:50	2:00	1:50	1:55
R14 - Emerald Bay	1:50	1:45	1:25	1:45	1:45	1:40	1:25
R15 - Irvine Cove	1:35	1:25	1:25	1:30	1:30	1:25	1:30
R16 - Mar Vista	1:30	1:25	1:25	1:30	1:30	1:25	1:25
R17 - Old Top of the World	1:40	1:30	1:30	1:35	1:35	1:30	1:30
R18 - Park Avenue	1:25	1:20	1:25	1:30	1:30	1:25	1:25
R19 - Sunset	1:30	1:25	1:25	1:30	1:30	1:25	1:25
R20 - Temple Hills	1:35	1:30	1:30	1:35	1:35	1:30	1:30
R21 - Top of the World	1:35	1:25	1:25	1:35	1:35	1:25	1:25
R22 - Wesley	1:30	1:20	1:20	1:30	1:30	1:25	1:25
R23 - North Laguna	2:00	2:00	1:40	1:55	2:00	1:50	1:40
R24 - Central Laguna	2:15	2:10	1:45	2:15	2:25	2:10	1:40
R25 - South Laguna	2:15	2:10	1:40	1:55	2:10	2:05	1:35
R26 - North and Central Laguna	2:50	2:35	2:05	2:35	2:50	2:20	2:00
R27 - South and Central Laguna	3:15	3:00	2:35	3:05	3:30	2:50	2:25
R28 - All EMZs + 100% of Shadow Region along Ridge Line	3:45	3:40	3:05	3:20	3:45	3:15	2:40
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	3:30	3:20	3:00	3:15	3:40	2:55	2:40
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	3:35	3:30	2:50	3:20	3:40	3:00	2:35

[1] Events that reduce roadway capacity, like thick smoke causing decreased sight distance, can significantly impact the evacuation of the City of Laguna Beach.

Table 7-2. Time to Clear the Indicated Area of 100 Percent of the Affected Population

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal	Normal	Normal	Normal	Reduced Roadway Capacity[1]	Normal	Normal
R01 - Arch Beach Heights	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R02 - Balboa/Nyes	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R03 - Big Bend	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R04 - Bluebird Canyon	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R05 - Boat Canyon	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R06 - Canyon Acres	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R07 - Ceanothus	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R08 - Club Laguna	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R09 - North Coast	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R10 - Central Coast	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R11 - South Coast	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R12 - Downtown	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R13 - El Toro	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R14 - Emerald Bay	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R15 - Irvine Cove	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R16 - Mar Vista	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R17 - Old Top of the World	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R18 - Park Avenue	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R19 - Sunset	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R20 - Temple Hills	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R21 - Top of the World	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R22 - Wesley	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R23 - North Laguna	3:35	3:35	3:35	3:35	3:35	3:35	3:35
R24 - Central Laguna	3:35	3:35	3:35	3:35	3:35	3:35	3:35
R25 - South Laguna	3:35	3:35	3:35	3:35	3:35	3:35	3:35
R26 - North and Central Laguna	3:50	3:35	3:35	3:35	3:35	3:35	3:35
R27 - South and Central Laguna	4:30	4:15	3:35	4:20	5:00	4:10	3:35
R28 – All EMZs + 100% of Shadow Region along Ridge Line	4:50	4:50	3:40	4:45	5:20	4:10	3:35
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	4:20	4:35	3:40	4:40	5:05	3:45	3:35
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	4:50	4:20	3:35	4:40	5:10	4:10	3:35

Table ES-1. Summary of Roadway Closure Scenarios

Closed Roadway(s)	Max Increase in Evacuation Time
SR-133	40 minutes
SR-133 AND SR-73 (between SR-133 and I-405)	1 hour and 20 minutes
SR-1 NB and SR-133	4 hours
SR-1 SB and SR-133	3 hours and 45 minutes

1 INTRODUCTION

This section provides an introduction of the study and an overview of the process used to compute the evacuation time estimates (ETE) for the City of Laguna Beach, including preliminary activities of the project.

This report describes the analyses undertaken to examine anticipated traffic conditions and evacuation times associated with various rates of evacuation responses and alternative management strategies that could be used in response to them for the Emergency Management Zones (EMZs) within the City of Laguna Beach, California. This study, and the results contained within this report, will further inform and enhance the City of Laguna Beach's emergency planning procedures.

In the performance of this effort, guidance is provided by documents published by Federal and State Governmental agencies. The nuclear industry is highly regulated and offers a number of resources for developing evacuation studies. Very few such documents exist for wildfire hazards. While the hazard is different, much of the concepts of evacuation (warning time, smaller/isolated communities, lower density roadway networks, etc.) are appliable. As such, most of the references used in this study have been published by the US Nuclear Regulatory Commission (NRC). Most important of these are:

- Title 10, Code of Federal Regulations, Appendix E to Part 50 (10CFR50), Emergency Planning and Preparedness for Production and Utilization Facilities, NRC, 2011.
- Criteria for Development of Evacuation Time Estimate Studies, NUREG/CR-7002, November 2011.
- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/FEMA REP 1, Rev. 1, November 1980.
- Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones, NUREG/CR 1745, November 1980.

The work effort reported herein was supported and guided by local stakeholders who contributed suggestions, critiques, and the local knowledge base required. Table 1-1 presents a summary of stakeholders and interactions.

1.1 Overview of the ETE Process

The following outline presents a brief description of the work effort in chronological sequence:

1. Information Gathering:
    a. Defined the scope of work in discussions with representatives from the City of Laguna Beach.
    b. Attended meetings with local stakeholders to define methodology.

c. Conducted a detailed field survey of the highway system and of area traffic conditions within the EMZs and Shadow Region.

d. Obtained demographic data from the 2010 Census. Projected the 2010 Census data to the year 2020 (see Section 3.1).

e. Estimated the number of non-EMZ year-round employees using data obtained from the US Census Longitudinal Employer-Household Dynamics from the OnTheMap Census analysis tool (see Section 3.4).

f. Conducted a random sample demographic survey of EMZ residents. This survey was conducted at local gathering points and social media via an online platform.

g. Obtained data (to the extent available) to update the database of schools, colleges, medical facilities, tourist attractions, seasonal workers, recreational facilities, and transportation resources available. Majority of this data was provided by the City and supplemented with internet searches where no data was received.

2. Estimated distribution of trip generation times representing the time required by various population groups (permanent residents, employees, and tourists) to prepare (mobilize) for the evacuation trip and updated where necessary. These estimates were based upon the demographic survey results and notification time calculation (see Section 5 and Appendix F).

3. Defined Evacuation Scenarios. These scenarios reflect the variation in demand, in trip generation distribution and in highway capacities, associated with different seasons, day of week, time of day and roadway conditions. The scenarios selected were bound by the normal wildfire season.

4. Created Evacuation Regions. "Regions" are individual or groups of EMZs for which ETE are calculated. The configurations of these Regions reflect evacuation of each EMZ and a combination of EMZs (see Appendix G).

5. Estimated demand for transit services for persons at special facilities and for transit-dependent persons.

6. Identified and mapped access impaired neighborhoods throughout the City of Laguna Beach wherein there are clusters of houses, limited ingress/egress routes, and could not be passable during a wildfire (surrounded by a lot of fuel). These neighborhoods were surveyed and safe refuge area options were recommended in neighborhoods identified as having access impaired challenges.

7. Prepared the input streams for the DYNEV II system which computes ETE (see Appendices B and C).

   a. Estimated the evacuation traffic demand, based on the available information derived from Census data, from data provided by local agencies, and from the demographic survey.

b. Created the link-node representation of the evacuation network, which was used as the basis for the computer analysis that calculates the ETE.

c. Applied the procedures specified in the 2016 Highway Capacity Manual (HCM[1]) to the data acquired during the field survey, to estimate the capacity of all highway segments comprising the evacuation routes.

d. Calculated the evacuating traffic demand for each Region and for each Scenario.

e. Specified selected candidate destinations for each "origin" (location of each "source" where evacuation trips are generated over the mobilization time) to support evacuation travel consistent with outbound movement relative to the location of the wildfire.

8. Executed the DYNEV II model to determine optimal evacuation routing and compute ETE for all residents, tourists/seasonal workers and employees ("general population") with access to private vehicles. Generated a complete set of ETE for all specified Regions and Scenarios.

9. Identified Traffic Control Points (TCP) and Access Control Points (ACP) within the study area. See Section 10.

10. Calculated the ETE for all transit activities including those for special facilities (schools and medical facilities) and for the transit-dependent population.

11. Documented ETE results.

12. Evacuation signage was evaluated within the City and access impaired neighborhoods.

13. Four roadway closure scenarios (wildfire events) were considered. The first wildfire event forced all evacuees to evacuate towards Newport Beach (North) by closing SR-1 southbound and SR-133/Laguna Canyon Rd northbound[2]. The second event forced all evacuees towards Dana Point (South) by closing SR-1 northbound and SR-133/Laguna Canyon Rd northbound[2]. The third event forced all evacuees towards either Newport Beach (North) or Dana Point (South) by closing SR-133/Laguna Canyon Rd northbound[2]. The fourth wildfire event involved a closure of both SR-133/Laguna Canyon Rd northbound and of SR-73 in both directions between I-405 and SR-133/Laguna Canyon Rd[2].

14. Tested what-if scenarios to evaluate alternative management strategies that could be used in response to wildfire situations.

1.2 Location of the Study Area

The EMZs are in the City of Laguna Beach in Orange County, California. The City of Laguna Beach is located approximately 65 miles north of San Diego, CA and 45 miles south of Los

[1] Highway Capacity Manual (HCM 2016), Transportation Research Board, National Research Council, 2016.

[2] Due to the unique geometry of EMZ 8, some evacuees from this zone will be permitted to evacuate via El Toro Rd and SR-73.

Angeles, CA. Figure 1-1 displays the area surrounding the EMZs. This map identifies the local communities in the area and the major roadways.

1.3 Preliminary Activities

These activities are described below.

Field Surveys of the Highway Network

KLD personnel drove the entire highway system within the EMZs and the Shadow Region[3]. The Shadow Region is defined as the area beyond the EMZs, shown in Figure 1-1, including municipalities of Irvine, Newport Beach, Laguna Woods, Laguna Hills, Aliso Viejo, Laguna Niguel, Dana Point and San Juan Capistrano. The Shadow Region is bounded by I-405 and I-5 to the North, Jamboree Road to the West, and I-5 and Pacific Coast Highway to the East. The characteristics of each section of highway were recorded. These characteristics are shown in Table 1-2.

Video and audio recording equipment were used to capture a permanent record of the highway infrastructure. No attempt was made to meticulously measure such attributes as lane width and shoulder width; estimates of these measures based on visual observation and recorded images were considered appropriate for the purpose of estimating the capacity of highway sections. For example, Exhibit 15-7 in the HCM indicates that a reduction in lane width from 12 feet (the "base" value) to 10 feet can reduce free flow speed (FFS) by 1.1 mph – not a material difference – for two-lane highways. Exhibit 15-46 in the HCM shows little sensitivity for the estimates of Service Volumes at Level of Service (LOS) E (near capacity), with respect to FFS, for two-lane highways.

The data from the audio and video recordings were used to create detailed geographic information systems (GIS) shapefiles and databases of the roadway characteristics and of the traffic control devices observed during the road survey; this information was referenced while preparing the input stream for the DYNEV II System.

As documented on page 15-6 of the HCM 2016, the capacity of a two-lane highway is 1700 passenger cars per hour in one direction. For freeway sections, a value of 2250 vehicles per hour per lane is assigned, as per Exhibit 12-37 of the HCM 2016. The road survey has identified several segments which are characterized by adverse geometrics (steep hills and tight curves with no shoulders) on two-lane highways which are reflected in reduced values for both capacity and speed. These estimates are consistent with the service volumes for LOS E presented in HCM Exhibit 15-46. These links may be identified by reviewing Appendix H. Link capacity is an input to DYNEV II which computes the ETE. Further discussion of roadway capacity is provided in Section 4 of this report.

Traffic signals are either pre-timed (signal timings are fixed over time and do not change with the traffic volume on competing approaches) or are actuated (signal timings vary over time

[3] An evacuation in the shadow region occurs when residents voluntarily evacuate from areas beyond the area officially given the evacuation order. This phenomenon can cause unwanted congestion and increase clearance times for people in the areas of actual risk.

based on the changing traffic volumes on competing approaches). Actuated signals require detectors to provide the traffic data used by the signal controller to adjust the signal timings. These detectors are typically magnetic loops in the roadway, or video cameras mounted on the signal masts and pointed toward the intersection approaches. If detectors were observed on the approaches to a signalized intersection during the road survey, detailed signal timings were not collected as the timings vary with traffic volume. Traffic Control Points at locations which have control devices are represented as actuated signals in the DYNEV II system.

If no detectors were observed, the signal control at the intersection was considered pre-timed, and detailed signal timings were gathered for several signal cycles. These signal timings were input to the DYNEV II system used to compute ETE.

Figure 1-2 presents the link-node analysis network that was constructed to model the evacuation roadway network in the EMZs and Shadow Region. The directional arrows on the links and the node numbers have been removed from Figure 1-2 to clarify the figure. The detailed figures provided in Appendix H depict the analysis network with directional arrows shown and node numbers provided. The observations made during the field survey along with aerial imagery were used to calibrate the analysis network.

Demographic Survey

A demographic survey was performed to gather information needed for the evacuation study. Appendix F presents the survey instrument, the procedures used, and tabulations of data compiled from the survey returns.

This data was utilized to develop estimates of vehicle occupancy to estimate the number of evacuating vehicles during an evacuation and to estimate elements of the mobilization process. This database was also referenced to estimate the number of transit-dependent people.

Computing the Evacuation Time Estimates

The overall study procedure is outlined in Appendix D. Demographic data was obtained from several sources, as detailed later in this report. These data were analyzed and converted into vehicle demand data. The vehicle demand was loaded onto appropriate “source” links of the analysis network using GIS mapping software. The DYNEV II system was then used to compute ETE for all Regions and Scenarios.

Analytical Tools

The DYNEV II System[4] that was employed for this study is comprised of several integrated computer models. One of these is the DYNEV (DYnamic Network EVacuation) macroscopic simulation model, a new version of the IDYNEV model that was developed by KLD under contract with the Federal Emergency Management Agency (FEMA).

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[4] The models of the IDYNEV System were recognized as state of the art by the Atomic Safety & Licensing Board (ASLB) in past hearings. (Sources: Atomic Safety & Licensing Board Hearings on Seabrook and Shoreham; Urbanik). The models have continuously been refined and extended since those hearings and were independently validated by a consultant retained by the NRC. The new DYNEV II model incorporates the latest technology in traffic simulation and in dynamic traffic assignment. (Urbanik, T., et. al. Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code, NUREG/CR-4873, Nuclear Regulatory Commission, June, 1988.)

DYNEV II consists of four sub-models:

- A macroscopic traffic simulation model (for details, see Appendix C).
- A Trip Distribution (TD) model that assigns a set of candidate destination (D) nodes for each "origin" (O) located within the analysis network, where evacuation trips are "generated" over time. This establishes a set of O-D tables.
- A Dynamic Traffic Assignment (DTA) model which assigns trips to paths of travel (routes) which satisfy the O-D tables, over time. The TD and DTA models are integrated to form the DTRAD (Dynamic Traffic Assignment and Distribution) model, as described in Appendix B.
- A Myopic Traffic Diversion model which diverts traffic to avoid intense, local congestion, if possible.

Another software product developed by KLD, named UNITES (UNIfied Transportation Engineering System) was used to expedite data entry and to automate the production of output tables.

The dynamics of traffic flow over the network are graphically animated using the software product, EVAN (EVacuation ANimator), developed by KLD. EVAN is GIS based and displays statistics such as LOS, vehicles discharged, average speed, and percent of vehicles evacuated, output by the DYNEV II System. The use of a GIS framework enables the user to zoom in on areas of congestion and query road name, town name and other geographic information.

The procedure for applying the DYNEV II System within the framework of developing ETE is outlined in Appendix D. Appendix A is a glossary of terms.

For the reader interested in an evaluation of the original model, I-DYNEV, the following references are suggested:

- NUREG/CR-4873 – Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code.
- NUREG/CR-4874 – The Sensitivity of Evacuation Time Estimates to Changes in Input Parameters for the I-DYNEV Computer Code.

The evacuation analysis procedures are based upon the need to:

- Route traffic along paths of travel that will expedite their travel from their respective points of origin to points outside the evacuation region.
- Restrict movement toward the wildfire to the extent practicable and disperse traffic demand so as to avoid focusing demand on a limited number of highways.
- Move traffic in directions that are generally outbound relative to the location of the wildfire.

DYNEV II provides a detailed description of traffic operations on the evacuation network. This description enables the analyst to identify bottlenecks and to develop countermeasures that are designed to represent the behavioral responses of evacuees. The effects of these countermeasures may then be tested with the model.

Table 1-1. Stakeholder Interaction

<table>
<tr><th>Stakeholder</th><th>Nature of Stakeholder Interaction</th></tr>
<tr><td>City of Laguna Beach Emergency Management</td><td>Attended meetings to define methodology and data requirements. Assisted in data collection. Assisted in surveying access impaired neighborhoods. Reviewed and discussed all study assumptions and list of special facilities.</td></tr>
<tr><td>City of Laguna Beach Police Department</td><td>Attended meetings to define methodology and data requirements. Assisted in surveying access impaired neighborhoods. Reviewed and discussed all study assumptions and list of special facilities.</td></tr>
<tr><td>City of Laguna Beach Community Development</td><td>Attended meetings to define methodology and data requirements. Reviewed and discussed all study assumptions and list of special facilities.</td></tr>
<tr><td>Orange County Transit Authority</td><td rowspan="2">Attended meetings to define methodology and data requirements. Informed KLD of general practices and procedures during wildfires and of any planned roadway construction projects in the study area.</td></tr>
<tr><td>California Department of Transportation (Caltrans)</td></tr>
</table>

Table 1-2. Highway Characteristics

- Number of lanes
- Lane width
- Shoulder type & width
- Interchange geometries
- Lane channelization & queuing capacity (including turn bays/lanes)
- Geometrics: curves, grades (>4%)
- Posted speed
- Actual free speed
- Abutting land use
- Control devices
- Intersection configuration (including roundabouts where applicable)
- Traffic signal type
- Unusual characteristics: Narrow bridges, sharp curves, poor pavement, flood warning signs, inadequate delineations, toll booths, etc.

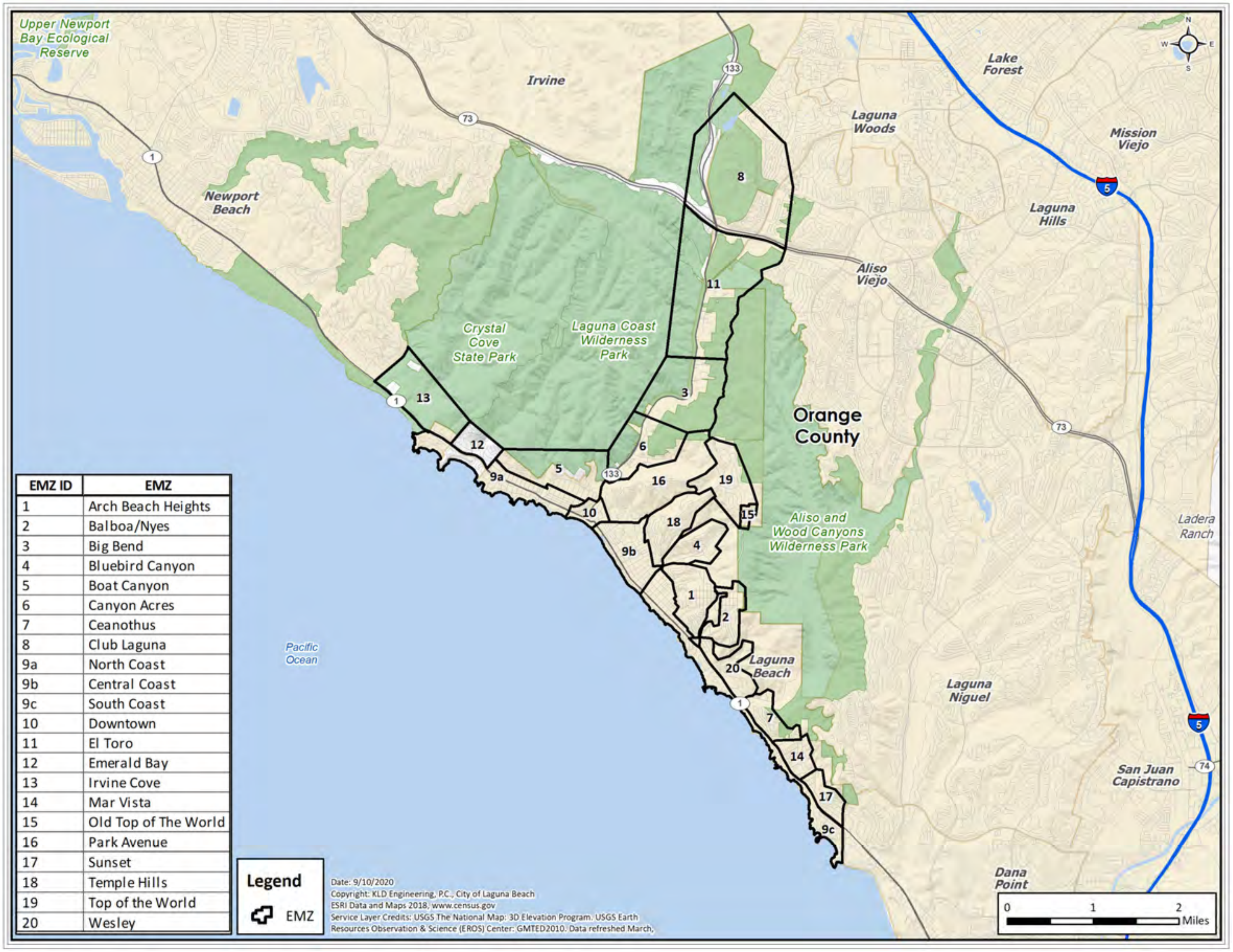


Figure 1-1. Study Area Location

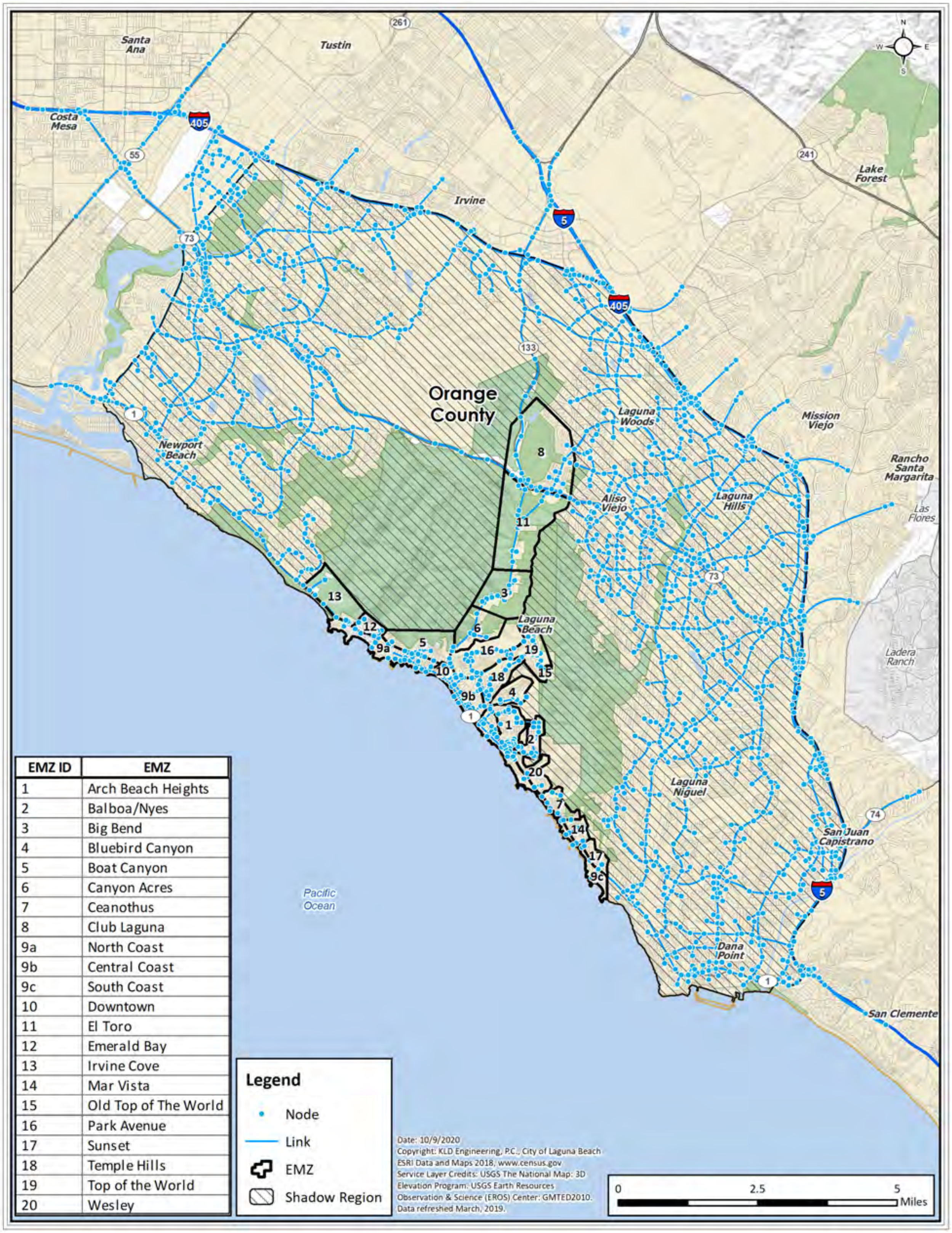


Figure 1-2. Study Area Link-Node Analysis Network

2 STUDY ESTIMATES AND ASSUMPTIONS

This section discusses the data estimates and project assumptions utilized in this study. These assumptions were discussed with representatives from the City of Laguna Beach Police Department, California Department of Transportation and county transit managers. An assumptions memorandum documenting all the project assumptions was reviewed and approved by the City of Laguna Beach Department of Emergency Management and Police Department prior to their use in this study.

2.1 Data Estimates

1. The estimate of permanent resident population was based upon the 2010 U.S. Census population data from the Census Bureau website[1] extrapolated to July 2020 using annual growth rates that were computed from the 2019 Census population estimates (see Section 3.1).
2. Estimates of year-round employees who reside outside the EMZ and commute to work within the EMZ were based upon data obtained from the US Census Longitudinal Employer-Household Dynamics from the OnTheMap Census analysis tool[2].
3. Population estimates at transient and special facilities were based on the data received from the City of Laguna Beach Police Department and internet searches (see Sections 3.1.2, 3.3, 3.5 and 3.7).
4. Evacuee mobilization times were based on a statistical analysis of data acquired from a random sample demographic survey of the EMZ residents conducted in late 2019 (see Section 5 and Appendix F).
5. The relationship between permanent resident population and evacuating vehicles was extracted from the 2019 demographic survey (see Appendix F). Average values of 2.39 persons per household (Figure F-1) and 1.64 evacuating vehicles per household (Figure F-8) were used for permanent resident population. The relationship between persons and vehicles for other population groups in the EMZs is as follows:
    a. Employees: 1.04 employees per vehicle (demographic survey results) for all major employers. See Section 3.4 and Section F.3.1.
    b. Tourists Population Data (Vehicle Occupancy Average is 2.85 tourists per vehicle; see Section 3.3 and Appendix E for additional information):
        i. Lodging Facilities: Operate at maximum capacity and have an average vehicle occupancy of 3.32 persons per vehicle.
        ii. Other tourist facilities: Vehicle occupancy varies between 1.97 and 3.00 persons per vehicle.
        iii. It was assumed that parking lots are full at peak hours and if no data was provided, it was assumed that the vehicle occupancy rate is equal to the average household size, 2.39 persons per vehicle.

[1] www.census.gov

[2] http://onthemap.ces.census.gov/

6. Roadway capacity estimates were based on field surveys performed in November 2019 and the application of the Highway Capacity Manual 2016.

2.2 Study Methodological Assumptions

1. A total of 7 "Scenarios" representing different temporal variations (season, time of day, day of week) and conditions were considered. These Scenarios are outlined in Table 2-1.
2. Five different wildfire events were considered. The first wildfire evacuation scenario allows evacuees to travel in any direction. The second wildfire event forces all evacuees to evacuate towards Newport Beach (North) by closing SR-1 southbound and SR-133/Laguna Canyon Rd northbound[3]. The third event forces all evacuees towards Dana Point (South) by closing SR-1 northbound and SR-133/Laguna Canyon Rd northbound[3]. The fourth event forces all evacuees towards either Newport Beach (North) or Dana Point (South) by closing SR-133/Laguna Canyon Rd northbound[3]. The fifth wildfire event involves a closure of both SR-133/Laguna Canyon Rd northbound and of SR-73 in both directions between I-405 and SR-133/Laguna Canyon Rd[3].
3. Several sensitivity studies were conducted to determine the elasticity of the evacuation time estimates based on the notification time distribution. One such study included a compressed notification time distribution that would result from a robust siren system that was not present at the time of the 2019 demographic survey but is expected to be installed in the near future. See Appendix J.
4. The notification time distribution (the time required for evacuees to receive notification of an evacuation) used in the study will be based on the results of the 2019 demographic survey. Table 2-2 displays the notification distribution that was used in the study.
5. The Shadow Region was defined as the area beyond the EMZ including municipalities of Irvine, Newport Beach, Laguna Woods, Laguna Hills, Aliso Viejo, Laguna Niguel, Dana Point and San Juan Capistrano. The Shadow Region was bounded by I-405 and I-5 to the North, Jamboree Road to the West, and I-5 and SR-1 to the East.
6. Approximately fourteen percent (14%) of the population within the Shadow Region and within the EMZ not advised to evacuate will voluntarily evacuate based on the results of the demographic survey performed within the EMZ[4].
7. The DYNEV II System was used to compute ETE in this study.
8. Evacuation movements (paths of travel) are generally outbound relative to the wildfire to the extent permitted by the highway network. All major evacuation routes were used in the analysis, except for those wildfire events wherein certain major evacuation routes are closed (see number 2).

[3] Due to the unique geometry of EMZ 8, some evacuees from this zone will be permitted to evacuate via El Toro Rd and SR-73.

[4] For some cases, a 100% shadow evacuation was considered for Shadow Region that borders the ridge line. See Figure G-29.

2.3 Study Assumptions

1. The Planning Basis Assumption for the calculation of ETE is a rapidly escalating hazard that requires immediate evacuation, and includes the following:
    a. Advisory to evacuate is announced coincident with local emergency alerts (NIXLE Alert Orange County, Outdoor Warning System, social media, local news and similar communication systems).
    b. Mobilization of the general population will commence within 15 minutes after the emergency alerts.
    c. ETE are measured relative to the advisory to evacuate.
2. One hundred percent (100%) of the EMZ population can be notified within 30 minutes of the advisory to evacuate.
3. One hundred percent (100%) of the people told to evacuate, will do so.
4. Evacuees will drive safely, travel away from the wildfire to the extent practicable given the highway network, and obey all control devices and traffic guides.
5. Buses will be used to transport those without access to private vehicles:
    a. Schools and childcare facilities[5]
        i. It was assumed that parents will pick up children at childcare facilities prior to evacuation.
        ii. It was assumed that most parents will pick up school children prior to the arrival of buses[6].
        iii. Schoolchildren, if school is in session, are given priority in assigning transit vehicles.
    b. Medical Facilities
        i. Buses, wheelchair transport vehicles and ambulance will be used to evacuate patients at medical facilities.
    c. Transit dependent general population are evacuated by bus or trolley.
    d. Access and functional needs population are included in the transit dependent population and will be evacuated by bus or trolley.
    e. Households with 3 or more vehicles were assumed to have no need for transit vehicles.
6. Transit vehicle capacities and maximum speed limits:
    a. School buses – the study assumed 80 students per bus for elementary school students and 55 students per bus for middle school and high school students.
    b. Ambulatory transit-dependent persons and medical facility patients = 30 people per bus/trolley.
    c. Basic Life Support (BLS) (ambulances) = 2 persons.
    d. Wheelchair transport vehicles – the study assumed 15 persons per wheelchair bus and 2 persons per trolley.

[5] Elementary, Middle, and High schools were considered Schools. Anything pre-elementary level was considered a childcare facility.

[6] School bus demand was computed for all schools based on enrollment for emergency planning purposes regardless of whether or not parents will pick up school children prior to evacuating.

e. The maximum bus speed assumed is 55 miles per hour, based on California Vehicle Code, Section 22406[7].

7. Transit vehicles mobilization times:
   a. School and transit buses will arrive at schools and facilities to be evacuated within 60 minutes of the advisory to evacuate.
   b. Transit dependent buses are mobilized within 150 minutes of the advisory to evacuate.
   c. Vehicles will arrive at hospitals, medical facilities, and senior living facilities to be evacuated within 25 minutes of the advisory to evacuate.
8. Transit Vehicle loading times:
   a. School buses will be loaded in 15 minutes.
   b. Transit Dependent buses and trolleys will require 1 minute of loading time per passenger.
   c. Buses for medical facilities will require 1 minute of loading time per ambulatory passenger.
   d. Wheelchair transport vehicles for medical facilities will require 5 minutes of loading time per passenger.
   e. Ambulances for medical facilities will require 30 minutes per bedridden passenger.
9. The percent breakdown of ambulatory (50%), wheelchair bound (40%) and bedridden patients (10%) was applied to total populations provided at Providence Mission Hospital Laguna Beach and Vista Aliso, accounting for rounding errors. The remaining medical facilities were assumed to have only ambulatory patients.
10. It was assumed that drivers for all transit vehicles identified in Table 9-1 are available.
11. Approximately seventy six percent (76%) of transit-dependent population will rideshare with a neighbor or friend, based on the 2019 demographic survey results.
12. Vehicles will be traveling through the study area (external-external trips) at the start of a wildfire. After the advisory to evacuate is announced, these pass-through travelers will also evacuate. External traffic vehicles will utilize Coast Highway (SR-1), Santa Ana Freeway (I-5), San Diego Freeway (I-405), and SR-73 to pass through the area. Dynamic and variable message signs will be strategically positioned outside of the hazard area at logical diversion points to attempt to divert traffic away from these routes. As such, it was assumed this pass-through (external) traffic will diminish over time with all external traffic flow stopping at 2 hours after the advisory to evacuate. See Section 3.8.
13. Access control will be implemented on SR-1 and on the SR-73 exit ramps to SR-133 during an emergency in Laguna Beach. The access control will be implemented over the course of 2 hours to allow police to mobilize personnel and equipment to block the roadways and to allow time for commuters to return home and unite with family (see Section 3.8).
14. Traffic Control Points (TCP), as defined in the City of Laguna Beach Evacuation Plan (dated April 2018), were considered in this analysis. TCPs are placed at locations that

[7] http://www.californiacarlaws.com/speed-limit/

benefit the evacuation during the analysis period. Their number and location will depend on the Region to be evacuated and resources available. The objectives of these TCPs are:

   a. Facilitate the movements of all (mostly evacuating) vehicles at the location.
   b. Discourage inadvertent vehicle movements towards the wildfire.
   c. Provide assurance and guidance to any traveler who is unsure of the appropriate actions or routing.
   d. Act as local surveillance and communications center.
   e. Provide information to the county and other emergency workers as needed, based on direct observation or on information provided by evacuees.

15. External Traffic was estimated to be reduced by 60% during evening scenarios (Scenario 3 and 7).
16. This study does not assume that roadways are empty at the start of the first time period. Rather, there is a 30-minute initialization period (often referred to as “fill time in traffic simulation) wherein the traffic volumes from the first time period were loaded onto roadways in the study area. The amount of initialization/fill traffic that is on the roadways in the study area at the start of the first time period depends on the scenario and the region being evacuated. See Section 3.9.
17. Reduced roadway capacity was considered for a fall, midweek, midday scenario (Scenario 5). The capacity and free flow speeds were reduced by 10 percent for this scenario. Fall means that school is in session. Summer means that school is not in session.
18. Trip generation time (also known as mobilization time, or the time to prepare for and begin the evacuation) will be based upon the results of the 2019 demographic survey.
19. Based on the results of the 2019 demographic survey, 56 percent of the households in the EMZ have at least 1 commuter; 18 percent of those households will await the return of household members before beginning their evacuation trip, based on the demographic survey results. Therefore, 10 percent (56% x 18% = 10%) of households will await the return of household members, prior to beginning their evacuation trip.
20. Public parking lots within the EMZ are filled to capacity during peak times for tourists and seasonal workers.
21. It was assumed that anyone evacuating by foot will have a walking speed of 3.5 feet per second[8]. It was also assumed that those evacuating by foot will not use hiking trails to evacuate as they could be dangerous during a wildfire.

[8] 2014 California Manual on Uniform Traffic Control Devices (CA MUTCD), Revision 4 – Section 4N.02 Page 990

Table 2-1. Evacuation Scenario Definitions

Scenarios	Season[9]	Day of Week	Time of Day	Conditions
1	Summer	Midweek	Midday	Normal
2	Summer/Spring	Weekend	Midday	Normal
3	Summer/Spring	Midweek, Weekend	Evening	Normal
4	Fall	Midweek	Midday	Normal
5	Fall	Midweek	Midday	Reduced Roadway Capacity
6	Fall	Weekend	Midday	Normal
7	Fall	Midweek, Weekend	Evening	Normal

Table 2-2. Cumulative Percent Notified

Elapsed Time (Minutes)	Cumulative Percent Notified
0	0%
5	69.8%
10	89.8%
15	95.6%
20	97.5%
25	98.1%
30	100%

[9] Fall means that school is in session at normal enrollment levels (also applies to spring and winter). Summer means that school is in session at summer school enrollment levels (lower than normal enrollment).

3 DEMAND ESTIMATION

This section discusses the estimates of demand, expressed in terms of people and vehicles, which constitute a critical element in developing an evacuation plan. This section also documents these sources of data, as well as the methodology used to extract relevant data from these sources. These estimates consist of three components:

1. An estimate of population within the Emergency Management Zones (EMZ), stratified into groups (e.g., resident, employee, tourists, special facilities, etc.).
2. An estimate, for each population group, of mean occupancy per evacuating vehicle. This estimate is used to determine the number of evacuating vehicles.
3. An estimate of potential double-counting of vehicles.

Appendix E presents much of the source material for the population estimates. Our primary source of population data, the 2010 Census, however, is not adequate for directly estimating some tourists.

Throughout the year, vacationers and tourists enter the EMZ. These non-residents may dwell within the EMZ for a short period (e.g., a few days or one or two weeks), or may enter and leave within one day. Estimates of the size of these population components must be obtained, so that the associated number of evacuating vehicles can be ascertained.

The potential for double-counting people and vehicles must be addressed. For example:

- A resident who works and shops within the EMZ could be counted as a resident, again as an employee and once again as a shopper.
- A visitor who stays at a hotel and spends time at a park, then goes shopping could be counted three times.

Furthermore, the number of vehicles at a location depends on time of day. For example, motel parking lots may be full at dawn and empty at noon. Similarly, parking lots at area parks, which are full at noon, may be almost empty at dawn. Estimating counts of vehicles by simply adding up the capacities of different types of parking facilities will tend to overestimate the number of tourists and can lead to ETE that are too conservative.

Analysis of the population characteristics of the study area indicates the need to identify three distinct groups:

- Permanent residents - people who are year-round residents of the EMZ.
- Tourists and seasonal residents - people who reside outside of the EMZ who enter the area for a specific purpose (shopping, recreation, seasonal employment) and then leave the area.
- Employees - people who reside outside of the EMZ and commute to work within the EMZ on a daily basis year round.

Estimates of the population and number of evacuating vehicles for each of the population groups are presented for each EMZ. The EMZ boundaries are shown in Figure 3-1.

3.1 Permanent Residents

The primary source for estimating permanent population is the latest U.S. Census data. The U.S. Census Bureau conducts a physical census of the permanent resident population in the U.S. every ten years. The last census began on April 1, 2010 with data from the census being published on April 1, 2011. In the years between the decennial censuses, the Census Bureau works with state and local agencies to provide annual population estimates at the state and local levels. These estimates are done using data on deaths, births and migration. This annual data gathering process and analysis is extensive. As such, population estimates are a year behind – 2019 data are released in 2020[1].

This study is based on 2010 Census population data from the Census Bureau website[2] extrapolated to 2020 using annual growth rates computed from the 2019 Census population estimates as outlined in the methodology below.

The Census Bureau QuickFacts[3] website provides annual population estimates for each state, county, and municipality[4] in the United States. As discussed above, Census population estimates are a year behind. Thus, the most recent population estimates available for the counties and municipalities are for the time period from April 1, 2010 to July 1, 2019. The population change and annual growth rate for each county and municipality in the study area (the EMZ plus Shadow Region) are provided in Table 3-1 and Table 3-2, respectively. Figure 3-2 shows the county and municipality boundaries identified by the Census Bureau.

The permanent resident population, as per the 2010 Census, for the EMZ and the Shadow Region was projected to 2020 using the compound growth formula (Equation 1). In the compound growth formula, g is the annual growth rate and X is the number of years projected forward from Year 2010. The compound growth formula can be solved for g as shown in Equation 2.

Equation 1

$$(Compound\ Growth\ for\ X\ years): Population\ 201X\ =\ Population\ 2010\ (1\ +\ g)^{\ x}$$

Equation 2

$$(Solving\ for\ the\ annual\ growth\ rate): g =\ (Population\ 201X\ \div\ Population\ 2010)^{1/x} - 1$$

The 2010 and 2019 population data provided in Table 3-1 and Table 3-2 were used in Equation 2 to compute the annual growth rate for each county and municipality in the study area using X = 9.25 (9 years and 3 months from April 1, 2010 to July 1, 2019). The computed annual growth rate for each county and municipality is summarized in the final column of Table 3-1 and Table 3-2, respectively.

[1] The schedule for release of Census data is provided on the Census website: https://www.census.gov/programs-surveys/popest/about/schedule.html

[2] www.census.gov

[3] https://www.census.gov/quickfacts/fact/table/US/PST045218

[4] https://www.census.gov/data/datasets/time-series/demo/popest/2010s-total-cities-and-towns.html

The most detailed data should always be used when forecasting population. In terms of detailed data, municipal data is the finest level of detail, then county data, and state data. The municipality growth rate was used first and if that was not available or applicable within the study area, then the county growth rate was used. County growth rates are available for the entire study area and were used (in the absence of municipal data) as they are the finest level of detail available for the entire study area. Thus, state data was not used.

The Census Bureau does not provide population data specific to the boundaries of the study area. As such, the county or municipality population was used to compute the annual growth rate. Then, the appropriate municipality or county growth rate was applied only to those Census blocks located within the study area. All other blocks outside of the study area were not considered as part of the EMZ or Shadow Region population, even if they are located within one of the municipalities or counties that intersect the study area.

The appropriate annual growth rate was applied to each Census block in the study area depending on which county or municipality the block is located within. The population was extrapolated to July 1, 2020 using Equation 1 with X = 10.25 (10 years and 3 months from the April 1, 2010 Census date to July 1, 2020), as the base year for this study.

The permanent resident population is estimated by cutting the census block polygons by the EMZ boundaries. A ratio of the original area of each census block and the updated area (after cutting) is multiplied by the total block population to estimate what the population is within the EMZ. This methodology (referred to as the “area ratio method”) assumes that the population is evenly distributed across a census block. Table 3-3 provides the permanent resident population within the EMZ for 2010 (based on the most recent U.S. Census) and for 2020 (based on the methodology above). As indicated, the permanent resident population within the EMZ has increased by approximately 0.78% since the 2010 Census.

The 2020 extrapolated permanent resident population is divided by the average household size and then multiplied by the average number of evacuating vehicles per household to estimate number of vehicles. The average household size (2.39 persons/household) was estimated using the demographic survey results (see Appendix F, sub-section F.3.1). The number of evacuating vehicles per household (1.64 vehicles/household – See Appendix F, sub-section F.3.2) was also adapted from the demographic survey results. Permanent resident population and vehicle estimates are presented in Table 3-4.

It can be argued that this estimate of permanent residents overstates, somewhat, the number of evacuating vehicles, especially during the summer. It is certainly reasonable to assert that some portion of the population would be on vacation during the summer and would travel elsewhere. A rough estimate of this reduction can be obtained as follows:

- Assume 50 percent of all households vacation for a two-week period over the summer.
- Assume these vacations, in aggregate, are uniformly dispersed over 10 weeks, i.e. 10 percent of the population is on vacation during each two-week interval.
- Assume half of these vacationers leave the area.

On this basis, the permanent resident population would be reduced by 5 percent in the summer and by a lesser amount in the off-season. Given the uncertainty in this estimate, we elected to apply no reductions in permanent resident population for the summer scenarios to account for residents who may be out of the area.

3.1.1 Special Facilities

Fourteen medical facilities are located within the EMZ (see Table E-2). These facilities have permanent residents that are included in the Census; however, these facilities are transit dependent (will not evacuate in personal vehicles) and are addressed below in Section 3.5. As such, these residents are included in the resident population, but no personal evacuating vehicles are considered. The vehicles in Table 3-4 have been adjusted accordingly.

3.1.2 College Students

Laguna College of Art and Design is the only college in the EMZ. This college has four campuses within the EMZ: Big Bend Campus, Main Campus, MFA Campus and South Campus. Upon examination for Census blocks in the vicinity of these campuses, it does not appear the resident students were captured in the Census. As such, no modifications to residents or resident vehicles were made to account for this college.

Based on the data provided by the City of Laguna Beach, some students will evacuate in private vehicles which are accounted for in the "Colleges" columns in Table 3-13 and Table 3-14. Other students either rideshare with a fellow classmate or evacuate by buses. The campuses are broken down as follows.

Big Bend Campus:

- Total enrollment of 250 students, 75% of which live on campus and 25% live off campus.
- According to the city, 75% of the students own private vehicles, and the remaining students (25%) take public transportation or rideshare. Therefore, 188 (250 x 75%) students have personal vehicles, and the remaining 62 (250 - 188) students will be evacuated via ridesharing or buses.
- Based on the demographic survey results, 76% of transit-dependent people will rideshare with a neighbor or friend (see Section 2.3, Assumption 11). Apply this ratio to the number of students without personal vehicles, 47 (62 x 76%) students will rideshare to evacuate, and the remaining 15 (62 – 47) students are considered as transit dependent and need a bus to evacuate.
- Using the capacity of 30 people per bus (see Section 2.3, Assumption 6), Big Bend Campus needs 1 (15 ÷ 30 = 1, rounded up) transit-dependent bus or 2 passenger car equivalent (pce's) vehicles (1 bus is equivalent to 2 passenger vehicles).
- In summary, 235 (188 + 47) commuter/ridesharing students will be evacuated in 188 private vehicles, and 15 transit-dependent students will be evacuated in 1 bus (2 pce's).

Main Campus:

- Total enrollment of 500 students, 75% of which live on campus and 25% live off campus.

- According to the city, the percentage of students that own private vehicles is 75%. Using the same estimation approach as described above, the number of commuter students is 375 (500 x 75%), the number of ridesharing students is 95 ((500 – 375) x 76%), and the number of transit-dependent students is 30 (500 – 375 – 95).
- In summary, 470 (375 + 95) commuter/ridesharing students will be evacuated in 375 private vehicles, and 30 transit-dependent students will be evacuated in 1 (30 ÷ 30) bus or 2 pce's.

MFA Campus:

- The total enrollment is 15. The data provided by the city reveals that there is no on-campus housing, therefore, all the students are considered as commuter students. No buses are needed for this campus. Since this is a commuter college, a vehicle occupancy of 1.04 students per vehicle, obtained from the demographic survey (See Appendix F, sub-section F.3.1, "Commuter Travel Modes"), was used to determine the number of evacuating vehicles for this facility. As such, a total of 14 vehicles was assigned to this facility.

South Campus:

- Total enrollment of 60 students, 75% of which live on campus and 25% live off campus.
- According to the city, the percentage of students that own private vehicles is 75%. Using the same estimation approach as described for Big Bend Campus, the number of commuter students is 45 (60 x 75%), the number of ridesharing students is 11 ((60 – 45) x 76%), and the number of transit-dependent students is 4 (60 – 45 – 11).
- In summary, 56 (45 + 11) commuter/ridesharing students will be evacuated in 45 private vehicles, and 30 transit-dependent students will be evacuated in 1 (4 ÷ 30, rounded up) bus or 2 pce's.

3.2 Shadow Population

A portion of the population living outside the evacuation area includes the municipalities of Dana Point, Irvine, Newport Beach, Laguna Woods, Laguna Hills, Aliso Viejo, Laguna Niguel and San Juan Capistrano. These areas may elect to evacuate without having been instructed to do so. Based on the demographic survey, it is assumed that 14 percent[5] of the permanent resident population, based on U.S. Census Bureau data, in this Shadow Region will elect to evacuate.

Shadow population characteristics (household size, evacuating vehicles per household, mobilization time) are assumed to be the same as that of the permanent resident population. There are 332,331 permanent residents and 228,040 vehicles in the Shadow Region.

[5] For some cases, a 100% shadow evacuation was considered for Shadow Region that borders the ridge line. See Figure G-29.

3.3 Tourist and Seasonal Worker Population

Tourist population groups are defined as those people (who are not permanent residents, nor commuting employees) who enter the EMZ for a specific purpose (shopping, recreation). Tourists may spend less than one day or stay overnight at camping facilities, hotels and motels. Seasonal workers are defined as those people who commute into the EMZ for temporary employment during peak times. Data was provided by the City of Laguna Beach for the majority of these facilities. For facilities wherein no data was provided or data was not available at that time, parking lot spaces were used to estimate facility capacities, see Section 2.1, Assumption 5b. Vehicle occupancy rates vary by facility from 1.97 persons per vehicle to 3.00 persons per vehicle. The EMZ has a number of areas and facilities that attract tourists, including:

- Recreation Centers
- Lodging Facilities
- Museums
- Parks
- Theaters

There is one recreation center and seven parks within the study area. Surveys of these facilities were conducted to determine the average daily attendance of the non-EMZ visitors during the peak season. Average vehicle occupancy and parking capacity were also studied for these facilities. These data were used to estimate the number of evacuating vehicles for tourists and seasonal workers at each of these facilities. A total of 7,486 tourists and 2,943 vehicles (an average of 2.54 persons per vehicle) is assigned to the recreation center and parks in the EMZ. This estimate includes seasonal workers at restaurants, bars, gift shops, ice cream shops, etc.

Surveys of museums and theaters within the EMZ were conducted to determine the average daily peak attendance of the non-EMZ visitors, average vehicle occupancy, and parking capacity. These data were used to estimate the number of tourists and evacuating vehicles at each of these facilities. A total of tourists 3,365 and 1,103 vehicles (an average of 3.05 persons per vehicle) are assigned to museums and theaters in the EMZ. Note, the vehicles for the museums are adjusted to 0 to avoid double counting population as the non-EMZ tourists are likely to visit other tourist attractions in the EMZ.

Surveys of lodging facilities within the EMZ were conducted to determine the number of guest rooms, average vehicle occupancy, and parking capacity for each facility. It is conservatively assumed that all the guest rooms are occupied. These data were used to estimate the number of tourists and evacuating vehicles at each of these lodging facilities. A total of 4,738 tourists in 1,426 vehicles (an average of 3.32 persons per vehicle) are assigned to lodging facilities in the EMZ.

Appendix E summarizes the tourist data that was estimated for the study area. Table E-4 presents the number of tourists visiting recreational facilities (recreation centers, parks and other recreational facilities) within the study area. Table E-5 presents the number of tourists visiting museums and theaters within the study area. Table E-6 presents the number of tourists visiting lodging facilities within the study area.

In total, there are 15,589 tourists evacuating in 5,472 vehicles (an average of 2.85 tourists per vehicle) in the study area. Table 3-5 presents tourist population and vehicle estimates in the study area.

3.4 Year-round Employees

Employees who work year-round within the EMZ fall into two categories:

- Those who live and work in the EMZ
- Those who live outside of the EMZ and commute to jobs within the EMZ

Those of the first category are already counted as part of the permanent resident population. To avoid double counting, we focus only on those employees commuting from outside the EMZ who will evacuate along with the permanent resident population.

Data obtained from the US Census Longitudinal Employer-Household Dynamics from the OnTheMap Census analysis tool[6] were used to estimate the number of employees commuting into the EMZ. The latest Workplace Area Characteristic data available (2017), was also obtained from this website and was used to determine the number of employees by Census Block within the EMZ.

Since not all employees are working at facilities within the EMZ at one time, a maximum shift reduction was applied. The Work Area Profile Report, also output by the OnTheMap Application, breaks down jobs within the EMZ by industry sector. Assuming maximum shift employment occurs Monday through Friday between 9 AM and 5 PM, the following jobs take place outside the typical 9-5 workday:

- Manufacturing – 2.6% of jobs; takes place in shifts over 24 hours
- Arts, Entertainment, and Recreation – 2.9% of jobs; takes place in evenings and on weekends
- Accommodations and Food Services – 41.4% of jobs; peaks in the evenings

The maximum shift in the EMZ is about 53.1% (100% - 2.6% - 2.9% - 41.4% = 53.1%). This value was applied to the total employment in 2017 to represent the maximum number of employees present in the EMZ at any one time. The Inflow/Outflow Report was then used to calculate the percent of employees that work within the EMZ but live outside. This value, 90.7%, was applied to the maximum shift employee values to compute the number of people commuting into the EMZ to work at peak times. Table E-3 in Appendix E summarizes the number of employees commuting into the EMZ during the peak shift.

In Table 3-6, a vehicle occupancy of 1.04 employees per vehicle obtained from the demographic survey (See Appendix F, sub-section F.3.1, "Commuter Travel Modes") was used to determine

[6] http://onthemap.ces.census.gov/

the number of evacuating employee vehicles for all major employers. Table 3-6 presents employee and vehicle estimates by EMZ[7].

3.5 Medical Facilities

The data for the fourteen medical facilities was provided by the City of Laguna Beach. Table E-2 in Appendix E summarizes the data gathered. Table 3-7 presents the current census and transportation requirement of medical facilities in the EMZ. As shown in these tables, 254 people have been identified as living in, or being treated in, these facilities. Since the average number of patients at large medical facilities fluctuates daily, a percent breakdown of ambulatory, wheelchair bound, and bedridden patients was used to estimate the number of each type of patient (see Section 2.3, Assumption 9) at Providence Mission Hospital Laguna Beach and Vista Aliso. The estimated breakdown for both facilities consists of about 50% ambulatory, 40% wheelchair bound, and 10% bedridden patients, accounting for rounding errors. The number of ambulance runs is determined by assuming that 2 patients can be accommodated per ambulance trip; the number of wheelchair bus runs assumes 15 and 4 wheelchairs per trip, respectively, and the number of bus runs estimated assumes 30 ambulatory patients per trip (see Section 2.3, Assumption 6).

3.6 Transit Dependent Population

The demographic survey (see Appendix F) results were used to estimate the portion of the population requiring transit service:

- Those persons in households that do not have a vehicle available.
- Those persons in households that do have vehicle(s) that would not be available at the time the evacuation is advised.

In the latter group, the vehicle(s) may be used by a commuter(s) who does not return (or is not expected to return) home to evacuate the household.

Table 3-8 presents estimates of transit-dependent people. Note:

- Estimates of persons requiring transit vehicles include schoolchildren. For those evacuation scenarios where children are at school when an evacuation is ordered, separate transportation is provided for the schoolchildren. The actual need for transit vehicles by residents is thereby less than the given estimates. However, estimates of transit vehicles are not reduced when schools are in session.
- It is reasonable and appropriate to consider that many transit-dependent persons will evacuate by ride-sharing with neighbors, friends or family. For example, nearly 80 percent of those who evacuated from Mississauga, Ontario[8] who did not use their own cars, shared a ride with neighbors or friends. Other documents report that

[7] This estimate represents the number of employee and employee vehicles that commute into the EMZ all year long. This number does not include seasonal workers.

[8] 1979 Mississauga Train Derailment

approximately 70 percent of transit dependent persons were evacuated via ride sharing. The results from the demographic survey indicate approximately 76 percent is appropriate for this area. As such, 76 percent ride-sharing was utilized to estimate the transit dependent population within the EMZ.

The estimated number of bus trips needed to service transit-dependent persons is based on an estimate of average bus/trolley occupancy of 30 persons at the conclusion of the bus/trolley run. Transit vehicle seating capacities for buses typically equal or exceed 60 children on average (roughly equivalent to 40 adults). If transit vehicle evacuees are two thirds adults and one third children, then the number of "adult seats" taken by 30 persons is 20 + (2/3 x10) = 27. On this basis, the average load factor anticipated is (27/40) x 100 = 68 percent. Thus, if the actual demand for service exceeds the estimates of Table 3-8 by 50 percent, the demand for service can still be accommodated by the available bus seating capacity.

$$\left[20 + \left(\frac{2}{3} \times 10\right)\right] \div 40 \times 1.5 = 1.00$$

Table 3-8 indicates that transportation must be provided for 197 people. Therefore, a total of **9 bus or trolley runs** (even though only 7 buses or trolleys are needed from a capacity standpoint) are required to transport this population outside of the EMZ.

To illustrate this estimation procedure, we calculate the number of persons, P, requiring public transit or ride-share, and the number of buses, B, required for the EMZ:

$$P = No. of\ HH \times \sum_{i=0}^{n} \{(\%\ HH\ with\ i\ vehicles) \times [(Average\ HH\ Size) - i]\} \times A^i C^i$$

Where,

A = Percent of households with commuters

C = Percent of households who will not await the return of a commuter

$$P = 10{,}710 \times [1.00 \times 0.0025 + 0.2210 \times (1.37 - 1) \times 0.5564 \times 0.8216 + 0.4960 \times (2.35 - 2) \times (0.5564 \times 0.8216)^2] = 816$$

$$B = ((1 - 0.7612) \times P) \div 30 = 7$$

These calculations are explained as follows:

- Number of households is computed by dividing the EMZ population (25,598) by the average household size (2.39) and equates to 10,710.
- All members (1.00 avg.) of households (HH) with no vehicles (0.25%) will evacuate by public transit or ride-share. The term 10,710 (number of households) x 0.0025 x

1.00, accounts for these people.

- The members of HH with 1 vehicle (22.10%) away, who are at home, equal (1.37-1). The number of HH where the commuter will not return home is equal to (10,710 x 0.2210 x 0.37 x 0.5564 x 0.8216), as 55.64% of EMZ households have a commuter, 82.16% of which would not return home in the event of an emergency. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms.
- The members of HH with 2 vehicles (49.60%) that are away, who are at home, equal (2.35 – 2). The number of HH where neither commuter will return home is equal to 10,710 x 0.4960 x 0.35 x $(0.5564 \times 0.8216)^2$. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms (the last term is squared to represent the probability that neither commuter will return).
- Households with 3 or more vehicles are assumed to have no need for transit vehicles.
- The total number of persons requiring public transit is the sum of such people in HH with 1 or 2 vehicles that are away from home and households with no vehicles.

It is assumed that transients and those with access and functional needs who may also need assistance and do not reside in medical facilities are included in these calculations. Data was not provided on transients or those with access and functional needs.

KLD designed routes to service the transit dependent population in each EMZ. These routes are shown in Figure 11-2 and described in Table 11-1. These routes were designed by grouping EMZs into clusters to minimize the number of buses needed. For example, using a weighted distribution, there are 20 people in Central Coast and 9 people in Temple Hills that would need transportation assistance to evacuate. Since these EMZs border one another, a single bus or trolley could be used to traverse the roadways in these EMZs and gather those who need transportation assistance. Assuming a bus or trolley capacity of 30 people, as discussed above, only one bus/trolley is needed to evacuate these two EMZs, rather than using two buses/trolleys to evacuate these EMZs individually. This grouping of EMZs should be considered when looking at the summary of vehicle demand by EMZ in Table 3-14.

Page 13 of the City of Laguna Beach Evacuation Plan (April 2018) states that buses and paratransit vehicles will be used to evacuate people with disabilities and those with access and/or functional needs. Page 17 of the plan states that Laguna Beach Transit will be the first option for evacuation transportation. The City owns 19 trolleys and 6 buses. A majority of the drivers are part-time and depending on the time of day and year, they may need to be called from home.

3.7 School Population Demand

Table 3-9 presents the school population and transportation requirements for the direct evacuation of all schools within the EMZ. This information was provided by the City of Laguna Beach supplemented by internet searches for schools in which no data was provided. The column in Table 3-9 entitled "Buses Required" specifies the number of buses required for each school under the following set of assumptions and estimates:

- No students will be picked up by their parents prior to the arrival of the buses.
- The estimate of buses required for school evacuation does not consider the use of private vehicles by students.
- Bus capacity, expressed in students per bus, was assumed to be 55 for High School and Middle School buses, and 80 for Elementary School buses.
- Students at pre-schools/day cares will be picked up by parents. These pre-schools/days cares are listed in Table 3-9 and show zero buses required.
- Those staff members who do not accompany the students will evacuate in their private vehicles.
- No allowance is made for student absenteeism, typically 3 percent daily.

The City of Laguna Beach may consider procedures whereby the schools are contacted prior to the dispatch of buses from the depot to ascertain the current estimate of students to be evacuated. In this way, the number of buses dispatched to the schools will reflect the actual number needed. The need for buses would be reduced by any high school students who have evacuated using private automobiles (if permitted by school authorities). Those buses originally allocated to evacuate schoolchildren that are not needed due to children being picked up by their parents, can be gainfully assigned to service other facilities or those persons who do not have access to private vehicles or to ride-sharing.

3.8 External Traffic

Vehicles will be traveling through the study area (external-external trips) at the time of an event. After the Advisory to Evacuate is announced, these through-travelers will also evacuate. These through vehicles are assumed to travel on the major routes traversing the study area – Interstate 5, Interstate 405, California 1 (SR-1), and California 55 (SR-55). Dynamic and variable message signs will be strategically positioned outside of the study area at logical diversion points to attempt to divert traffic away from the area at risk. As such, it is assumed this external traffic will diminish over 120 minutes following the Advisory to Evacuate.

Average Annual Daily Traffic (AADT) data was obtained from Caltrans[9] to estimate the number of vehicles per hour on the aforementioned routes. The AADT was multiplied by the K-Factor, which is the proportion of the AADT on a roadway segment or link during the design hour, resulting in the Design Hour Volume (DHV). The design hour is usually the 30th highest hourly traffic volume of the year, measured in vehicles per hour (vph). The DHV is then multiplied by

[9] https://dot.ca.gov/programs/traffic-operations/census/

the D-Factor, which is the proportion of the DHV occurring in the peak direction of travel (also known as the directional split).

The resulting values are the directional design hourly volumes (DDHV) and are presented in Table 3-10, for each of the routes considered. The DDHV is then multiplied by 30-minutes (dynamic messaging signs are assumed to be activated within the 30 minutes of the ATE; no vehicles have diverted during this time) to estimate the total number of external vehicles loaded on the analysis network. As indicated in Table 3-10, there are 20,504 vehicles entering the study area as external-external trips prior to any diversion of traffic. Table 3-11 shows the assumed percentage of diverted vehicles throughout the evacuation. Utilizing the procedure as discussed above and the diversion percentages shown in Table 3-11, 20,504 pass-through vehicles enter the study area between 0 and 30 minutes after the advisory to evacuate. Another 15,380 pass-through vehicles enter the study area between 30 minutes and 1 hour into the evacuation, and 10,251 pass-through vehicles enter the study area between 1 and 1.5 hours into the evacuation. Finally, another 5,129 pass-through vehicles enter the study area between 1.5 and 2 hours into the evacuation. At this time, it is assumed that all vehicles will divert from entering the study area for the remainder of the evacuation.

As shown in Table 3-12, throughout the 2-hours first two hours of the evacuation, the total external traffic that will enter the study area is 51,264 vehicles. This number is reduced by 60% for evening scenarios (Scenarios 3 and 7) as discussed in Section 6.

3.9 Background Traffic

Section 5 discusses the time needed for the people in the study area to mobilize and begin their evacuation trips. As shown in Table 5-8, there are 14 time periods during which traffic is loaded on to roadways in the study area to model the mobilization time of people in the study area. All traffic is loaded within these 14 time periods. Note, there is no traffic generated during the 15th time period, as this time period is intended to allow traffic that has already begun evacuating to clear the study area boundaries.

In traffic simulations, the network is initially empty. Thus, for this study, the network needs to be filled (to represent a routine travel conditions just prior to an evacuation order) so that system performance can be assessed under a more realistic set of conditions. As such, there is a 30-minute initialization time period (often referred to as “fill time” in traffic simulation) wherein the traffic volumes from Time Period 1 are loaded onto roadways in the study area. The amount of initialization/fill traffic that is on the roadways in the study area at the start of Time Period 1 depends on the scenario and the region being evacuated (see Section 6). There are 14,749 vehicles on the roadways in the study area at the end of fill time for an evacuation of all the EMZ (Region R28) under Scenario 1 (summer, midweek, midday, normal) conditions.

3.10 Summary of Demand

A summary of population and vehicle demand is provided in Table 3-13 and Table 3-14, respectively. This summary includes all population groups described in this section. A total of

381,404 people and 305,814 vehicles (254,550 evacuating vehicles and 51,264 external vehicles) are considered in this study.

Table 3-1. County Population Change and Annual Growth Rate from April 1, 2010 to July 1, 2019

County	2010 Population	2019 Population	Percent Change	Annual Growth Rate
Orange	3,008,989	3,175,692	5.54%	0.58%

Table 3-2. Municipality Population Change and Annual Growth Rate from April 1, 2010 to July 1, 2019

Municipality	2010 Population	2019 Population	Percent Change	Annual Growth Rate
Orange County, CA				
EMZ				
Aliso Viejo	47,674	50,887	6.74%	0.71%
Laguna Beach	22,733	22,827	0.41%	0.04%
Laguna Woods	15,991	15,850	-0.88%	-0.10%
Shadow Region				
Dana Point	33,290	33,577	0.86%	0.09%
Irvine	212,107	287,401	35.50%	3.34%
Laguna Hills	30,673	31,207	1.74%	0.19%
Laguna Niguel	62,989	66,385	5.39%	0.57%
Mission Viejo	93,103	94,381	1.37%	0.15%
Newport Beach	85,211	84,534	-0.79%	-0.09%
San Juan Capistrano	34,426	35,911	4.31%	0.46%

Table 3-3. EMZ Permanent Resident Population

EMZ ID	EMZ	2010 Population	2020 Extrapolated Population
1	Arch Beach Heights	1,616	1,619
2	Balboa/Nyes	862	863
3	Big Bend	259	261
4	Bluebird Canyon	1,012	1,016
5	Boat Canyon	1,195	1,196
6	Canyon Acres	300	301
7	Ceanothus	1,057	1,060
8	Club Laguna	3,391	3,480
9a	North Coast	2,915	2,934
9b	Central Coast	2,643	2,645
9c	South Coast	2,641	2,646
10	Downtown	628	630
11	El Toro	176	181
12	Emerald Bay	701	743
13	Irvine Cove	135	138
14	Mar Vista	835	835
15	Old Top of The World	175	175
16	Park Avenue	1,166	1,169
17	Sunset	706	709
18	Temple Hills	1,205	1,209
19	Top of the World	1,351	1,355
20	Wesley	432	433
	TOTAL	**25,401**	**25,598**
		Population Growth (2010-2020):	**0.78%**
	Shadow	299,304	332,331
	STUDY AREA TOTAL	**324,705**	**357,929**

Table 3-4. Permanent Resident Population and Vehicles by EMZ

EMZ ID	EMZ	2020 Extrapolated Population	2020 Resident Vehicles
1	**Arch Beach Heights**	1,619	1,110
2	**Balboa/Nyes**	863	592
3	**Big Bend**	261	179
4	**Bluebird Canyon**	1,016	698
5	**Boat Canyon**	1,196	821
6	**Canyon Acres**	301	207
7	**Ceanothus**	1,060	728
8	**Club Laguna**	3,480	2,386
9a	**North Coast**	2,934	2,017
9b	**Central Coast**	2,645	1,818
9c	**South Coast**	2,646	1,813
10	**Downtown**	630	433
11	**El Toro**	181	124
12	**Emerald Bay**	743	511
13	**Irvine Cove**	138	95
14	**Mar Vista**	835	570
15	**Old Top of The World**	175	120
16	**Park Avenue**	1,169	802
17	**Sunset**	709	489
18	**Temple Hills**	1,209	829
19	**Top of the World**	1,355	932
20	**Wesley**	433	297
	TOTAL	**25,598**	**17,571**
	Shadow	332,331	228,040
	STUDY AREA TOTAL	**357,929**	**245,611**

Table 3-5. Summary of Tourists and Tourist Vehicles

EMZ ID	EMZ	Tourists	Tourist Vehicles
1	Arch Beach Heights	0	0
2	Balboa/Nyes	0	0
3	Big Bend	0	0
4	Bluebird Canyon	0	0
5	Boat Canyon	2,790	1103
6	Canyon Acres	575	405[10]
7	Ceanothus	567	162
8	Club Laguna	135	45
9a	North Coast	438	272[10]
9b	Central Coast	1,906	1,100[10]
9c	South Coast	2,968	635[11]
10	Downtown	5,470	1,253[10]
11	El Toro	0	0
12	Emerald Bay	0	0
13	Irvine Cove	0	0
14	Mar Vista	0	0
15	Old Top of The World	0	0
16	Park Avenue	0	257[10]
17	Sunset	0	0
18	Temple Hills	0	0
19	Top of the World	0	0
20	Wesley	140	40
	TOTAL	**14,989**	**5,272**
	Shadow	600	200
	STUDY AREA TOTAL	**15,589**	**5,472**

[10] The vehicles for tourists visiting Main Beach Park in EMZ Downtown (EMZ ID – 10) are parked at multiple places in EMZs Canyon Acres, Central Coast, North Coast and Park Avenue (EMZ ID – 6, 9a, 9b and 16). See Appendix E for additional information.

[11] The average daily peak attendance of the non-EMZ tourists visiting Aliso Beach County Park in EMZ South Coast (EMZ ID – 9c) exceeds the limit of parking capacity at this park. It is assumed that some vehicles are parked in the parking lots nearby. See Appendix E for additional information.

Table 3-6. Summary of Employees and Employee Vehicles Commuting into the EMZ

EMZ ID	EMZ	Employees	Employee Vehicles
1	**Arch Beach Heights**	0	0
2	**Balboa/Nyes**	0	0
3	**Big Bend**	0	0
4	**Bluebird Canyon**	0	0
5	**Boat Canyon**	160	154
6	**Canyon Acres**	140	135
7	**Ceanothus**	89	86
8	**Club Laguna**	0	0
9a	**North Coast**	325	312
9b	**Central Coast**	802	773
9c	**South Coast**	392	377
10	**Downtown**	722	695
11	**El Toro**	29	28
12	**Emerald Bay**	0	0
13	**Irvine Cove**	0	0
14	**Mar Vista**	52	50
15	**Old Top of The World**	0	0
16	**Park Avenue**	126	121
17	**Sunset**	31	30
18	**Temple Hills**	0	0
19	**Top of the World**	0	0
20	**Wesley**	0	0
	TOTAL	**2,868**	**2,761**

Table 3-7. Medical Facilities Transit Demand Estimates

EMZ ID	EMZ	Facility Name	Capacity	Typical Census	Ambulatory	Wheel-chair Bound	Bed-ridden	Bus Runs	Wheel-chair Bus Runs	Ambulance Runs
2	**Balboa/Nyes**	Oceanfront Recovery at Laguna Beach, LLC	6	6	6	0	0	1	0	0
7	**Ceanothus**	Laguna View Center, LLC[12]	6	6	6	0	0	0	0	0
9a	**North Coast**	Miramar Health, INC.[13]	6	6	6	0	0	0	0	0
9b	**Central Coast**	Coast to Coast Referral Center, INC.	6	6	6	0	0	1	0	0
9b	**Central Coast**	Spencer Recovery Centers, INC.[14]	6	6	6	0	0	0	0	0
9b	**Central Coast**	Spencer Recovery Centers, INC.	28	28	28	0	0	1	0	0
9c	**South Coast**	Sunshine Behavioral Health LLC[12]	6	6	6	0	0	0	0	0
10	**Downtown**	Pillars Recovery, LLC	10	10	10	0	0	1	0	0
14	**Mar Vista**	Providence Mission Hospital Laguna Beach	178	75	37	30	8	2	2	4
15	**Old Top of The World**	Pillars Recovery, LLC[14]	6	6	6	0	0	0	0	0
17	**Sunset**	Complete Resurgency, LLC[12]	12	12	12	0	0	0	0	0
19	**Top of The World**	Oceanfront Recovery at Laguna Beach, LLC[14]	6	6	6	0	0	0	0	0
19	**Top of The World**	Oceanfront Recovery at Laguna Beach, LLC[14]	6	6	6	0	0	0	0	0
20	**Wesley**	Vista Aliso	75	75	37	30	8	2	2	4
TOTAL:			**357**	**254**	**178**	**60**	**16**	**8**	**4**	**8**

[12] Assumed to evacuate with Oceanfront Recovery at Laguna Beach, LLC in EMZ 2 – Balboa/Nyes

[13] Assumed to evacuate with Pillars Recovery, LLC in EMZ 10 - Downtown

[14] Assumed to evacuate with Coast to Coast Referral Center, INC. in EMZ 9b – Central Coast

Table 3-8. Transit-Dependent Population Estimates

Projected 2020 EMZ Population	Survey Average HH Size with Indicated No. of Vehicles			Estimated No. of Households	Survey Percent HH with Indicated No. of Vehicles			Survey Percent HH with Commuters	Survey Percent HH with Non-Returning Commuters	Total People Requiring Transport	Estimated Ridesharing Percentage	People Requiring Public Transit	Percent Population Requiring Public Transit
	0	1	2		0	1	2						
25,598	1.00	1.37	2.35	10,710	0.25%	22.10%	49.60%	55.64%	82.16%	816	76.12%	195	0.76%

Table 3-9. School Population Demand Estimates

EMZ ID	EMZ	School Name	Enrollment	Buses Required
3	**Big Bend**	Laguna College of Art and Design - Main Campus	500	1
3	**Big Bend**	Laguna College of Art and Design - Big Bend Campus	250	1
6	**Canyon Acres**	Laguna College of Art and Design - South Campus	60	1
13	**Irvine Cove**	El Morro Elementary School	524	7
15	**Old Top of The World**	Top of the World Elementary School	669	9
16	**Park Avenue**	Thurston Middle School	762	14
17	**Sunset**	Heidi's Pre-School	25	1
9b	**Central Coast**	Laguna Beach High School	1116	21
		TOTAL:	**3,906**	**55**
3	**Big Bend**	Laguna College of Art and Design - MFA Campus	15	0
10	**Downtown**	Laguna Presbyterian Pre-School	50	0
11	**El Toro**	Anneliese's Schools - Willowbrook	250	0
16	**Park Avenue**	Anneliese's Schools - Manzanita	50	0
20	**Wesley**	Anneliese's Schools - Aliso	50	0
20	**Wesley**	St. Catherine of Siena Parish School	173	0
9b	**Central Coast**	Montessori School-Laguna Beach	75	0
		TOTAL (USE PERSONAL VEHICLES OR PRIVATE TRANSPORTATION TO EVACUATE):	**663**	**-**

Table 3-10. Study Area External Traffic During First 30 Minutes

Road Name	Direction	Caltrans AADT[15]	K-Factor[16]	D-Factor[16]	Hourly Volume	External Traffic
I-5	NB	280,000	0.067	0.5	9,380	4,690
I-5	SB	280,000	0.067	0.5	9,380	4,690
I-405	SB	250,400	0.067	0.5	8,388	4,194
SR-1	SB	40,000	0.107	0.5	2,140	1,070
SR-1	NB	40,000	0.107	0.5	2,140	1,070
SR-55	NB	116,800	0.082	0.5	4,789	2,395
SR-55	SB	116,800	0.082	0.5	4,789	2,395
					TOTAL:	**20,504**

Table 3-11. External Traffic Diversion Percentages Over Time

Time Period	Percentage of External Traffic Diverted	External Traffic within the Study Area
0 - 30	0%	20,504
30 - 60	25%	15,380
60 - 90	50%	10,251
90 - 120	75%	5,129
120 - ∞	100%	0
	TOTAL:	**51,264**

[15] California Department of Transportation (Caltrans), https://dot.ca.gov/programs/traffic-operations/census/
[16] HCM 2016

Table 3-12. Study Area External Traffic

Upstream Node	Downstream Node	Road Name	Direction	Caltrans AADT[15]	K-Factor[16]	D-Factor[16]	Hourly Volume	External Traffic[17]
8000	178	I-5	NB	280,000	0.067	0.5	9,380	11,726
8010	230	I-5	SB	280,000	0.067	0.5	9,380	11,726
8012	1241	I-405	SB	250,400	0.067	0.5	8,388	10,486
8013	974	SR-1	SB	40,000	0.107	0.5	2,140	2,676
1271	1272	SR-1	NB	40,000	0.107	0.5	2,140	2,676
8017	1712	SR-55	NB	116,800	0.082	0.5	4,789	5,987
8018	1721	SR-55	SB	116,800	0.082	0.5	4,789	5,987
							TOTAL:	**51,264**

[17] External Traffic displayed includes calculations as discussed in Section 3.8, which also includes a diversion percentage after the first 30 minutes.

Table 3-13. Summary of Population Demand

EMZ ID	EMZ	Residents	Transit-Dependent	Tourists	Employees	Medical Facilities	Schools	Colleges	External Traffic	Total
1	**Arch Beach Heights**	1,619	12	0	0	0	0	0	0	1,631
2	**Balboa/Nyes**	863	7	0	0	6	0	0	0	876
3	**Big Bend**	261	2	0	0	0	0	765	0	1,028
4	**Bluebird Canyon**	1,016	8	0	0	0	0	0	0	1,024
5	**Boat Canyon**	1,196	9	2,790	160	0	0	0	0	4,155
6	**Canyon Acres**	301	2	575	140	0	0	60	0	1,078
7	**Ceanothus**	1,060	8	567	89	6	0	0	0	1,730
8	**Club Laguna**	3,480	28	135	0	0	0	0	0	3,643
9a	**North Coast**	2,934	23	438	325	6	0	0	0	3,726
9b	**Central Coast**	2,645	20	1,906	802	40	1,191	0	0	6,604
9c	**South Coast**	2,646	20	2,968	392	6	0	0	0	6,032
10	**Downtown**	630	5	5,470	722	10	50	0	0	6,887
11	**El Toro**	181	1	0	29	0	250	0	0	461
12	**Emerald Bay**	743	6	0	0	0	0	0	0	749
13	**Irvine Cove**	138	1	0	0	0	524	0	0	663
14	**Mar Vista**	835	6	0	52	75	0	0	0	968
15	**Old Top of The World**	175	1	0	0	6	669	0	0	851
16	**Park Avenue**	1,169	9	0	126	0	812	0	0	2,116
17	**Sunset**	709	5	0	31	12	25	0	0	782
18	**Temple Hills**	1,209	9	0	0	0	0	0	0	1,218
19	**Top of the World**	1,355	10	0	0	12	0	0	0	1,377
20	**Wesley**	433	3	140	0	75	223	0	0	874
Shadow		332,331[18]	0	600	0	0	0	0	0	332,931
Total		**357,929**	**195**	**15,589**	**2,868**	**254**	**3,744**	**825**	**0**	**381,404**

[18] Only 14% of these people are assumed to evacuate unless located along a ridge line for some evacuation cases.

Table 3-14. Summary of Vehicle Demand

EMZ ID	EMZ	Residents	Transit-Dependent[19]	Tourists	Employees	Medical Facilities[19]	Schools[19]	Colleges[19]	External Traffic	Total
1	**Arch Beach Heights**	1,110	0	0	0	0	0	0	0	1,110
2	**Balboa/Nyes**	592	1	0	0	0	0	0	0	593
3	**Big Bend**	179	0	0	0	0	0	579	0	758
4	**Bluebird Canyon**	698	0	0	0	0	0	0	0	698
5	**Boat Canyon**	821	0	1,103	154	0	0	0	0	2,078
6	**Canyon Acres**	207	0	405	135	0	0	46	0	793
7	**Ceanothus**	728	0	162	86	1	0	0	0	977
8	**Club Laguna**	2,386	1	45	0	0	0	0	0	2,432
9a	**North Coast**	2,017	1	272	312	1	0	0	0	2,603
9b	**Central Coast**	1,818	1	1,100	773	2	21	0	0	3,715
9c	**South Coast**	1,813	1	635	377	0	0	0	0	2,826
10	**Downtown**	433	0	1,253	695	0	0	0	0	2,381
11	**El Toro**	124	1	0	28	0	0	0	0	153
12	**Emerald Bay**	511	0	0	0	0	0	0	0	511
13	**Irvine Cove**	95	1	0	0	0	7	0	0	103
14	**Mar Vista**	570	1	0	50	8	0	0	0	629
15	**Old Top of The World**	120	0	0	0	0	9	0	0	129
16	**Park Avenue**	802	0	257	121	0	14	0	0	1,194
17	**Sunset**	489	0	0	30	0	1	0	0	520
18	**Temple Hills**	829	0	0	0	0	0	0	0	829
19	**Top of the World**	932	0	0	0	0	0	0	0	932
20	**Wesley**	297	1	40	0	8	0	0	0	346
Shadow		228,040[18]	0	200	0	0	0	0	0	279,504
Total		**245,611**	**9**	**5,472**	**2,761**	**20**	**52**	**625**	**51,264**	**305,814**

[19] One bus is equivalent to 2 pce's. As such, buses/trolleys for transit dependent persons, ambulatory and wheelchair bound medical facility patients, schools and colleges are doubled in the simulation.

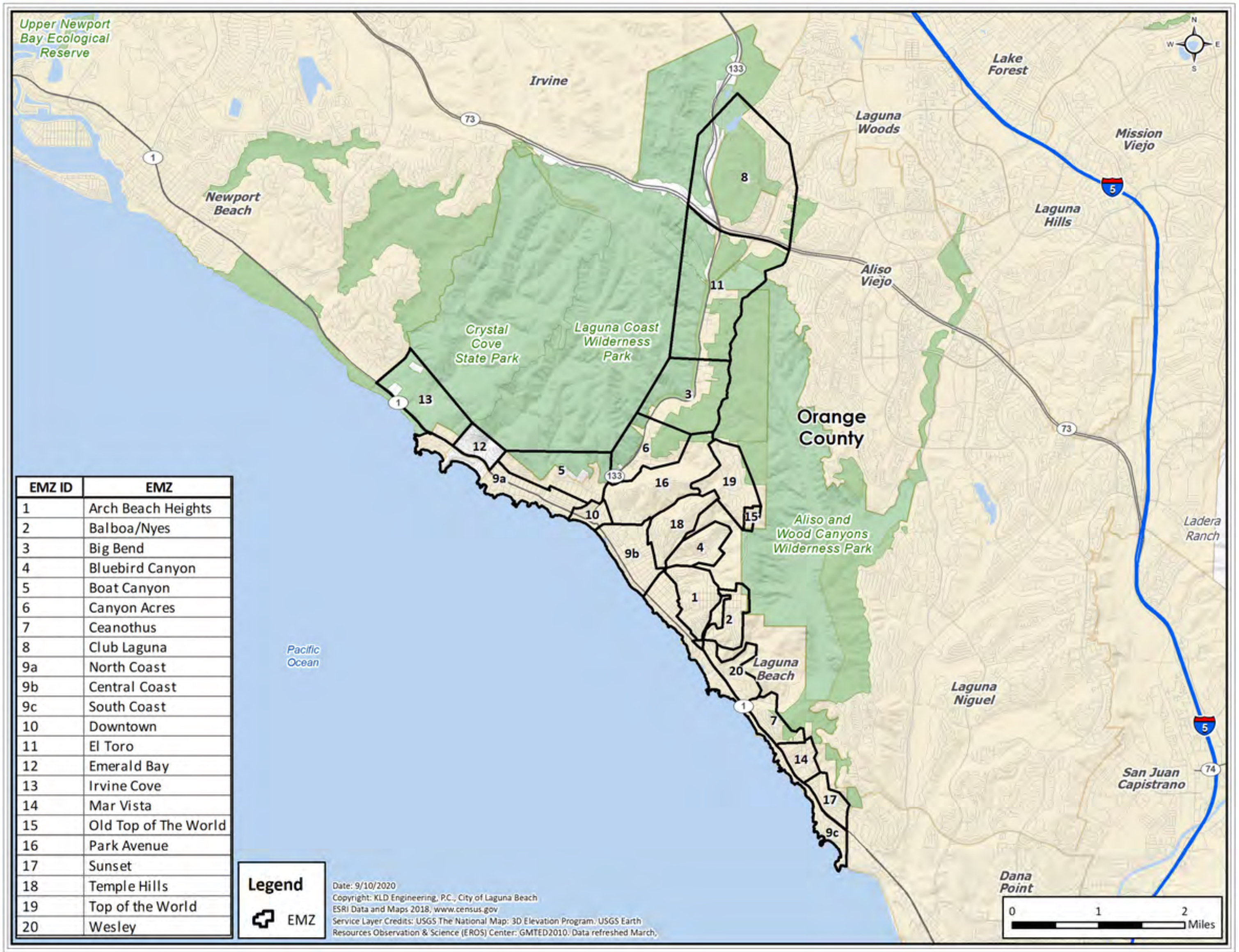


Figure 3-1. EMZ Boundaries

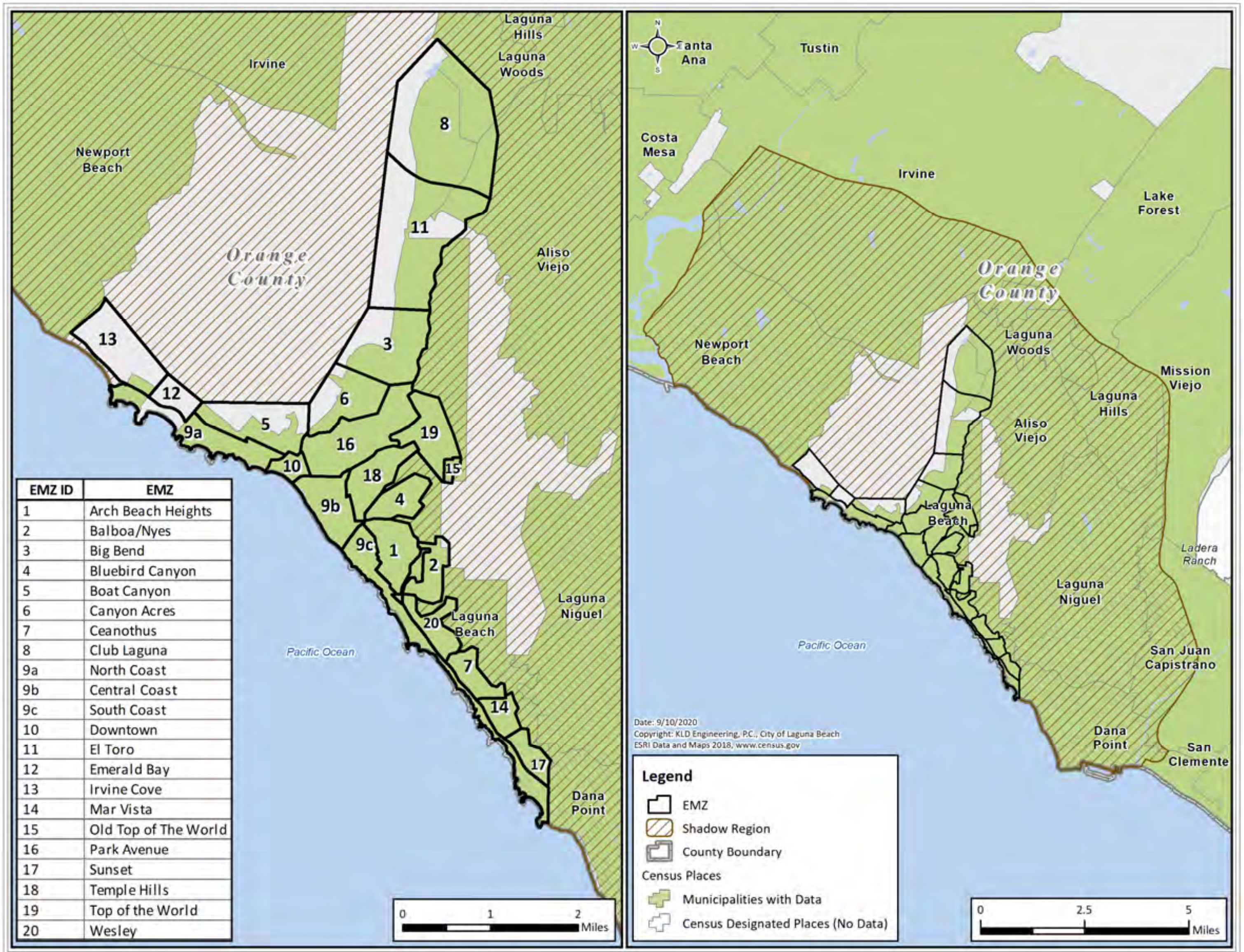


Figure 3-2. Census Boundaries within the Study Area

4 ESTIMATION OF HIGHWAY CAPACITY

The ability of the road network to service vehicle demand is a major factor in determining how rapidly an evacuation can be completed. The capacity of a road is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane of roadway during a given time period under prevailing roadway, traffic and control conditions, as stated in the 2016 Highway Capacity Manual (HCM 2016). This section discusses how the capacity of the roadway network was estimated.

In discussing capacity, different operating conditions have been assigned alphabetical designations, A through F, to reflect the range of traffic operational characteristics. These designations have been termed "Levels of Service" (LOS). For example, LOS A connotes free-flow and high-speed operating conditions; LOS F represents a forced flow condition. LOS E describes traffic operating at or near capacity.

Another concept, closely associated with capacity, is "Service Volume" (SV). Service volume is defined as "The maximum hourly rate at which vehicles, bicycles or persons reasonably can be expected to traverse a point or uniform section of a roadway during an hour under specific assumed conditions while maintaining a designated level of service." This definition is similar to that for capacity. The major distinction is that values of SV vary from one LOS to another, while capacity is the service volume at the upper bound of LOS E, only.

Thus, in simple terms, a service volume is the maximum traffic that can travel on a road and still maintain a certain perceived level of quality to a driver based on the A, B, C, rating system (LOS). Any additional vehicles above the service volume would drop the rating to a lower letter grade.

This distinction is illustrated in Exhibit 12-37 of the HCM 2016. As indicated there, the SV varies with Free Flow Speed (FFS), and LOS. The SV is calculated by the DYNEV II simulation model, based on the specified link attributes, FFS, capacity, control device and traffic demand.

Other factors also influence capacity. These include, but are not limited to:

- Lane width
- Shoulder width
- Pavement condition
- Horizontal and vertical alignment (curvature and grade)
- Percent truck traffic
- Control device (and timing, if it is a signal)
- Weather conditions (rain, snow, fog, wind speed, ice)

These factors are considered during the road survey and in the capacity estimation process; some factors have greater influence on capacity than others. For example, lane and shoulder width have only a limited influence on Base Free Flow Speed (BFFS[1]) according to Exhibit 15-7 of the HCM. Consequently, lane and shoulder widths at the narrowest points were observed

[1] A very rough estimate of BFFS might be taken as the posted speed limit plus 10 mph (HCM 2016 Page 15-15).

during the road survey and these observations were recorded, but no detailed measurements of lane or shoulder width were taken. Horizontal and vertical alignment can influence both FFS and capacity. The estimated FFS were measured using the survey vehicle's speedometer and observing local traffic, under free flow conditions. Capacity is estimated from the procedures of the 2016 HCM. For example, HCM Exhibit 7-1(b) shows the sensitivity of Service Volume at the upper bound of LOS D to grade (capacity is the Service Volume at the upper bound of LOS E).

The amount of traffic that can flow on a roadway is effectively governed by vehicle speed and spacing. The faster that vehicles can travel when closely spaced, the higher the amount of flow. As discussed in Section 2.3, it is necessary to adjust capacity figures to represent the prevailing conditions. Adverse conditions like inclement weather, construction, and other incidents tend to slow traffic down and, often, also increase vehicle-to-vehicle separation, thus decreasing the amount of traffic flow. Based on limited empirical data, conditions such as rain or thick smoke reduce the values of free-flow speed and of highway capacity by approximately 10 percent. Over the last decade new studies have been made on the effects of rain on traffic capacity. These studies indicate a range of effects between 5 and 20 percent depending on wind speed and precipitation rates. As indicated in Section 2.3, we employ a reduction in free speed and in highway capacity of 10 percent for rain.

Since congestion arising from evacuation may be significant, estimates of roadway capacity must be determined with great care. Because of its importance, a brief discussion of the major factors that influence highway capacity is presented in this section.

Rural highways generally consist of: (1) one or more uniform sections with limited access (driveways, parking areas) characterized by "uninterrupted" flow; and (2) approaches to at-grade intersections where flow can be "interrupted" by a control device or by turning or crossing traffic at the intersection. Due to these differences, separate estimates of capacity must be made for each section. Often, the approach to the intersection is widened by the addition of one or more lanes (turn pockets or turn bays), to compensate for the lower capacity of the approach due to the factors there that can interrupt the flow of traffic. These additional lanes are recorded during the field survey and later entered as input to the DYNEV II system.

4.1 Capacity Estimations on Approaches to Intersections

At-grade intersections are apt to become the first bottleneck locations under local heavy traffic volume conditions. This characteristic reflects the need to allocate access time to the respective competing traffic streams by exerting some form of control. During evacuation, control at critical intersections will often be provided by traffic control personnel assigned for that purpose, whose directions may supersede traffic control devices.

The per-lane capacity of an approach to a signalized intersection can be expressed (simplistically) in the following form:

$$Q_{cap,m} = \left(\frac{3600}{h_m}\right) \times \left(\frac{G-L}{C}\right)_m = \left(\frac{3600}{h_m}\right) \times P_m$$

where:

$Q_{cap,m}$	=	Capacity of a single lane of traffic on an approach, which executes movement, *m*, upon entering the intersection; vehicles per hour (vph)
h_m	=	Mean queue discharge headway of vehicles on this lane that are executing movement, *m*; seconds per vehicle
G	=	Mean duration of GREEN time servicing vehicles that are executing movement, *m*, for each signal cycle; seconds
L	=	Mean "lost time" for each signal phase servicing movement, *m*; seconds
C	=	Duration of each signal cycle; seconds
P_m	=	Proportion of GREEN time allocated for vehicles executing movement, *m*, from this lane. This value is specified as part of the control treatment.
m	=	The movement executed by vehicles after they enter the intersection: through, left-turn, right-turn, and diagonal.

The turn-movement-specific mean discharge headway h_m, depends in a complex way upon many factors: roadway geometrics, turn percentages, the extent of conflicting traffic streams, the control treatment, and others. A primary factor is the value of "saturation queue discharge headway", h_{sat}, which applies to through vehicles that are not impeded by other conflicting traffic streams. This value, itself, depends upon many factors including motorist behavior. Formally, we can write,

$$h_m = f_m(h_{sat}, F_1, F_2, \ldots)$$

where:

h_{sat}	=	Saturation discharge headway for through vehicles; seconds per vehicle
F_1, F_2	=	The various known factors influencing h_m
$f_m(\ )$	=	Complex function relating h_m to the known (or estimated) values of h_{sat}, F_1, F_2, …

The estimation of h_m for specified values of h_{sat}, F_1, F_2, … is undertaken within the DYNEV II simulation model by a mathematical model[2]. The resulting values for h_m always satisfy the condition:

$$h_m \geq h_{sat}$$

That is, the turn-movement-specific discharge headways are always greater than, or equal to

[2]Lieberman, E., "Determining Lateral Deployment of Traffic on an Approach to an Intersection", McShane, W. & Lieberman, E., "Service Rates of Mixed Traffic on the far Left Lane of an Approach". Both papers appear in Transportation Research Record 772, 1980. Lieberman, E., Xin, W., "Macroscopic Traffic Modeling For Large-Scale Evacuation Planning", presented at the TRB 2012 Annual Meeting, January 22-26, 2012.

the saturation discharge headway for through vehicles. These headways (or its inverse equivalent, "saturation flow rate"), may be determined by observation or using the procedures of the HCM 2016.

The above discussion is necessarily brief given the scope of this Evacuation Time Estimate (ETE) report and the complexity of the subject of intersection capacity. In fact, Chapters 19, 20 and 21 in the HCM 2016 address this topic. The factors, F_1, F_2, ..., influencing saturation flow rate are identified in equation (19-8) of the HCM 2016.

The traffic signals within the EMZ and Shadow Region are modeled using representative phasing plans and phase durations obtained as part of the field data collection. Traffic responsive signal installations allow the proportion of green time allocated (P_m) for each approach to each intersection to be determined by the expected traffic volumes on each approach during evacuation circumstances. The amount of green time (G) allocated is subject to maximum and minimum phase duration constraints; 2 seconds of yellow time are indicated for each signal phase and 1 second of all-red time is assigned between signal phases, typically. If a signal is pre-timed, the yellow and all-red times observed during the road survey are used. A lost time (L) of 2.0 seconds is used for each signal phase in the analysis.

4.2 Capacity Estimation along Sections of Highway

The capacity of highway <u>sections</u> -- as distinct from approaches to intersections -- is a function of roadway geometrics, traffic composition (e.g. percent heavy trucks and buses in the traffic stream) and, of course, motorist behavior. There is a fundamental relationship which relates service volume (i.e. the number of vehicles serviced within a uniform highway section in a given time period) to traffic density. The top curve in Figure 4-1 illustrates this relationship.

As indicated, there are two flow regimes: (1) Free Flow (left side of curve); and (2) Forced Flow (right side). In the Free Flow regime, the traffic demand is fully serviced; the service volume increases as demand volume and density increase, until the service volume attains its maximum value, which is the capacity of the highway section. As traffic demand and the resulting highway density increase beyond this "critical" value, the rate at which traffic can be serviced (i.e. the service volume) can actually <u>decline</u> below capacity ("capacity drop"). Therefore, in order to realistically represent traffic performance during congested conditions (i.e. when demand exceeds capacity), it is necessary to estimate the service volume, V_F, under congested conditions.

The value of V_F can be expressed as:

$$V_F = R \times Capacity$$

where:

R = Reduction factor which is less than unity

We have employed a value of R=0.90. The advisability of such a capacity reduction factor is based upon empirical studies that identified a fall-off in the service flow rate when congestion occurs at “bottlenecks” or “choke points” on a freeway system. Zhang and Levinson[3] describe a research program that collected data from a computer-based surveillance system (loop detectors) installed on the Interstate Highway System, at 27 active bottlenecks in the twin cities metro area in Minnesota over a 7-week period. When flow breakdown occurs, queues are formed which discharge at lower flow rates than the maximum capacity prior to observed breakdown. These queue discharge flow (QDF) rates vary from one location to the next and also vary by day of week and time of day based upon local circumstances. The cited reference presents a mean QDF of 2,016 passenger cars per hour per lane (pcphpl). This figure compares with the nominal capacity estimate of 2,250 pcphpl estimated for the ETE and indicated in Appendix H for freeway links. The ratio of these two numbers is 0.896 which translates into a capacity reduction factor of 0.90.

Since the principal objective of evacuation time estimate analyses is to develop a “realistic” estimate of evacuation times, use of the representative value for this capacity reduction factor (R=0.90) is justified. This factor is applied only when flow breaks down, as determined by the simulation model.

Rural roads, like freeways, are classified as “uninterrupted flow” facilities. (This is in contrast with urban street systems which have closely spaced signalized intersections and are classified as “interrupted flow” facilities.) As such, traffic flow along rural roads is subject to the same effects as freeways in the event traffic demand exceeds the nominal capacity, resulting in queuing and lower QDF rates. As a practical matter, rural roads rarely break down at locations away from intersections. Any breakdowns on rural roads are generally experienced at intersections where other model logic applies, or at lane drops which reduce capacity there. Therefore, the application of a factor of 0.90 is appropriate on rural roads, but rarely, if ever, activated.

The estimated value of capacity is based primarily upon the type of facility and on roadway geometrics. Sections of roadway with adverse geometrics are characterized by lower free-flow speeds and lane capacity. Exhibit 15-46 in the Highway Capacity Manual was referenced to estimate saturation flow rates. The impact of narrow lanes and shoulders on free-flow speed and on capacity is not material, particularly when flow is predominantly in one direction as is the case during an evacuation.

The procedure used here was to estimate "section" capacity, V_E, based on observations made traveling over each section of the evacuation network, based on the posted speed limits and travel behavior of other motorists and by reference to the 2016 HCM. The DYNEV II simulation model determines for each highway section, represented as a network link, whether its capacity would be limited by the "section-specific" service volume, V_E, or by the intersection-specific capacity. For each link, the model selects the lower value of capacity.

[3]Lei Zhang and David Levinson, “Some Properties of Flows at Freeway Bottlenecks,” Transportation Research Record 1883, 2004.

4.3 Application to the City of Laguna Beach Study Area

As part of the development of the link-node analysis network for the study area, an estimate of roadway capacity is required. The source material for the capacity estimates presented herein is contained in:

> 2016 Highway Capacity Manual (HCM)
> Transportation Research Board
> National Research Council
> Washington, D.C.

The highway system in the study area consists primarily of three categories of roads and, of course, intersections:

- Two-Lane roads: Local, State
- Multi-Lane Highways (at-grade)
- Freeways

Each of these classifications will be discussed.

4.3.1 Two-Lane Roads

Ref: HCM Chapter 15

Two lane roads comprise the majority of highways within the study area. The per-lane capacity of a two-lane highway is estimated at 1,700 passenger cars per hour (pc/h). This estimate is essentially independent of the directional distribution of traffic volume except that, for extended distances, the two-way capacity will not exceed 3,200 pc/h. The HCM procedures then estimate LOS and Average Travel Speed. The DYNEV II simulation model accepts the specified value of capacity as input and computes average speed based on the time-varying demand: capacity relations.

Based on the field survey and on expected traffic operations associated with evacuation scenarios:

- Most sections of two-lane roads within the study area are classified as “Class I”, with "level terrain"; some are “rolling terrain”.
- “Class II” highways are mostly those within urban and suburban centers.

4.3.2 Multi-Lane Highway

Ref: HCM Chapter 12

Exhibit 12-8 of the HCM 2016 presents a set of curves that indicate a per-lane capacity ranging from approximately 1,900 to 2,300 pc/h, for free-speeds of 45 to 70 mph, respectively. Based on observation, the multi-lane highways outside of urban areas within the study area service traffic with free-speeds in this range. The actual time-varying speeds computed by the simulation model reflect the demand and capacity relationship and the impact of control at intersections. A conservative estimate of per-lane capacity of 1,900 pc/h is adopted for this study for multi-lane highways outside of urban areas, as shown in Appendix H.

4.3.3 Freeways

Ref: HCM Chapters 10, 12, 13, 14

Chapter 10 of the HCM 2016 describes a procedure for integrating the results obtained in Chapters 12, 13 and 14, which compute capacity and LOS for freeway components. Chapter 10 also presents a discussion of simulation models. The DYNEV II simulation model automatically performs this integration process.

Chapter 12 of the HCM 2016 presents procedures for estimating capacity and LOS for "Basic Freeway Segments". Exhibit 12-37 of the HCM 2016 presents capacity vs. free speed estimates, which are provided below.

Free Speed (mph):	55	60	65	70+
Per-Lane Capacity (pc/h):	2,250	2,300	2,350	2,400

The inputs to the simulation model are highway geometrics, free-speeds and capacity based on field observations. The simulation logic calculates actual time-varying speeds based on demand: capacity relationships. A conservative estimate of per-lane capacity of 2,250 pc/h is adopted for this study for freeways, as shown in Appendix H.

Chapter 13 of the HCM 2016 presents procedures for estimating capacity, speed, density and LOS for freeway weaving sections. The simulation model contains logic that relates speed to demand volume: capacity ratio. The value of capacity obtained from the computational procedures detailed in Chapter 13 depends on the "Type" and geometrics of the weaving segment and on the "Volume Ratio" (ratio of weaving volume to total volume).

Chapter 14 of the HCM 2016 presents procedures for estimating capacities of ramps and of "merge" areas. There are three significant factors to the determination of capacity of a ramp-freeway junction: The capacity of the freeway immediately downstream of an on-ramp or immediately upstream of an off-ramp; the capacity of the ramp roadway; and the maximum flow rate entering the ramp influence area. In most cases, the freeway capacity is the controlling factor. Values of this merge area capacity are presented in Exhibit 14-10 of the HCM 2016 and depend on the number of freeway lanes and on the freeway free speed. Ramp capacity is presented in Exhibit 14-12 and is a function of the ramp's FFS. The DYNEV II simulation model logic simulates the merging operations of the ramp and freeway traffic in accord with the procedures in Chapter 14 of the HCM 2016. If congestion results from an excess of demand relative to capacity, then the model allocates service appropriately to the two entering traffic streams and produces LOS F conditions (The HCM does not address LOS F explicitly).

4.3.4 Intersections

Ref: HCM Chapters 19, 20, 21, 22

Procedures for estimating capacity and LOS for approaches to intersections are presented in Chapter 19 (signalized intersections), Chapters 20, 21 (un-signalized intersections) and Chapter 22 (roundabouts). The complexity of these computations is indicated by the aggregate length of these chapters. The DYNEV II simulation logic is likewise complex.

The simulation model explicitly models intersections: Stop/yield controlled intersections (both 2-way and all-way) and traffic signal controlled intersections. Where intersections are controlled by fixed time controllers, traffic signal timings are set to reflect average (non-evacuation) traffic conditions. Actuated traffic signal settings respond to the time-varying demands of evacuation traffic to adjust the relative capacities of the competing intersection approaches.

The model is also capable of modeling the presence of manned traffic control. At specific locations where it is advisable or where existing plans call for overriding existing traffic control to implement manned control, the model will use actuated signal timings that reflect the presence of traffic guides. At locations where a special traffic control strategy (continuous left-turns, contra-flow lanes) is used, the strategy is modeled explicitly. Where applicable, the location and type of traffic control for nodes in the evacuation network are noted in Appendix H.

4.4 Simulation and Capacity Estimation

Chapter 6 of the HCM is entitled, "HCM and Alternative Analysis Tools." The chapter discusses the use of alternative tools such as simulation modeling to evaluate the operational performance of highway networks. Among the reasons cited in Chapter 6 to consider using simulation as an alternative analysis tool is:

> *"The system under study involves a group of different facilities or travel modes with mutual interactions involving several HCM chapters. Alternative tools are able to analyze these facilities as a single system."*

This statement succinctly describes the analyses required to determine traffic operations across an area encompassing a study area operating under evacuation conditions. The model utilized for this study, DYNEV II, is further described in Appendix C. It is essential to recognize that simulation models do not replicate the methodology and procedures of the HCM – they *replace* these procedures by describing the complex interactions of traffic flow and computing Measures of Effectiveness (MOE) detailing the operational performance of traffic over time and by location. The DYNEV II simulation model includes some HCM 2016 procedures only for the purpose of estimating capacity.

All simulation models must be calibrated properly with field observations that quantify the performance parameters applicable to the analysis network. Two of the most important of these are: (1) FFS; and (2) saturation headway, h_{sat}. The first of these is estimated by direct observation during the road survey; the second is estimated using the concepts of the HCM 2016, as described earlier. These parameters are listed in Appendix H, for each network link.

It is important to note that simulation represents a mathematical representation of an assumed set of conditions using the best available knowledge and understanding of traffic flow and available inputs. Simulation should not be assumed to be a prediction of what will happen under any event because a real evacuation can be impacted by an infinite number of things – many of which will differ from these test cases – and many others cannot be taken into account with the tools available.

4.5 Boundary Conditions

As illustrated in Figure 1-2 and in Appendix H, the link-node analysis network used for this study is finite. The analysis network extends well beyond the EMZ in order to model intersections with other major population areas and evacuation routes beyond the study area. However, the network does have an end at the destination (exit) nodes as discussed in Appendix C. Beyond these destination nodes, there may be signalized intersections or merge points that impact the capacity of the evacuation routes leaving the study area. Rather than neglect these “boundary conditions,” this study assumes a 25% reduction in capacity on two-lane roads (Section 4.3.1 above) and multi-lane highways (Section 4.3.2 above). There is no reduction in capacity for freeways due to boundary conditions. The 25% reduction in capacity is based on the prevalence of actuated traffic signals in the study area and the fact that the evacuating traffic volume will be more significant than the competing traffic volume at any downstream signalized intersections, thereby warranting a more significant percentage (75% in this case) of the signal green time.

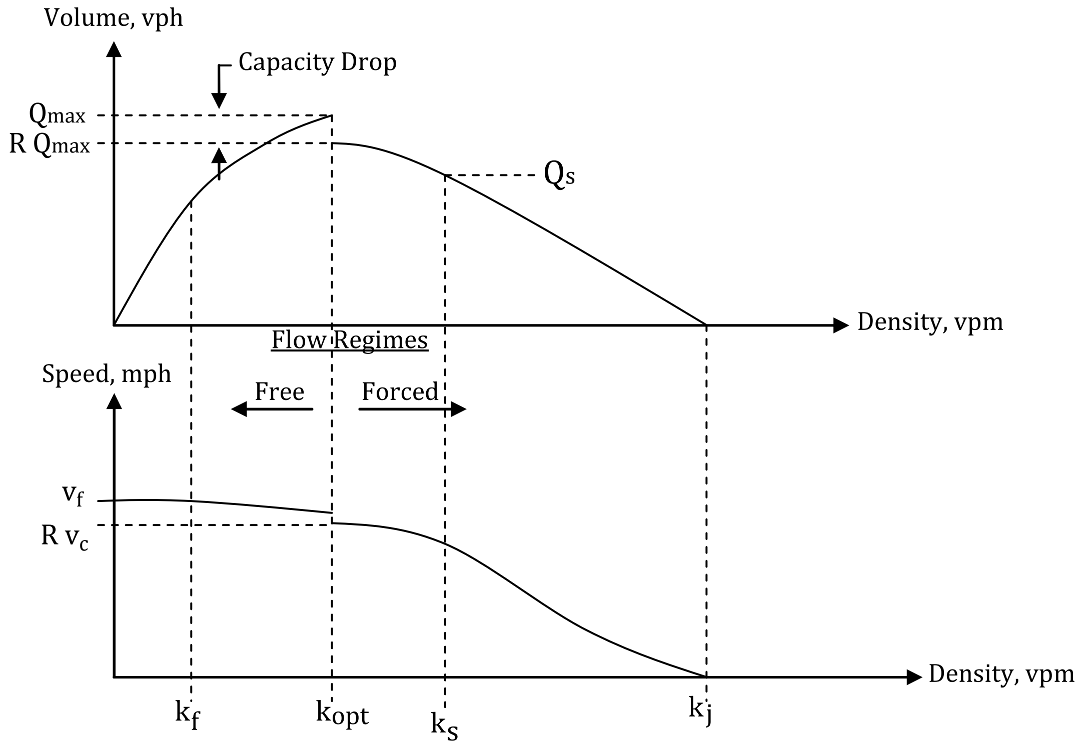


Figure 4-1. Fundamental Diagrams

5 ESTIMATION OF TRIP GENERATION TIME

It is general practice for planners to estimate the distributions of elapsed times associated with mobilization activities undertaken by the public to prepare for the evacuation trip. The elapsed time associated with each activity is represented as a statistical distribution reflecting differences between members of the public. The quantification of these activity-based distributions relies largely on the results of the demographic survey. We define the sum of these distributions of elapsed times as the Trip Generation Time Distribution. This section documents how the trip generation time distributions were estimated.

5.1 Background

In general, during a wildfire emergency, priorities are given to life safety, preservation of property and resource conservation. To ensure life safety, depending on the severity, wind speed and direction of the wildfire, emergency officials may issue warnings that include evacuation.

As a Planning Basis, we will adopt a conservative posture, a rapidly escalating wildfire situation, wherein evacuation is required, ordered promptly and no early protective actions have been implemented when calculating the Trip Generation Time. In these analyses, we have assumed:

1. The advisory to evacuate will be announced coincident with local emergency alerts (e.g. emergency alert systems (EAS) broadcasts, sirens, social media, local news, door-to-door and with alike communication systems).
2. Mobilization of the general population will commence within 15 minutes after emergency alerts.
3. ETE are measured relative to the advisory to evacuate.

We emphasize that the adoption of this planning basis is not a representation that these events will occur within the indicated time frame. Rather, these assumptions are necessary in order to:

1. Establish a temporal framework for estimating the Trip Generation distribution
2. Identify temporal points of reference that uniquely define "Clear Time" and ETE.

The notification process consists of two events:

1. Transmitting information using the alert and notification systems mentioned above.
2. Receiving and correctly interpreting the information that is transmitted.

The population within the Emergency Management Zone (EMZ) is dispersed over an area of approximately 9.7 square miles and is engaged in a wide variety of activities. It must be anticipated that some time will elapse between the transmission and receipt of the information advising the public of an event.

The amount of elapsed time will vary from one individual to the next depending on where that person is, what that person is doing, and related factors. Furthermore, some persons who will be directly involved with the evacuation process may be outside the EMZ at the time the emergency is declared. These people may be commuters, shoppers and other travelers who reside within the EMZ and who will return to join the other household members upon receiving notification of an emergency.

As indicated in Section 2.13 of NUREG/CR-6863, the estimated elapsed times for the receipt of notification can be expressed as a distribution reflecting the different notification times for different people within, and outside, the EMZ. By using time distributions, it is also possible to distinguish between different population groups and different day-of-week and time-of-day scenarios, so that accurate ETE may be computed.

For example, people at home or at work within the EMZ might be notified by siren, television and/or radio (if available). Those well outside the EMZ might be notified by word-of-mouth, with potentially longer time lags. Furthermore, the spatial distribution of the EMZ population will differ with time of day - families will be united in the evenings but dispersed during the day. In this respect, weekends will differ from weekdays.

As indicated in Section 4.1 of NUREG/CR-7002, the information required to compute trip generation times is typically obtained from a demographic survey of residents. Such a survey was conducted for this study. Appendix F presents the survey sampling results, survey instrument, and raw survey results. The remaining discussion will focus on the application of the trip generation data obtained from the demographic survey to the development of the ETE documented in this report.

5.2 Fundamental Considerations

The environment leading up to the time that people begin their evacuation trips consists of a sequence of events and activities. Each event (other than the first) occurs at an instant in time and is the outcome of an activity.

Activities are undertaken over a period of time. Activities may be in "series" (i.e. to undertake an activity implies the completion of all preceding events) or may be in parallel (two or more activities may take place over the same period of time). Activities conducted in series are functionally dependent on the completion of prior activities; activities conducted in parallel are functionally independent of one another. The relevant events associated with the public's preparation for evacuation are:

Event Number	Event Description
1	Notification
2	Awareness of Situation
3	Depart Work
4	Arrive Home
5	Depart on Evacuation Trip

Associated with each sequence of events are one or more activities, as outlined in Table 5-1.

These relationships are shown graphically in Figure 5-1.

- An Event is a ‘state’ that exists at a point in time (e.g., depart work, arrive home)

- An Activity is a 'process' that takes place over some elapsed time (e.g., prepare to leave work, travel home)

As such, a completed Activity changes the 'state' of an individual (e.g. the activity, 'travel home' changes the state from 'depart work' to 'arrive home'). Therefore, an Activity can be described as an 'Event Sequence'; the elapsed times to perform an event sequence vary from one person to the next and are described as statistical distributions on the following pages.

An employee who lives outside of the EMZ will follow sequence (c) of Figure 5-1. A household within the EMZ that has one or more commuters at work, and will await their return before beginning the evacuation trip will follow the first sequence of Figure 5-1(a). A household within the EMZ that has no commuters at work, or that will not await the return of any commuters, will follow the second sequence of Figure 5-1(a), regardless of day of week or time of day.

Households with no commuters on weekends or in the evening/night-time will follow the applicable sequence in Figure 5-1(b). Tourists will always follow one of the sequences of Figure 5-1(b). Some tourists away from their residence could elect to evacuate immediately without returning to the residence, as indicated in the second sequence.

It is seen from Figure 5-1, that the Trip Generation time (i.e. the total elapsed time from Event 1 to Event 5) depends on the scenario and will vary from one household to the next. Furthermore, Event 5 depends, in a complicated way, on the time distributions of all activities preceding that event. That is, to estimate the time distribution of Event 5, we must obtain estimates of the time distributions of all preceding events. For this study, we adopt the conservative posture that all activities will occur in sequence.

In some cases, assuming certain events occur strictly sequential (for instance, commuter returning home before beginning preparation to leave) can result in rather ***conservative*** (that is, longer) estimates of mobilization times. It is reasonable to expect that at least some parts of these events will overlap for many households, but that assumption is not made in this study.

5.3 Estimated Time Distributions of Activities Preceding Event 5

The time distribution of an event is obtained by "summing" the time distributions of all prior contributing activities. (This "summing" process is quite different than an algebraic sum since it is performed on distributions – not scalar numbers).

Time Distribution No. 1, Notification Process: Activity 1 → 2

A demographic survey of Laguna Beach residents was conducted to study evacuation behavior of the population within the EMZ. The survey results were used to create the notification time distribution. The survey asked specific questions about notifying neighbors and friends during an emergency using various methods like phone calls, text messages, social media, and in person conversation. Since the survey was statistically significant at the 95% confidence level, it can be assumed that the population within the EMZ will behave similarly to the survey respondents.

The City of Laguna Beach uses emergency alert systems such as NIXLE and Alert Orange County to push notifications to the population opted-in to the service. Furthermore, the City of Laguna Beach plans to strategically set up warning sirens within the EMZ. The presence of sirens will improve the notification process and notify the City residents and travelers much more efficiently.

Given the presence of the existing emergency alert systems, the alert systems that will be established in the near future and the results of the demographic survey, it was assumed that 70% of the EMZ population can be notified within 5 minutes of an emergency, 96% of the EMZ population can be notified within 15 minutes, and 100% of the EMZ population can be notified within 30 minutes. The distribution of Activity 1 → 2 shown in Table 5-2 reflects data obtained by the demographic survey and the above assumptions.

Given the uncertainty in some critical assumptions, several sensitivity studies were conducted as part of this work effort to determine the elasticity of the evacuation time estimates to those assumptions, see Appendix J.

Distribution No. 2, Prepare to Leave Work: Activity 2 → 3

It is reasonable to expect that the vast majority of business enterprises within the EMZ will elect to shut down following notification and most employees would leave work quickly. Commuters, who work outside the EMZ could, in all probability, also leave quickly since facilities outside the EMZ would remain open and other personnel would remain. Essential workers (medical personnel, teachers) responsible for patients or students would require additional time to secure their facility. The distribution of Activity 2 → 3 shown in Table 5-3 reflects data obtained by the demographic survey. This distribution is also applicable for residents to leave stores, restaurants, parks and other locations within the EMZ. This distribution is plotted in Figure 5-2.

Distribution No. 3, Travel Home: Activity 3 → 4

These data are provided directly by households that responded to the demographic survey. This distribution is plotted in Figure 5-2 and listed in Table 5-4.

Distribution No. 4, Prepare to Leave Home: Activity 2, 4 → 5

These data are provided directly by households that responded to the demographic survey. This distribution is plotted in Figure 5-2 and listed in Table 5-5.

5.4 Calculation of Trip Generation Time Distribution

The time distributions for each of the mobilization activities presented herein must be combined to form the appropriate Trip Generation Distributions. As discussed above, this study assumes that the stated events take place in sequence such that all preceding events must be completed before the current event can occur. For example, if a household awaits the return of a commuter, the work-to-home trip (Activity 3 → 4) must precede Activity 4 → 5.

To calculate the time distribution of an event that is dependent on two sequential activities, it is necessary to "sum" the distributions associated with these prior activities. The distribution summing algorithm is applied repeatedly as shown to form the required distribution. As an outcome of this procedure, new time distributions are formed; we assign "letter" designations to these intermediate distributions to describe the procedure. Table 5-6 presents the summing procedure to arrive at each designated distribution.

Table 5-7 presents a description of each of the final trip generation distributions achieved after the summing process is completed.

5.4.1 Statistical Outliers

As already mentioned, some portion of the survey respondents answer "Decline to State" to some questions or choose to not respond to a question. The mobilization activity distributions are based upon actual responses. But it is the nature of surveys that a few numeric responses are inconsistent with the overall pattern of results. An example would be a case in which for 500 responses, almost all of them estimate less than two hours for a given answer, but 3 say "four hours" and 4 say "six or more hours".

These "outliers" must be considered: are they valid responses, or so atypical that they should be dropped from the sample?

In assessing outliers, there are three alternates to consider:

1) Some responses with very long times may be valid, but reflect the reality that the respondent really needs to be classified in a different population subgroup, based upon special needs;

2) Other responses may be unrealistic (6 hours to return home from commuting distance, or 2 days to prepare the home for departure);

3) Some high values are representative and plausible, and one must not cut them as part of the consideration of outliers.

The issue is how to make the decision that a given response or set of responses are to be considered "outliers" for the component mobilization activities, using a method that objectively quantifies the process.

There is considerable statistical literature on the identification and treatment of outliers singly or in groups, much of which assumes the data is normally distributed and some of which uses non-parametric methods to avoid that assumption. The literature cites that limited work has been done directly on outliers in sample survey responses.

In establishing the overall mobilization time/trip generation distributions, the following principles are used:

1) It is recognized that the overall trip generation distributions are conservative estimates, because they assume a household will do the mobilization activities sequentially, with no overlap of activities;

2) The individual mobilization activities (receive notification, prepare to leave work, travel home, prepare home) are reviewed for outliers, and then the overall trip generation distributions are created (see Figure 5-1, Table 5-6, Table 5-7);
3) Outliers can be eliminated either because the response reflects a special population (e.g. special needs, transit dependent) or lack of realism, because the purpose is to estimate trip generation patterns for personal vehicles;
4) To eliminate outliers,
    a) the mean and standard deviation of the specific activity are estimated from the responses,
    b) the median of the same data is estimated, with its position relative to the mean noted,
    c) the histogram of the data is inspected, and
    d) all values greater than 3.5 standard deviations are flagged for attention, taking special note of whether there are gaps (categories with zero entries) in the histogram display.

    In general, only flagged values more than 3.8 standard deviations from the mean are allowed to be considered outliers, with gaps in the histogram expected.

    When flagged values are classified as outliers and dropped, steps "a" to "d" are repeated.

5) As a practical matter, even with outliers eliminated by the above, the resultant histogram, viewed as a cumulative distribution, is not a normal distribution. A typical situation that results is shown below in Figure 5-3.
6) In particular, the cumulative distribution differs from the normal distribution in two key aspects, both very important in loading a network to estimate evacuation times:

    - Most of the real data is to the left of the "normal" curve above, indicating that the network loads faster for the first 80-85% of the vehicles, potentially causing more (and earlier) congestion than otherwise modeled;
    - The last 10-15% of the real data "tails off" slower than the comparable "normal" curve, indicating that there is significant traffic still loading at later times.

    Because these two features are important to preserve, it is the histogram of the data that is used to describe the mobilization activities, not a "normal" curve fit to the data. One could consider other distributions, but using the shape of the *actual* data curve is unambiguous and preserves these important features;

7) With the mobilization activities each modeled according to Steps 1-6, including preserving the features cited in Step 6, the overall (or total) mobilization times are constructed.

This is done by using the data sets and distributions under different scenarios (e.g. commuter returning, no commuter returning in each). In general, these are additive, using weighting based upon the probability distributions of each element; Figure 5-4 presents the combined trip generation distributions designated A, C, and D. These distributions are presented on the same time scale. (As discussed earlier, the use of strictly additive activities is a conservative approach, because it makes all activities sequential – preparation for departure follows the return of the commuter. In practice, it is reasonable that some of these activities are done in parallel, at least to some extent – for instance, preparation to depart begins by a household member at home while the commuter is still on the road.)

The mobilization distributions that result is used in their tabular/graphical form as direct inputs to later computations that lead to the ETE.

The DYNEV II simulation model is designed to accept varying rates of vehicle trip generation for each origin centroid, expressed in the form of histograms. These histograms, which represent Distributions A, C, and D, properly displaced with respect to one another, are tabulated in

Table 5-8 (Distribution B, Arrive Home, omitted for clarity).

The final time period (15) is 600 minutes long. This time period is added to allow the analysis network to clear, in the event congestion persists beyond the trip generation period. Note that there are no trips generated during this final time period.

Table 5-1. Event Sequence for Evacuation Activities

Event Sequence	Activity	Distribution
1 → 2	Receive Notification	1
2 → 3	Prepare to Leave Work	2
2,3 → 4	Travel Home	3
2,4 → 5	Prepare to Leave to Evacuate	4

Table 5-2. Time Distribution for Notifying the Public

Elapsed Time (Minutes)	Percent of Population Notified
0	0%
5	70%
10	90%
15	96%
20	98%
25	98%
30	100%

Table 5-3. Time Distribution for Employees to Prepare to Leave Work/College

Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work
0	0%
5	46%
10	68%
15	79%
20	87%
25	89%
30	94%
35	96%
40	98%
45	100%

NOTE: The survey data was normalized to distribute the "Don't know" response. That is, the sample was reduced in size to include only those households who responded to this question. The underlying assumption is that the distribution of this activity for the "Don't know" responders, if the event takes place, would be the same as those responders who provided estimates.

Table 5-4. Time Distribution for Commuters to Travel Home

Elapsed Time (Minutes)	Cumulative Percent Returning Home	Elapsed Time (Minutes)	Cumulative Percent Returning Home
0	0%	50	89%
5	9%	60	94%
10	20%	70	95%
15	30%	80	97%
20	40%	90	99%
25	49%	100	99%
30	69%	105	100%
40	82%		

NOTE: The survey data was normalized to distribute the "Don't know" response

Table 5-5. Time Distribution for Population to Prepare to Evacuate

Elapsed Time (Minutes)	Cumulative Percent Ready to Evacuate
0	0%
15	22%
30	52%
45	66%
60	82%
75	91%
90	94%
105	96%
120	97%
135	99%
150	100%

NOTE: The survey data was normalized to distribute the "Don't know" response

Table 5-6. Mapping Distributions to Events

Apply "Summing" Algorithm To:	Distribution Obtained	Event Defined
Distributions 1 and 2	Distribution A	Event 3
Distributions A and 3	Distribution B	Event 4
Distributions B and 4	Distribution C	Event 5
Distributions 1 and 4	Distribution D	Event 5

Table 5-7. Description of the Distributions

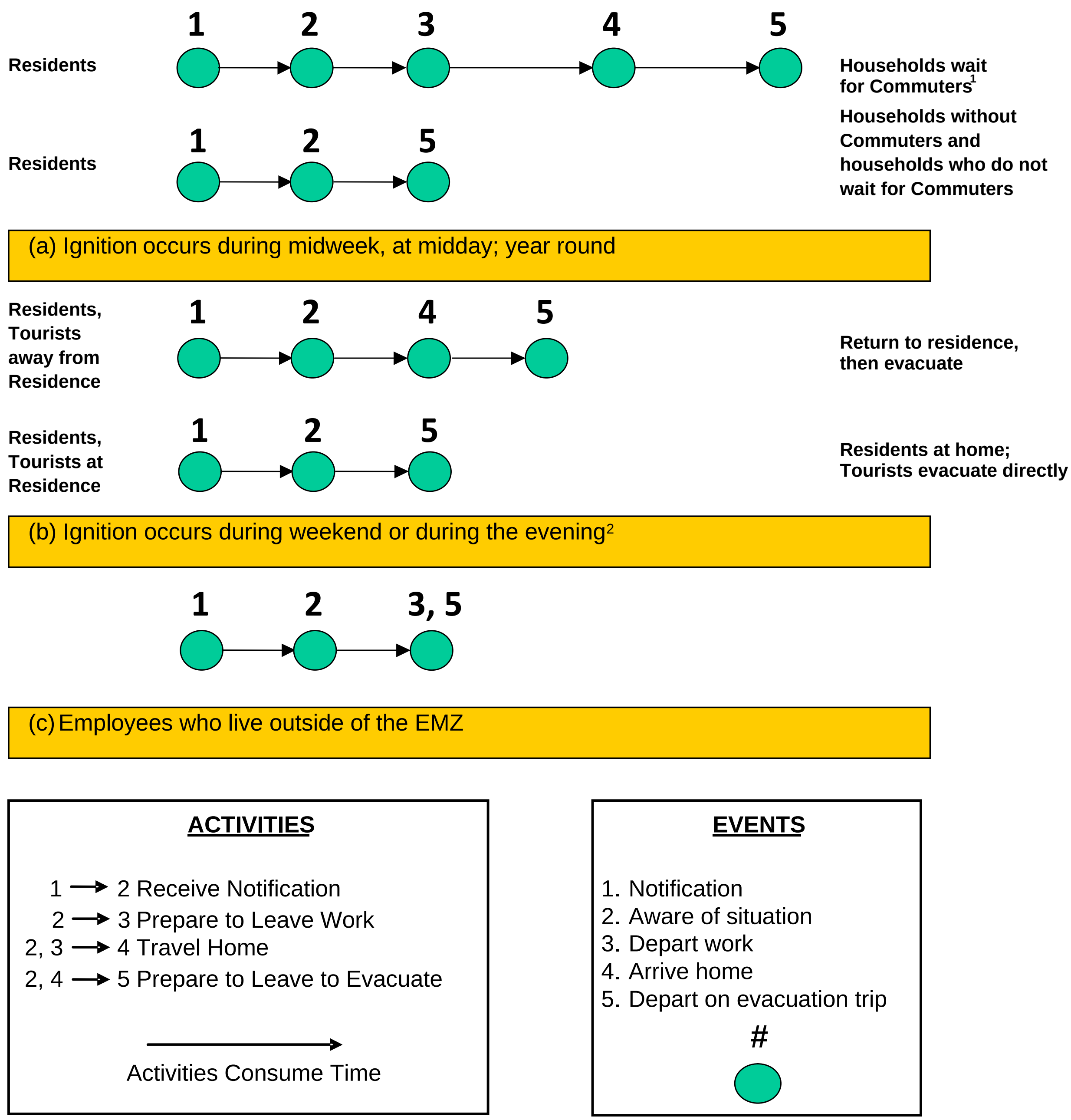
Distribution	Description
A	Time distribution of commuters departing place of work (Event 3). Also applies to employees (year-round and seasonal) who work within the EMZ who live outside, and to tourists within the EMZ.
B	Time distribution of commuters arriving home (Event 4).
C	Time distribution of residents with commuters who return home, leaving home to begin the evacuation trip (Event 5).
D	Time distribution of residents without commuters returning home, leaving home to begin the evacuation trip (Event 5).

Table 5-8. Trip Generation Histograms for the EMZ Population

Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period			
		Employees (Year-round and Seasonal) (Distribution A)	Tourists (Distribution B)	Residents with Commuters (Distribution C)	Residents Without Commuters (Distribution D)
1	15	57%	57%	0%	12%
2	15	29%	29%	2%	25%
3	15	11%	11%	8%	21%
4	15	3%	3%	15%	16%
5	15	0%	0%	18%	12%
6	15	0%	0%	17%	6%
7	15	0%	0%	14%	3%
8	15	0%	0%	9%	1%
9	15	0%	0%	6%	3%
10	15	0%	0%	4%	1%
11	15	0%	0%	3%	0%
12	15	0%	0%	2%	0%
13	15	0%	0%	1%	0%
14	15	0%	0%	1%	0%
15	600	0%	0%	0%	0%

NOTE:

- Shadow vehicles are loaded onto the analysis network (Figure 1-2) using Distributions C.



[1] Applies for evening and weekends also if commuters are at work.
[2] Applies throughout the year for tourists.

Figure 5-1. Events and Activities Preceding the Evacuation Trip

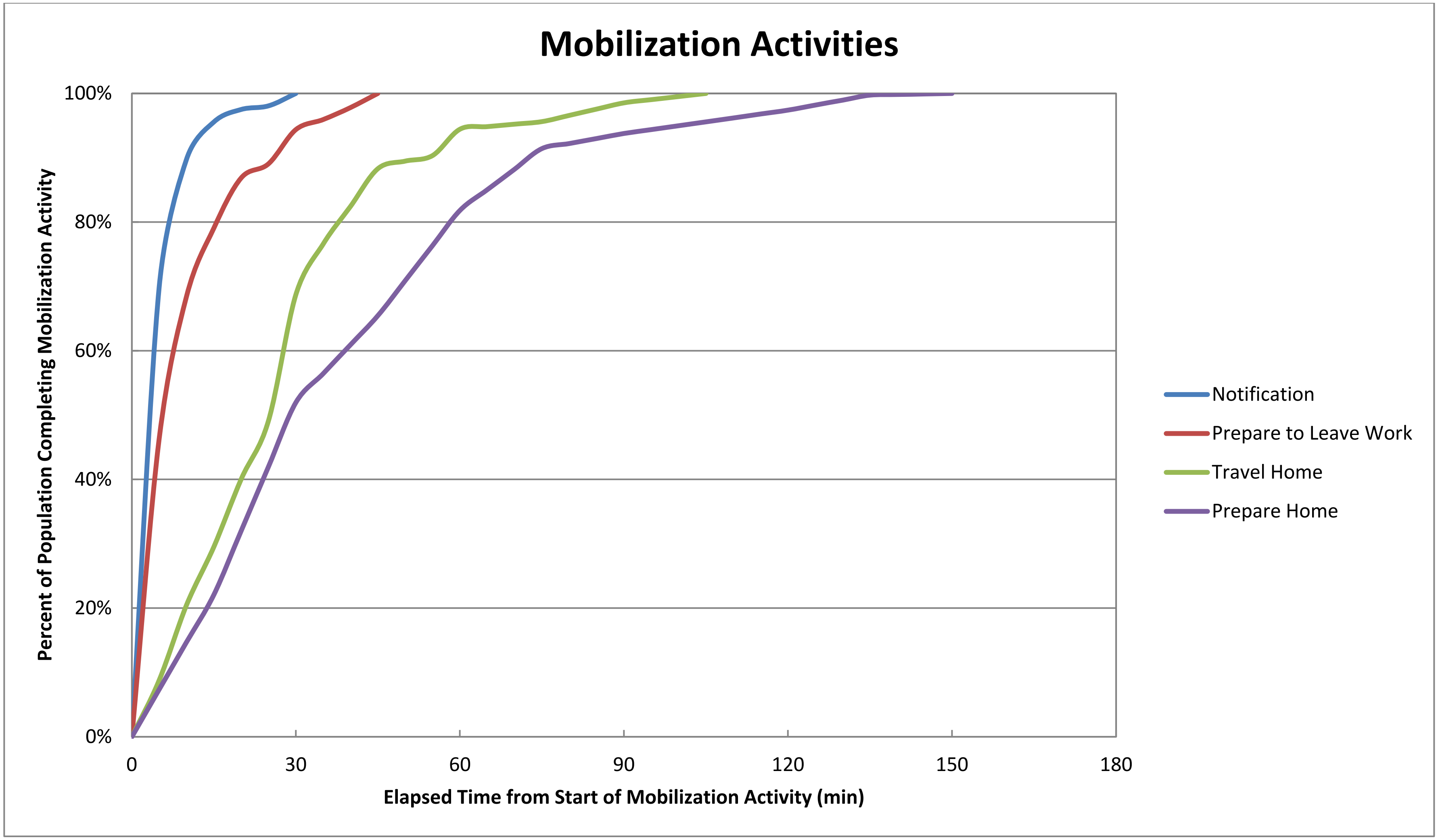


Figure 5-2. Evacuation Mobilization Activities

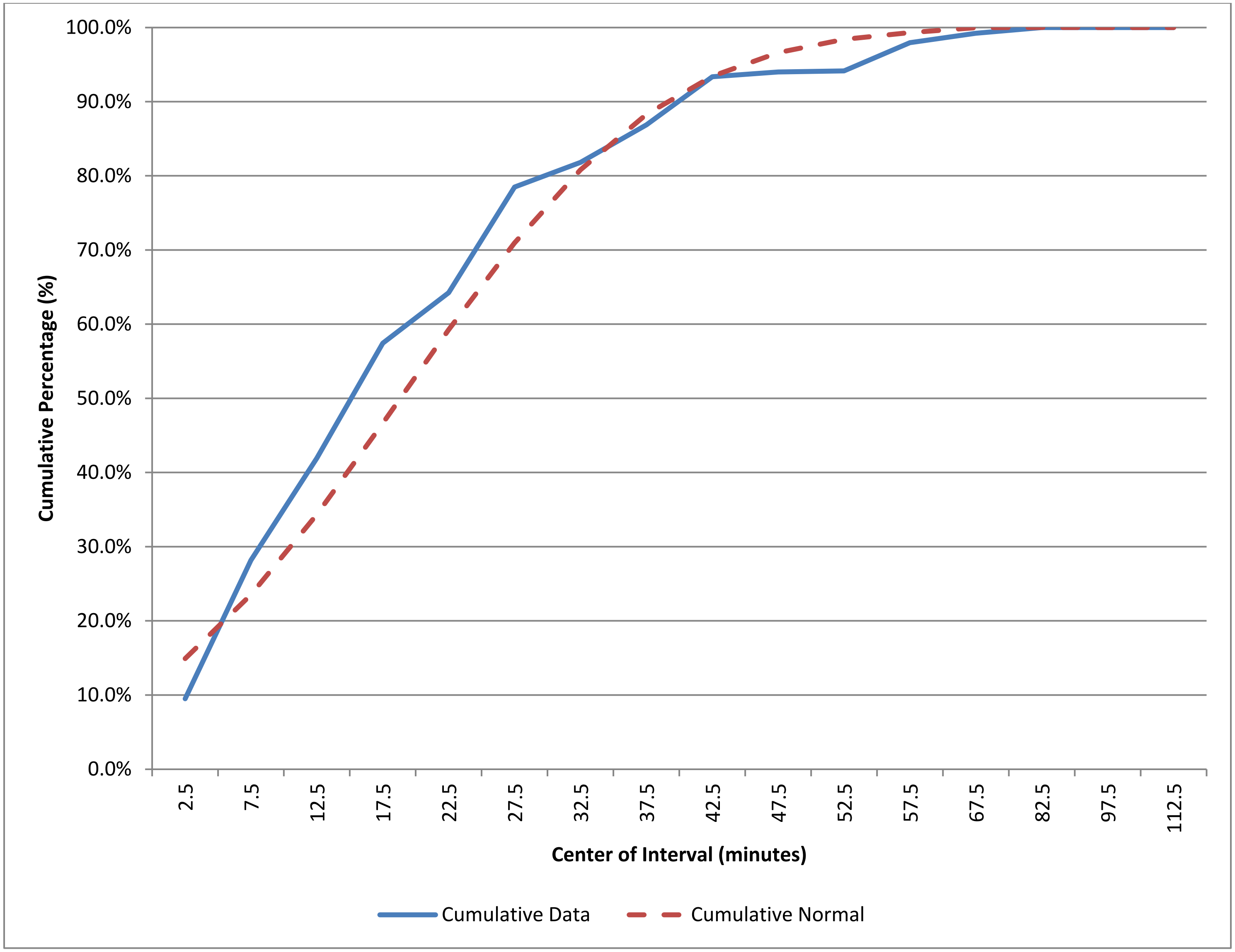


Figure 5-3. Comparison of Data Distribution and Normal Distribution

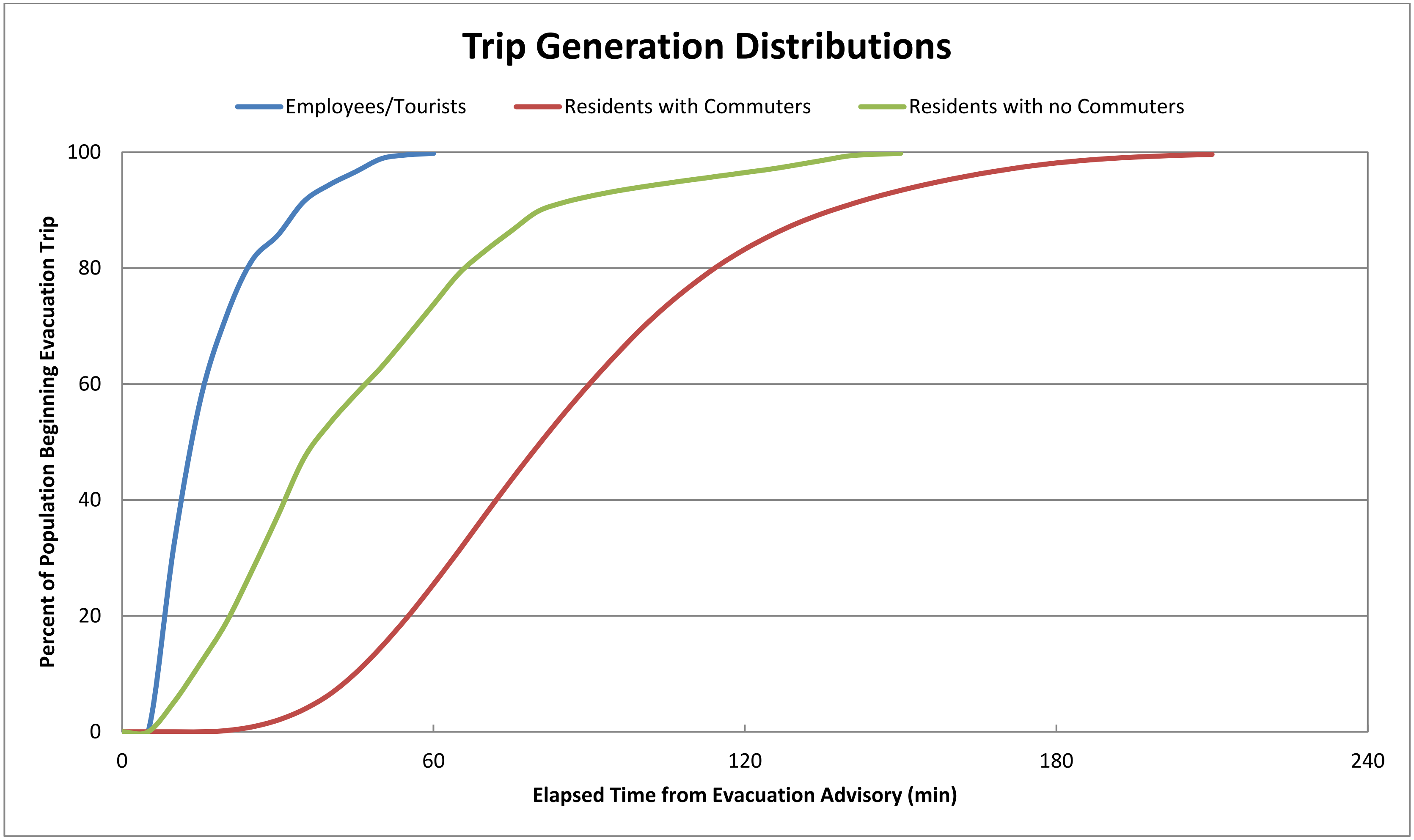


Figure 5-4. Comparison of Trip Generation Distributions

6 EVACUATION CASES

This section discusses the spatial and temporal variations in evacuation situations. The regions outlined in the study were created based on various geometric areas that would be evacuated in response to a wildfire emergency. The scenarios outlined in the study were created based on the various temporal changes that affect the number of vehicles evacuating during a wildfire emergency. This section provides an overview of all the possible evacuation cases that were studied. An evacuation "case" defines a combination of Evacuation Region and Evacuation Scenario. For this specific study, the definitions of "Region" and "Scenario" are as follows:

Region A grouping of contiguous evacuating EMZ that must be evacuated in response to a wildfire emergency.

Scenario A combination of circumstances, including time of day, day of week, season, and weather/roadway conditions. Scenarios define the number of people in each of the affected population groups and their respective mobilization time distributions.

A total of 28 Regions were defined which encompass all the groupings of EMZ considered. These Regions are defined in Table 6-1 by showing which EMZ evacuates for each Region. EMZs marked with a red "X" evacuate for that given Region. The EMZ boundaries are identified in Figure 6-1. The EMZ boundaries are based on the City of Laguna Beach Evacuation Plan for April 2018.

Regions R01 through R22 represent evacuations of each individual EMZ by itself. Regions R23 through R27 are evacuations of combinations of EMZ based on the origin of a potential wildfire and prevailing winds, as well as the existing egress routes to be utilized. The entirety of the EMZ is broken down into three region groups: North, Central, and South. These groupings of EMZ are shown in Figure 6-2. Regions R23, R24, and R25 represent the North, Central, and South groups, respectively. Region R26 involves the evacuation of the North and Central group; Region R27 involves the evacuation of the South and Central group. Lastly, Region R28 is the evacuation of all EMZ evacuating at once.

A total of 7 Scenarios were evaluated for all Regions. Thus, there are a total of 196 (28 x 7 = 196) evacuation cases. Table 6-2 is a description of all Scenarios.

Each combination of Region and Scenario implies a specific population to be evacuated. The population group and the vehicle estimates presented in Section 3 and in Appendix E are peak values. These peak values are adjusted depending on the scenario and region being considered, using Scenario and Region-specific percentages, such that the average population is considered for each evacuation case. The Scenario percentages are presented in Table 6-3, while the Region percentages are provided in Table G-1.

Table 6-4 presents the vehicle counts for each scenario for an evacuation of Region R28 – all the EMZ. Based on the scenario percentages in Table 6-3. The percentages presented in Table 6-3 were determined as follows:

The number of residents with commuters during the week (when workforce is at its peak) is equal to the product of 56% (the number of households with at least one commuter) and 18% (the number of households with a commuter that would await the return of the commuter prior to evacuating) – 10.08 percent (rounded to 10% in Table 6-3). See assumption 19 in Section 2.3. It is estimated for weekend and evening scenarios that 10% of households with returning commuters will have a commuter at work during those times.

Employment is assumed to be at its peak during the fall, midweek, midday scenarios. Employment is reduced slightly (96%) for summer, midweek, midday scenarios. This is based on the estimation that 50% of the employees commuting into the EMZ will be on vacation for a week during the approximate 12 weeks of summer. It is further estimated that those taking vacation will be uniformly dispersed throughout the summer with approximately 4% of employees vacationing each week. It is further estimated that only 10% of the employees are working in the evenings and during the weekends.

Tourist activity (including seasonal employment) is estimated to be at its peak (100%) during summer/spring, weekend, midday and less (45%) during the fall weekend, middays. Peak season for the majority of seasonal employment, parks and recreation centers in the area range from the months of April to October. This range includes all of the summer and roughly half of the fall season. Thus, tourist activity is estimated to be higher for summer compared to fall. As shown in Appendix E, approximately 46% of the tourist population inside the EMZ are from parks and recreation centers which are open during the day and closed at night; and seasonal employment can be higher at night during the summer. Thus, tourist activity on midweek/weekends evenings is estimated to be 50% and 80% for fall and summer/spring, respectively. Tourist activity is estimated to be 75% for summer and 40% for fall during midday midweek hours based on the days of the week that these facilities are operational.

As noted in the shadow footnote to Table 6-3, the shadow percentages are computed using a base of 14% (see assumption 6 in Section 2.2); to include the employees within the shadow region who may choose to evacuate, the voluntary evacuation is multiplied by a scenario-specific proportion of employees to permanent residents in the shadow region. For example, using the values provided in Table 6-4 for Scenario 1, the shadow percentage is computed as follows:

$$14\% \times \left(1 + \frac{2{,}651}{1{,}740 + 15{,}831}\right) = 16\%$$

As discussed in Section 7, schools are in session during the fall season, midweek, midday and 100% of buses will be needed under those circumstances. Since on campus students live at the school, 100% of these students are assumed to be present in the fall and spring. It is estimated that summer school/college enrollment is approximately 10% of enrollment during the regular school year for summer, midweek, midday scenarios. School is not in session during weekends and evenings, thus no buses for school children are needed under those circumstances and no off campus students are present during those scenarios.

Transit vehicles for the transit-dependent population and medical patients are set to 100% for all scenarios as it is assumed that the transit-dependent population and medical patients are present in the EMZ for all scenarios.

External traffic is estimated to be reduced by 60% during evening scenarios and is 100% for all other scenarios.

Table 6-1. Description of Evacuation Regions

Region		Emergency Management Zone (EMZ)																					
	Description	1	2	3	4	5	6	7	8	9a	9b	9c	10	11	12	13	14	15	16	17	18	19	20
R01	Arch Beach Heights	X																					
R02	Balboa/Nyes		X																				
R03	Big Bend			X																			
R04	Bluebird Canyon				X																		
R05	Boat Canyon					X																	
R06	Canyon Acres						X																
R07	Ceanothus							X															
R08	Club Laguna								X														
R09	North Coast									X													
R10	Central Coast										X												
R11	South Coast											X											
R12	Downtown												X										
R13	El Toro													X									
R14	Emerald Bay														X								
R15	Irvine Cove															X							
R16	Mar Vista																X						
R17	Old Top of the World																	X					
R18	Park Avenue																		X				
R19	Sunset																			X			
R20	Temple Hills																				X		
R21	Top of the World																					X	
R22	Wesley																						X
R23	North Laguna					X				X			X		X	X							
R24	Central Laguna			X	X		X		X		X		X	X				X	X		X	X	
R25	South Laguna	X	X					X				X					X			X			X

Region	Emergency Management Zone (EMZ)																						
	Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9a**	**9b**	**9c**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
R26	North and Central Laguna			X	X	X	X		X	X	X		X	X	X	X		X	X		X	X	
R27	South and Central Laguna	X	X	X	X		X	X	X		X	X	X	X			X	X	X	X	X	X	X
R28	All EMZs	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Zone(s) Shelter-in-Place | **Zone(s) Evacuate**

Table 6-2. Evacuation Scenario Definitions

Scenario	Season	Day of Week	Time of Day	Conditions
1	Summer	Midweek	Midday	Normal
2	Summer/Spring	Weekend	Midday	Normal
3	Summer/Spring	Midweek, Weekend	Evening	Normal
4	Fall	Midweek	Midday	Normal
5	Fall	Midweek	Midday	Reduced Roadway Capacity
6	Fall	Weekend	Midday	Normal
7	Fall	Midweek, Weekend	Evening	Normal

Table 6-3. Percent of Population Groups Evacuating for Various Scenarios

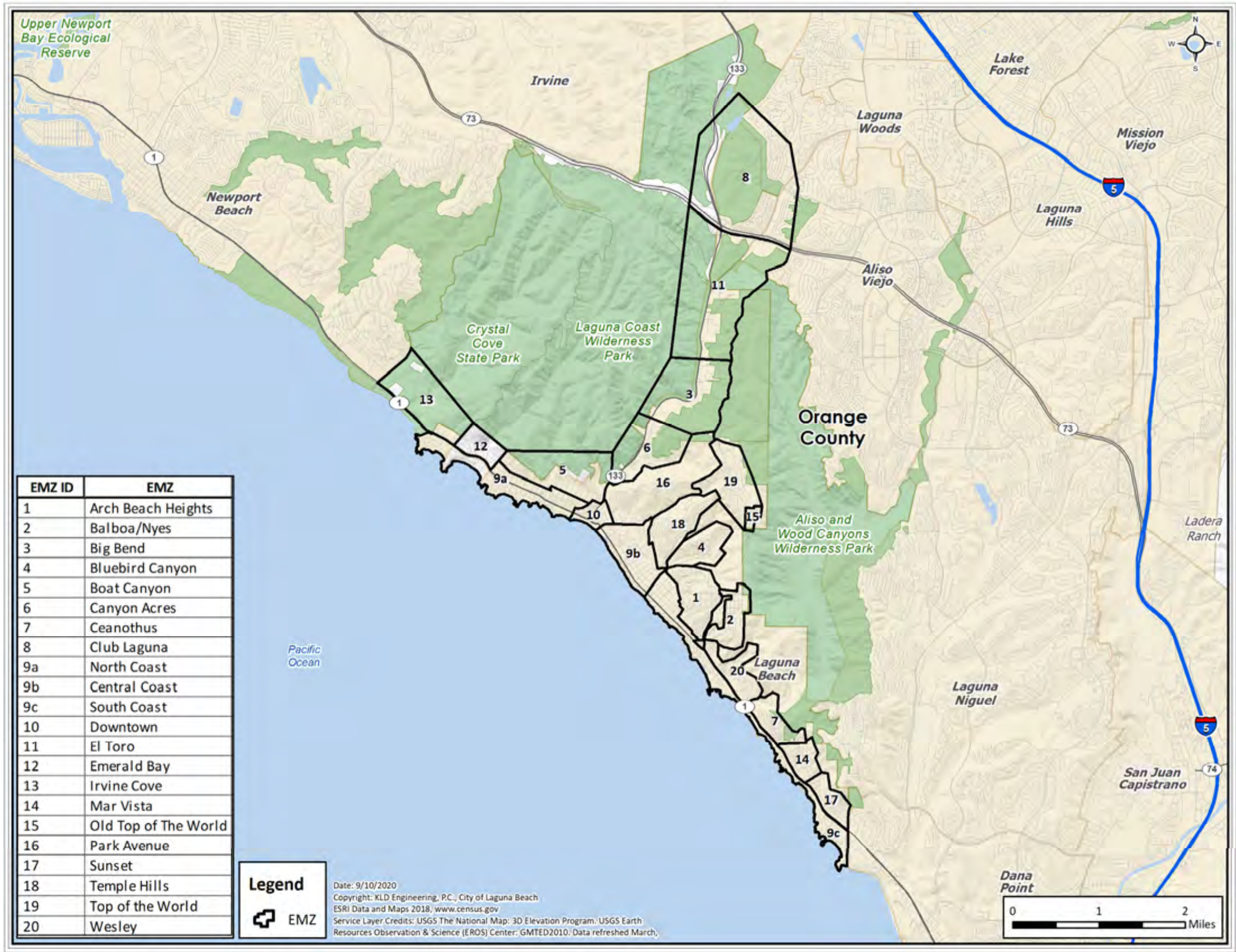
Scenario	Households With Returning Commuters	Households Without Returning Commuters	Employees	Tourists	Shadow	Medical Vehicles	On Campus Vehicles	Off Campus Vehicles	School/College Buses	Transit Buses	External Through Traffic
1	10%	90%	96%	75%	16%	100%	100%	10%	10%	100%	100%
2	1%	99%	10%	100%	14%	100%	100%	0%	0%	100%	100%
3	1%	99%	10%	80%	14%	100%	100%	0%	0%	100%	40%
4	10%	90%	100%	40%	16%	100%	100%	100%	100%	100%	100%
5	10%	90%	100%	40%	16%	100%	100%	100%	100%	100%	100%
6	1%	99%	10%	45%	14%	100%	100%	0%	0%	100%	100%
7	1%	99%	10%	50%	14%	100%	100%	0%	0%	100%	40%

Resident Households with Commuters....... Households of EMZ residents who await the return of commuters prior to beginning the evacuation trip.
Resident Households with No Commuters.. Households of EMZ residents who do not have commuters or will not await the return of commuters prior to beginning the evacuation trip.
Employees .... Year-round EMZ employees who live outside the EMZ.
Tourists .... People who are in the EMZ at the time of an event for recreational or other purposes, including seasonal employment.
Shadow .... Residents and employees in the shadow region (outside of the EMZ and not along the ridge line) who will spontaneously decide to relocate during the evacuation. The basis for the values shown is a 14% relocation of shadow residents along with a proportional percentage of shadow employees. One hundred percent of shadow evacuees along the ridge line are assumed to voluntarily evacuate.
On Campus Vehicles.................................. Students who reside on campus within the EMZ that will evacuate using a private vehicle.
Off Campus Vehicles .... Students who reside off campus within the EMZ that will evacuate using a private vehicle.
Medical, School and Transit Vehicles.......... Vehicle-equivalents present on the road during evacuation servicing medical facilities, schools and transit-dependent people (1 bus/trolley is equivalent to 2 passenger vehicles).
External Through Traffic............................ Traffic on interstates and major arterial roads at the start of the evacuation. This traffic is stopped by access control approximately 2 hours after the evacuation begins.

Table 6-4. Vehicle Estimates by Scenario

Scenario	Households With Returning Commuters	Households Without Returning Commuters	Employees	Tourists	Shadow	Shadow along Ridge Line	Medical Vehicles	On Campus Vehicles	Off Campus Vehicles + Buses	School Buses	Transit Buses	External Through Traffic	Total Scenario Vehicles[1]
1	1,740	15,831	2,651	4,104	29,624	28,058	32	467	16	10	18	51,264	133,816
2	174	17,401	276	5,472	28,167	28,058	32	467	-	-	18	51,264	131,329
3	174	17,401	276	4,378	28,167	28,058	32	467	-	-	18	20,506	99,477
4	1,740	15,831	2,761	2,189	29,692	28,058	32	467	161	104	18	51,264	132,317
5	1,740	15,831	2,761	2,189	29,692	28,058	32	467	161	104	18	51,264	132,317
6	174	17,401	276	2,462	28,167	28,058	32	467	-	-	18	51,264	128,319
7	174	17,401	276	2,736	28,167	28,058	32	467	-	-	18	20,506	97,835

[1] Vehicle estimates are for an evacuation of all EMZs (Region R28)



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure 6-1. EMZ Boundaries

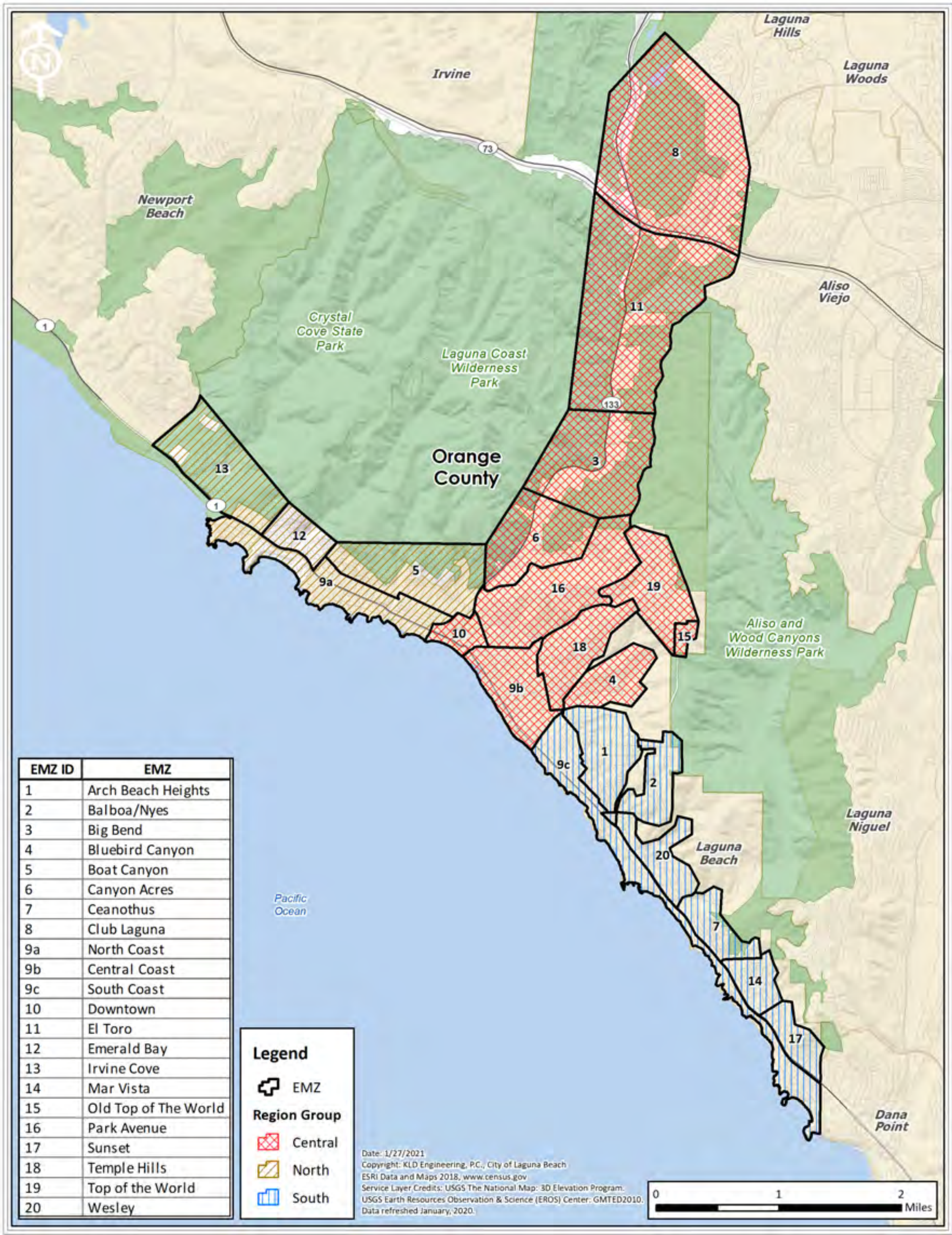


Figure 6-2. EMZ Groupings

7 GENERAL POPULATION EVACUATION TIME ESTIMATES (ETE)

This section presents the ETE results of the computer analyses using the DYNEV II System described in Appendices B, C and D. These results cover 28 Evacuation Regions and the 7 Evacuation Scenarios discussed in Section 6.

The ETE for all Evacuation Cases are presented in Table 7-1 and Table 7-2. These tables present the estimated times to clear the indicated population percentages from the Evacuation Regions for all Evacuation Scenarios. Table 6-1 and Table G-1 defines the Evacuation Regions considered. The tabulated values of ETE are obtained from the DYNEV II System outputs which are generated at 5-minute intervals.

7.1 Voluntary Evacuation and Shadow Evacuation

"Voluntary evacuees" are people within the EMZ for which an Advisory to Evacuate has not been issued, yet who elect to evacuate. "Shadow evacuation" is the voluntary outward movement of some people from the Shadow Region for whom no evacuation order has been issued. Both voluntary and shadow evacuations are assumed to take place over the same time frame as the evacuation from within the impacted Evacuation Region.

Within the EMZ, 14 percent of permanent residents located outside of the evacuation region who are not advised to evacuate, are assumed to elect to evacuate. Similarly, it is assumed that 14 percent of those people in the Shadow Region will choose to leave the area. For an evacuation of the full EMZ and groupings of EMZs, 100 percent of those people within the Shadow Region along the ridge line were assumed to voluntarily evacuate due to their proximity to possible wildfires. Fourteen percent of those beyond the ridge line were assumed to evacuate in these cases. See Figure G-29.

Figure 7-1 presents the area identified as the Shadow Region. This region extends beyond the 22 EMZs to include areas west of Interstate 5, south of Interstate 405, and east of Jamboree Road. The population and number of evacuating vehicles in the Shadow Region were estimated using the same methodology that was used for permanent residents within the EMZ (see Section 3.1). As discussed in Section 3.2, it is estimated that a total of 332,331 people reside in the Shadow Region; 14 percent[1] of them would evacuate. See Table 6-4 for the number of evacuating vehicles from the Shadow Region.

Traffic generated within this Shadow Region including external-external traffic, traveling away from the wildfire, has the potential for impeding evacuating vehicles from within the Evacuation Region. All ETE calculations include this shadow traffic movement.

[1] One hundred percent along the ridge line for some cases.

7.2 Patterns of Traffic Congestion during Evacuation

Figure 7-2 through Figure 7-7 illustrate the patterns of traffic congestion that arise for the case when all twenty-two EMZs (Region R28) are advised to evacuate during a summer, midweek, midday period under normal conditions (Scenario 1).

Traffic congestion, as the term is used here, is defined as Level of Service (LOS) F. LOS F is defined as follows (HCM 2016, page 5-5):

> The HCM uses LOS F to define operations that have either broken down (i.e., demand exceeds capacity) or have reached a point that most users would consider unsatisfactory, as described by a specified service measure value (or combination of service measure values). However, analysts may be interested in knowing just how bad the LOS F condition is, particularly for planning applications where different alternatives may be compared. Several measures are available for describing individually, or in combination, the severity of a LOS F condition:
>
> • *Demand-to-capacity ratios* describe the extent to which demand exceeds capacity during the analysis period (e.g., by 1%, 15%).
>
> • *Duration of LOS F* describes how long the condition persists (e.g., 15 min, 1 h, 3 h).
>
> • *Spatial extent measures* describe the areas affected by LOS F conditions. They include measures such as the back of queue and the identification of the specific intersection approaches or system elements experiencing LOS F conditions.

All highway "links" which experience LOS F are delineated in these figures by a thick red line; all others are lightly indicated. Congestion develops around concentrations of population and traffic bottlenecks.

Figure 7-2 displays the congestion patterns in the study area at just 30 minutes after the advisory to evacuate. Severe congestion has already developed on many of the local roadways and major evacuation routes within Laguna Beach. Moderate congestion develops along I-5 and I-405 which service external-external trips through the study area. Some of the larger communities along the ridge line in the Shadow Region – in Newport Beach, Aliso Viejo, and Laguna Niguel – are experiencing LOS F conditions since it was assumed that 100 percent of these people would evacuate as well. At this time, approximately 41% of vehicles have begun their evacuation trip and 13% of evacuating vehicles have successfully evacuated the area.

At one hour after the evacuation advisory, Laguna Beach experiences peak congestion with nearly all EMZs experiencing LOS F conditions, as shown in Figure 7-3. SR-133 exhibits LOS F conditions northbound from Downtown to El Toro Road where there is additional northbound capacity (provided by El Toro Rd) and access to SR-73. Since SR-1 within the EMZs is completely congested, all roadways that intersect SR-1 also experience congestion as they compete for green time at signalize intersections and look for acceptable gaps at stop and yield signs. In the Shadow Region to the north of the EMZs, parts of SR-73, SR-1 in Costa Mesa and Newport Beach experience LOS F conditions as evacuees from Laguna Beach meet with external traffic along these roadways and voluntary shadow evacuees. The combination of these vehicles exceeds the capacity of these roadways causing congestion. To the east in the Shadow Region, congestion along I-405 and I-5 worsens for the same reason. Congestion in the Shadow Region along the ridge line to the south has lessened a bit but has developed further south and east in Dana Point and San Juan Capistrano, as well as along Crown Valley Parkway. Congestion along SR-73 southbound has worsened. At this time, approximately 73% of vehicles have begun their evacuation trip and 27% of evacuating vehicles have successfully evacuated the area.

At two hours after the advisory to evacuate, as shown in Figure 7-4, congestion has dissipated in Bluebird Canyon, Balboa/Nyes, Club Laguna, Top of the World and Old Top of the world but remains in the other EMZs. SR-1 and C-133 remain severely congested as vehicles continue to mobilize and evacuate. At this time, all external traffic is assumed to be diverted. Congestion along I-405 west of the interchange with I-5, and along I-5 north of the interchange with I-405 has dissipated. With the exception of SR-1, all congestion in the Shadow Region north of Laguna Beach has dissipated. Slight congestion remains in Aliso Viejo along Oakgrove Dr and Westridge Dr. Congestion along remains along Crown Valley Parkway, SR-1 and I-5 in the Shadow Region, as well as on Camino Del Avion and Del Obispo St in San Juan Capistrano. At this time, approximately 95% of vehicles have begun their evacuation trip and 54% of evacuating vehicles have successfully evacuated out of the EMZs.

Congestion within the EMZs has lessened significantly at three hours after the evacuation advisory, as shown in Figure 7-5. At this time, Park Avenue, Temple Hills, and Boat Canyon are clear of congestion. Majority of the remaining congestion within the EMZs is on SR-1 and C-133. Almost all of the congestion in the Shadow region has dissipated, with just a small stretch of I-5 experiencing LOS F conditions in San Juan Capistrano. Slight congestion remains on Del Obispo St in San Juan Capistrano and at the interchange of SR-55 and SR-73 in Costa Mesa. Congestion along SR-1 remains in the Shadow Region to the north and south of Laguna Beach. At this time, almost all vehicles (99.8%) have mobilized and begun their evacuation trip, and 75% of evacuating vehicles have successfully evacuated the EMZs.

Over the next hour, at four hours after the advisory to evacuate, most of Laguna Beach clears of congestion, as seen in Figure 7-6. Downtown, Arch Beach Heights, Canyon Acres, Big Bend, and Wesley have little to no congestion. With the exception of SR-1, Irvine Cove, North Coast, Central Coast, South Coast, Ceanothus, Mar Vista, and Sunset are also clear of congestion. Congestion remains along SR-133 in El Toro. The only remnants of congestion in the Shadow Region are along SR-1. At this time, approximately 94% of evacuating vehicles have successfully evacuated the area.

Figure 7-7 shows the last bit of congestion in the EMZs along SR-1 northbound and slight congestion along SR-133 northbound at four hours and thirty minutes after the evacuation advisory. All evacuees successfully evacuate the EMZs ten minutes later at four hours and forty minutes after the advisory to evacuate. Congestion along SR-1 northbound in the Shadow Region clears at 5 hours after the evacuation advisory.

7.3 Evacuation Rates

Evacuation is a continuous process, as implied by Figure 7-8 through Figure 7-14. These figures indicate the rate at which traffic flows out of the indicated areas for the case of an evacuation of all EMZs (Region R28) under the indicated conditions. One figure is presented for each scenario considered.

The distance between the trip generation and ETE curves is the travel time. Plots of trip generation versus ETE are indicative of the level of traffic congestion during evacuation. The evacuation population mobilize over two hours and thirty minutes as discussed in Section 5. This disperses evacuees over a lengthy period of time, thus, as seen in Figure 7-8 through Figure 7-14, the maximum travel time experienced is approximately 160 minutes.

As indicated in these figures, there is typically a long "tail" to these distributions due to mobilization and not congestion. Vehicles begin to evacuate an area slowly at first, as people respond to the ATE at different rates. Then traffic demand builds rapidly (slopes of curves increase). As more routes clear, the aggregate rate of egress slows since many vehicles have already left the EMZs. Towards the end of the process, relatively few evacuation routes service the remaining demand.

This decline in aggregate flow rate, towards the end of the process, is characterized by these curves flattening and gradually becoming horizontal. Ideally, it would be desirable to fully saturate all evacuation routes equally so that all will service traffic near capacity levels and all will clear at the same time. For this ideal situation, all curves would retain the same slope until the end – thus minimizing evacuation time. In reality, this ideal is generally unattainable reflecting the spatial variation in population density, mobilization rates and in highway capacity over the study area.

7.4 Evacuation Time Estimate (ETE) Results

Table 7-1 and Table 7-2 present the ETE values for all 28 Evacuation Regions and all 7 Evacuation Scenarios. Region R28 is an evacuation of all EMZs with 100% evacuation of the Shadow Region along <u>both</u> northern and southern ridge lines (on both sides of SR-133) and 14% voluntary evacuation of the Shadow Region beyond the ridge line (see Figure G-29). Two additional Regions were considered for an evacuation of all EMZs. Region R29 is an evacuation of all EMZs (similar Region R28 as shown in Table 6-1) with 100% evacuation of the Shadow Region along both northern ridge line (north of SR-133) and <u>14% voluntary evacuation of the Shadow Region everywhere else</u>. Region R30 is an evacuation of all EMZs (similar Region R28 as shown in Table 6-1) with 100% evacuation of the Shadow Region along both southern ridge line (south of SR-133) and <u>14% voluntary evacuation of the Shadow Region everywhere else</u>.

Table	Contents
7-1	ETE represents the elapsed time required for 90 percent of the population within a Region, to evacuate from that Region. All Scenarios are considered.
7-2	ETE represents the elapsed time required for 100 percent of the population within a Region, to evacuate from that Region. All Scenarios are considered.

The animation snapshots described above reflect the ETE statistics for evacuation scenarios and regions, which are displayed in Figure 7-2 through Figure 7-7. Majority of the congestion is located on major evacuation routes, SR-1, SR-133, SR-73, I-405 and I-5 that serve a majority of the evacuation population.

The 100th percentile ETE ranges between 3:30 (Hours:Minutes) and 5:20 (Hours:Minutes) for all regions and scenarios. Since the trip generation time is at most 3 hours and 30 minutes, an ETE of or close to 3:30 implies that traffic congestion clears within the EMZs prior to the completion of mobilization time. A factor that significantly effects mobilization times are how quickly the public can be notified of an evacuation. This study assumed notification time of thirty minutes (see Section 5). If the evacuating population can be notified more quickly, this will truncate mobilization times and could reduce the 100th percentile ETE. Similarly, if it takes longer to notify the evacuation population, the 100th percentile ETE will be longer and will likely be equal to the longer trip mobilization time. Appendix J discusses how sensitive the ETE are to changes in mobilization time.

For cases wherein the ETE exceeds 3:30, congestion dictates ETE. That is the case for Regions R26 through R30. For these regions, combinations of EMZs are evacuated with a shadow evacuation of 100% along the ridge line. It is clear that when more vehicles in the Shadow Region evacuate, they consume available capacity on the major evacuation routes leaving the EMZs. As a result, there is limited capacity along these roadways available to evacuees. Congestion results delaying evacuation and prolonging ETE.

Alternatively, the 90th percentile ETE ranges between 0:55 (Hours:Minutes) and 3:45 (Hours:Minutes) for all regions and scenarios. When the EMZs evacuate alone, ETE range from 55 minutes to 2 hours. Big Bend and Canyon Acres have the shortest 90th percentile ETE since the majority of the population within these EMZs are quickly mobilizing tourists, employees, and/or commuting college students. Regions R28 through R30 have the longest 90th percentile ETE since they involve the evacuation of all the EMZs.

For most regions, the 90th and 100th percentile ETE for the reduced roadway closure scenario is the longest. The ETE increases by as much as 15 minutes at the 90th percentile and 30 minutes at the 100th percentile for the reduced roadway capacity scenario. Events that reduce roadway capacity, like thick smoke causing decreased sight distance, can significantly impact the evacuation of the City of Laguna Beach.

It is possible some people might elect to evacuate on foot or by bicycle or scooter. For an evacuation wherein all routes are viable, the furthest distance a person would need to travel to reach the EMZ boundary is estimated to be about 5 miles, using GIS software. The Manual on Uniform Traffic Control Devices (MUTCD) recommends using a walking speed of 3.5 feet per second when designing pedestrian facilities. It would take about 2 hours and 5 minutes to walk 5 miles at 3.5 feet per second. Bikes and scooters are faster than walking, so the time to evacuate for these vehicles would be even shorter.

In addition, if some evacuees elected to evacuate on foot, or by bike or scooter, rather than in their cars, the number of vehicles evacuating would reduce. A sensitivity study was conducted on a 40% reduction in evacuating vehicles (see Appendix J). The results of the sensitivity study indicate that although ETE dropped, it would still take longer than 2 hours and 5 minutes for the vehicular traffic to clear the area.

As a result, the time to walk out of the EMZ is less than the time needed for vehicles to evacuate the area, even with a possible reduction in evacuating vehicles. For this reason, the vehicular ETE should be used when making emergency planning decisions.

7.5 Guidance on Using ETE Tables

The user first determines the percentile of population for which the ETE is sought (federal guidance for nuclear emergencies calls for the 90th percentile). The applicable value of ETE within the chosen table may then be identified using the following procedure:

1. Identify the applicable **Scenario**:
   - Season
     - Summer
     - Fall
   - Day of Week
     - Midweek
     - Weekend
   - Time of Day
     - Midday
     - Evening
   - Roadway Conditions
     - Normal
     - Reduced Roadway Capacity (i.e. thick smoke or adverse weather)

   While these Scenarios are designed, in aggregate, to represent conditions throughout the year, some further clarification is warranted:

   - The seasons are defined as follows:
     - Summer assumes that public schools are not in session.
     - Fall considers that public schools are in session.
   - Time of Day: Midday implies the time over which most commuters are at work or are travelling to/from work.
2. With the desired percentile ETE and Scenario identified, now identify the **Evacuation Region**:
   - Determine which EMZ or combination of EMZs need to evacuate from Table 6-1:

- Individual EMZs (R01 through R22)
- Groupings/Combinations of EMZs (Region R23 through R27)
- All EMZs with 100% Shadow Region evacuation along the ridge line (Region R28)
- All EMZs with 100% Shadow Region evacuation along the ridge line to the north (Region R29)
- All EMZs with 100% Shadow Region evacuation along the ridge line to the south (Region R30)

3. Determine the **ETE Table** based on the **percentile** selected**.** Then, for the **Scenario** identified in Step 1 and the **Region** identified in Step 2, proceed as follows:
   - The columns of Table 7-1 are labeled with the Scenario numbers. Identify the proper column in the selected Table using the Scenario number defined in Step 1.
   - Identify the row in this table that provides ETE values for the Region identified in Step 2.
   - The unique data cell defined by the column and row so determined contains the desired value of ETE expressed in Hours:Minutes.

<u>Example</u>

It is desired to identify the ETE for the following conditions:

- Wednesday, October 14th at 12:00 PM.
- It is sunny.
- The wildfire threatens all the EMZs and is located north of SR-133.
- The desired ETE is that value needed to evacuate 90 percent of the population from within the impacted Region.

Table 7-1 is applicable because the 90th percentile ETE is desired. Proceed as follows:

1. Identify the Scenario as fall, midweek, midday and normal conditions. Entering Table 7-1, it is seen that this combination of circumstances describes Scenario 4.
2. In Table 6-1, locate the Region that has all EMZs evacuating together and 100% of the Shadow Region along the ridge line to the north of SR-133, Region R29.
3. In Table 7-1, locate the data cell containing the value of ETE for Scenario 4 and Region R29. This data cell is in column (4) and in the row for Region R29; it contains the ETE value of 3:15.

Table 7-1. Time to Clear the Indicated Area of *90* Percent of the Affected Population

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Midday		Evening	Midday		Midday	Evening
Region	Normal	Normal	Normal	Normal	Reduced Roadway Capacity	Normal	Normal
R01 - Arch Beach Heights	1:35	1:25	1:25	1:35	1:35	1:25	1:25
R02 - Balboa/Nyes	1:35	1:30	1:30	1:35	1:40	1:30	1:30
R03 - Big Bend	1:10	1:10	1:10	1:15	1:15	1:10	1:10
R04 - Bluebird Canyon	1:35	1:25	1:25	1:35	1:35	1:25	1:25
R05 - Boat Canyon	1:50	2:00	1:30	1:30	1:40	1:20	1:10
R06 - Canyon Acres	1:00	0:55	1:00	1:05	1:05	1:05	1:05
R07 - Ceanothus	1:25	1:20	1:20	1:30	1:30	1:25	1:25
R08 - Club Laguna	1:50	1:45	1:45	1:50	1:50	1:45	1:45
R09 - North Coast	1:50	1:45	1:35	1:55	2:00	1:55	1:40
R10 - Central Coast	1:45	1:40	1:30	1:45	1:55	1:45	1:35
R11 - South Coast	1:45	1:45	1:35	1:45	1:50	1:45	1:35
R12 - Downtown	1:40	1:40	1:35	1:45	1:50	1:45	1:40
R13 - El Toro	1:50	1:50	1:55	1:50	2:00	1:50	1:55
R14 - Emerald Bay	1:50	1:45	1:25	1:45	1:45	1:40	1:25
R15 - Irvine Cove	1:35	1:25	1:25	1:30	1:30	1:25	1:30
R16 - Mar Vista	1:30	1:25	1:25	1:30	1:30	1:25	1:25
R17 - Old Top of the World	1:40	1:30	1:30	1:35	1:35	1:30	1:30
R18 - Park Avenue	1:25	1:20	1:25	1:30	1:30	1:25	1:25
R19 - Sunset	1:30	1:25	1:25	1:30	1:30	1:25	1:25
R20 - Temple Hills	1:35	1:30	1:30	1:35	1:35	1:30	1:30
R21 - Top of the World	1:35	1:25	1:25	1:35	1:35	1:25	1:25
R22 - Wesley	1:30	1:20	1:20	1:30	1:30	1:25	1:25
R23 - North Laguna	2:00	2:00	1:40	1:55	2:00	1:50	1:40
R24 - Central Laguna	2:15	2:10	1:45	2:15	2:25	2:10	1:40
R25 - South Laguna	2:15	2:10	1:40	1:55	2:10	2:05	1:35
R26 - North and Central Laguna	2:50	2:35	2:05	2:35	2:50	2:20	2:00
R27 - South and Central Laguna	3:15	3:00	2:35	3:05	3:30	2:50	2:25
R28 - All EMZs + 100% of Shadow Region along Ridge Line	3:45	3:40	3:05	3:20	3:45	3:15	2:40
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	3:30	3:20	3:00	3:15	3:40	2:55	2:40
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	3:35	3:30	2:50	3:20	3:40	3:00	2:35

Table 7-2. Time to Clear the Indicated Area of *100* Percent of the Affected Population

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Midday		Evening	Midday		Midday	Evening
Region	Normal	Normal	Normal	Normal	Reduced Roadway Capacity	Normal	Normal
R01 - Arch Beach Heights	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R02 - Balboa/Nyes	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R03 - Big Bend	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R04 - Bluebird Canyon	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R05 - Boat Canyon	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R06 - Canyon Acres	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R07 - Ceanothus	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R08 - Club Laguna	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R09 - North Coast	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R10 - Central Coast	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R11 - South Coast	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R12 - Downtown	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R13 - El Toro	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R14 - Emerald Bay	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R15 - Irvine Cove	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R16 - Mar Vista	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R17 - Old Top of the World	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R18 - Park Avenue	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R19 - Sunset	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R20 - Temple Hills	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R21 - Top of the World	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R22 - Wesley	3:30	3:30	3:30	3:30	3:30	3:30	3:30
R23 - North Laguna	3:35	3:35	3:35	3:35	3:35	3:35	3:35
R24 - Central Laguna	3:35	3:35	3:35	3:35	3:35	3:35	3:35
R25 - South Laguna	3:35	3:35	3:35	3:35	3:35	3:35	3:35
R26 - North and Central Laguna	3:50	3:35	3:35	3:35	3:35	3:35	3:35
R27 - South and Central Laguna	4:30	4:15	3:35	4:20	5:00	4:10	3:35
R28 – All EMZs + 100% of Shadow Region along Ridge Line	4:50	4:50	3:40	4:45	5:20	4:10	3:35
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	4:20	4:35	3:40	4:40	5:05	3:45	3:35
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	4:50	4:20	3:35	4:40	5:10	4:10	3:35

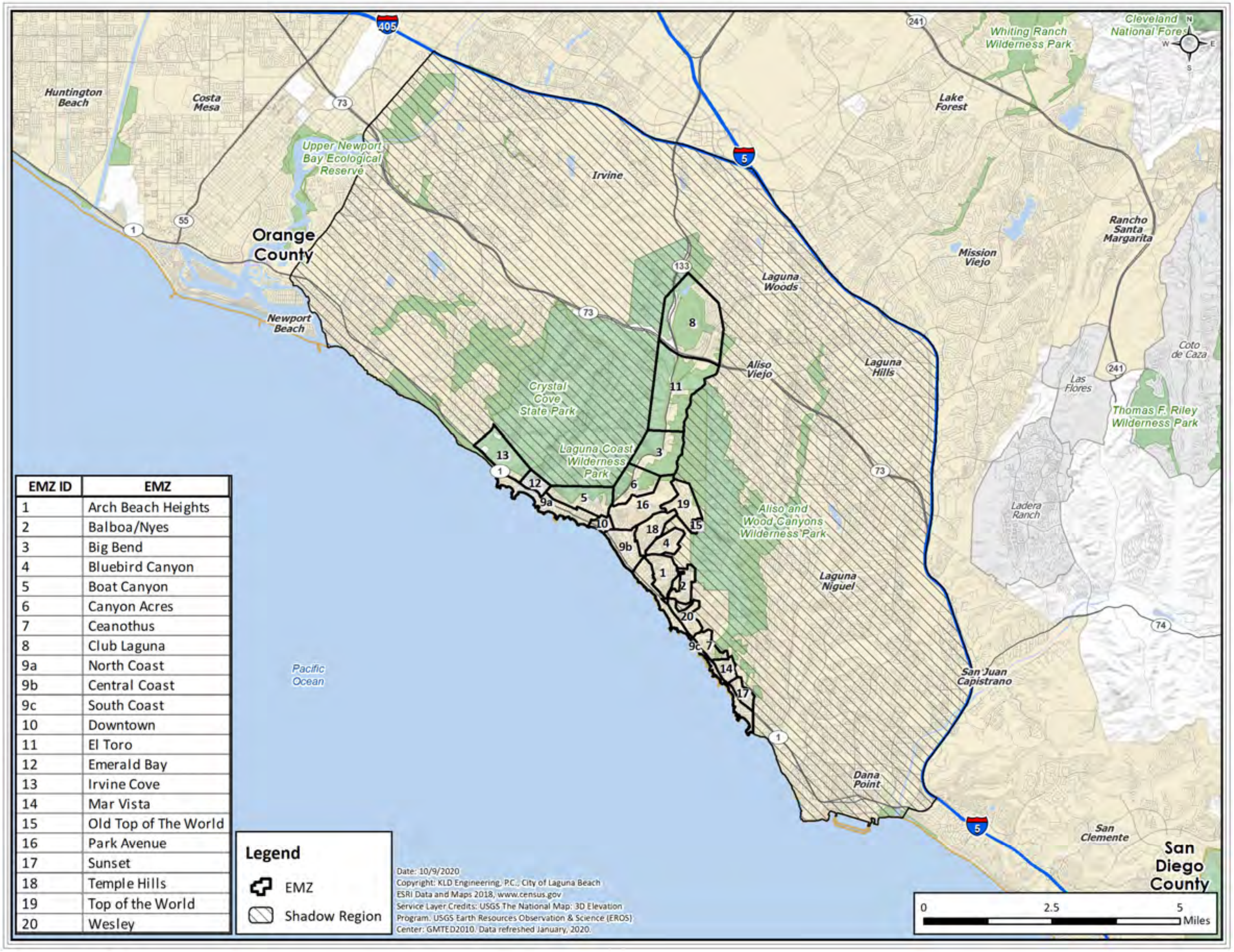


Figure 7-1. Study Area Shadow Region

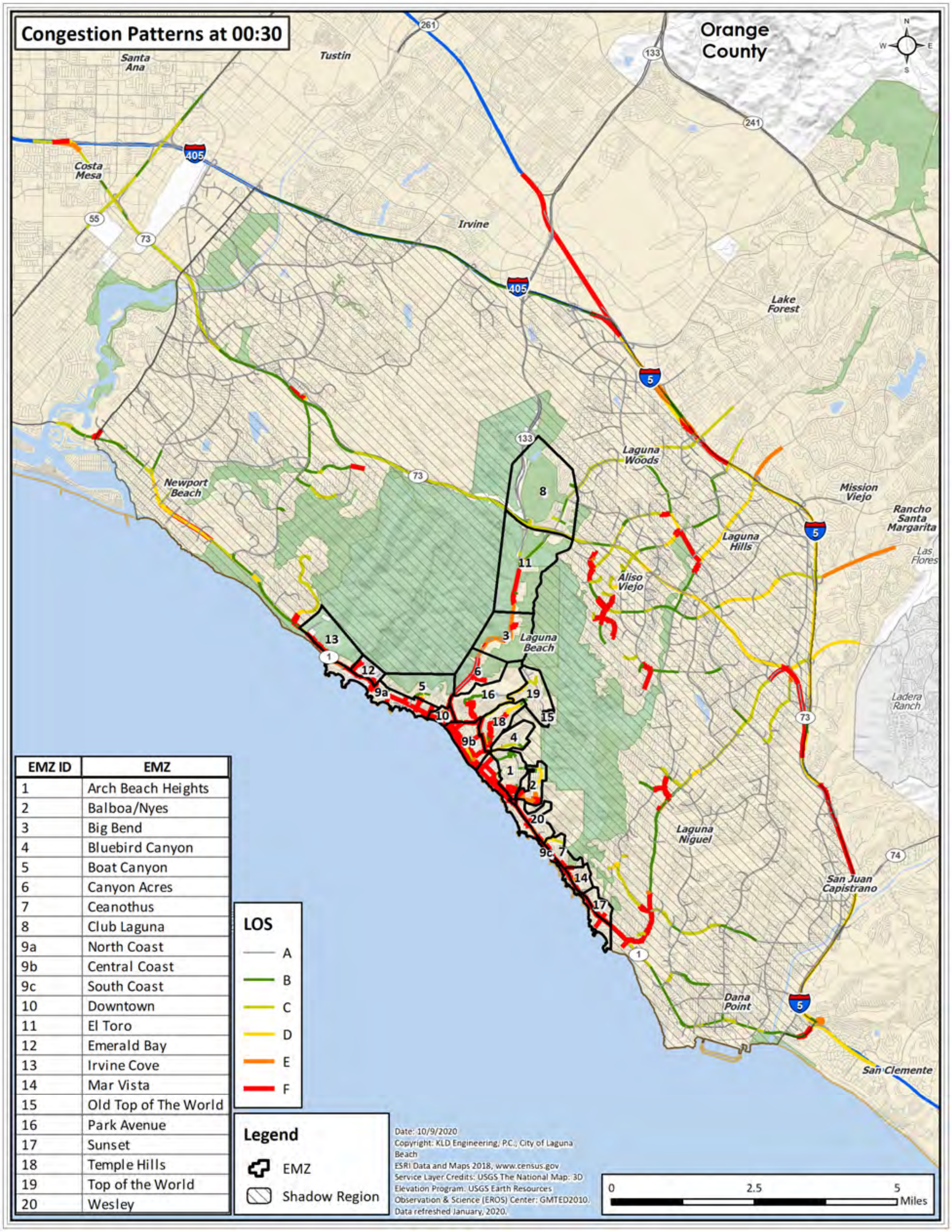


Figure 7-2. Congestion Patterns at 30 Minutes after the Advisory to Evacuate

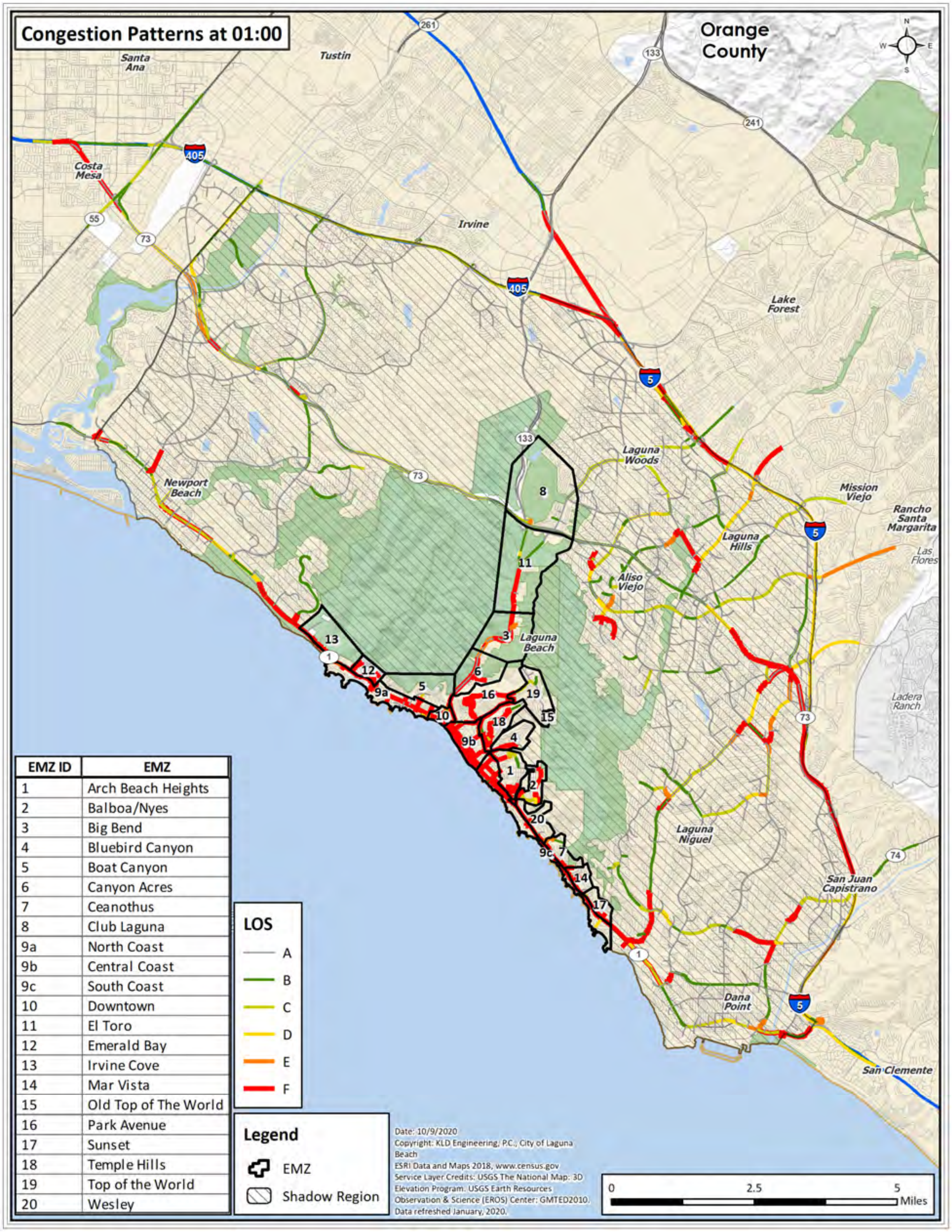


Figure 7-3. Congestion Patterns at 1 Hour after the Advisory to Evacuate

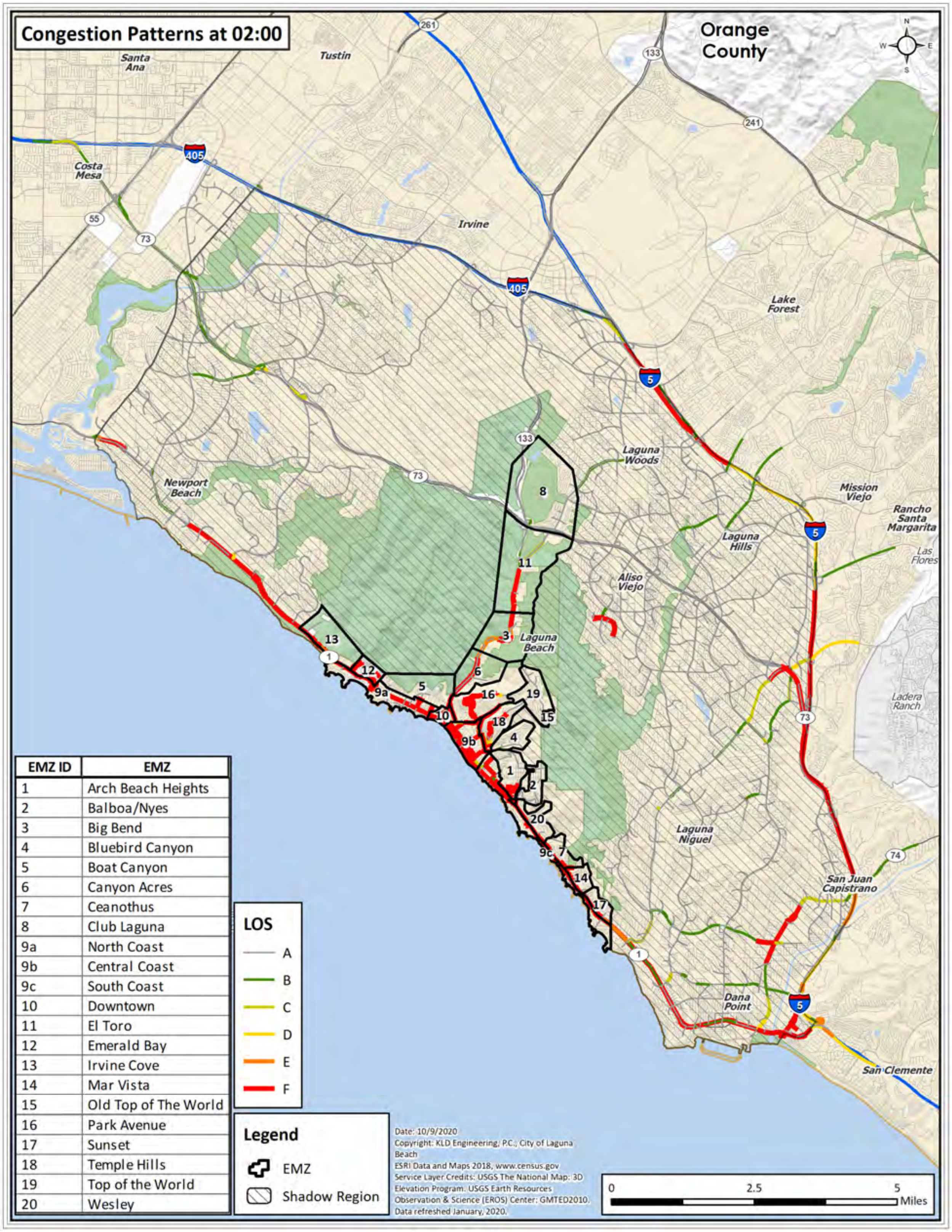


Figure 7-4. Congestion Patterns at 2 Hours after the Advisory to Evacuate

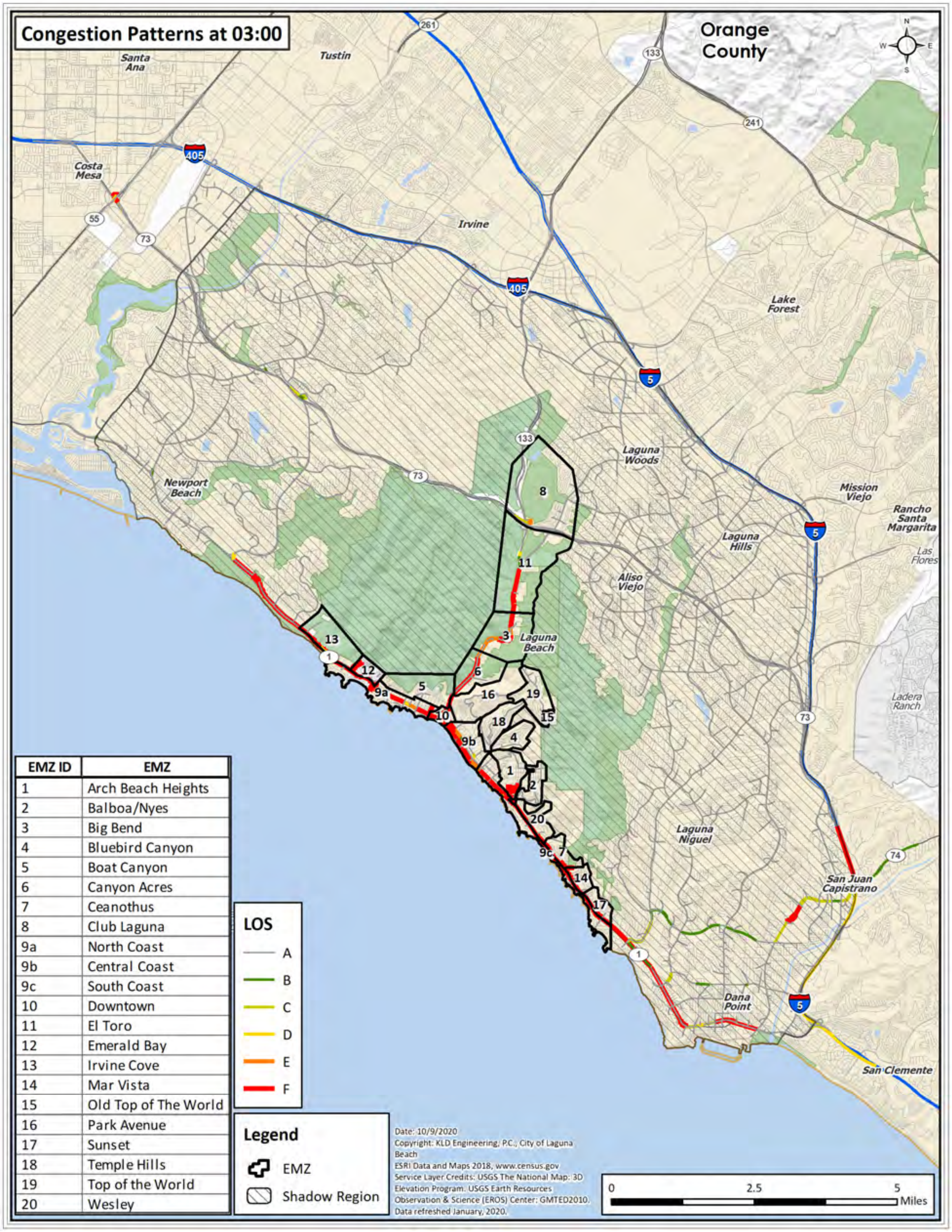


Figure 7-5. Congestion Patterns at 3 Hours after the Advisory to Evacuate

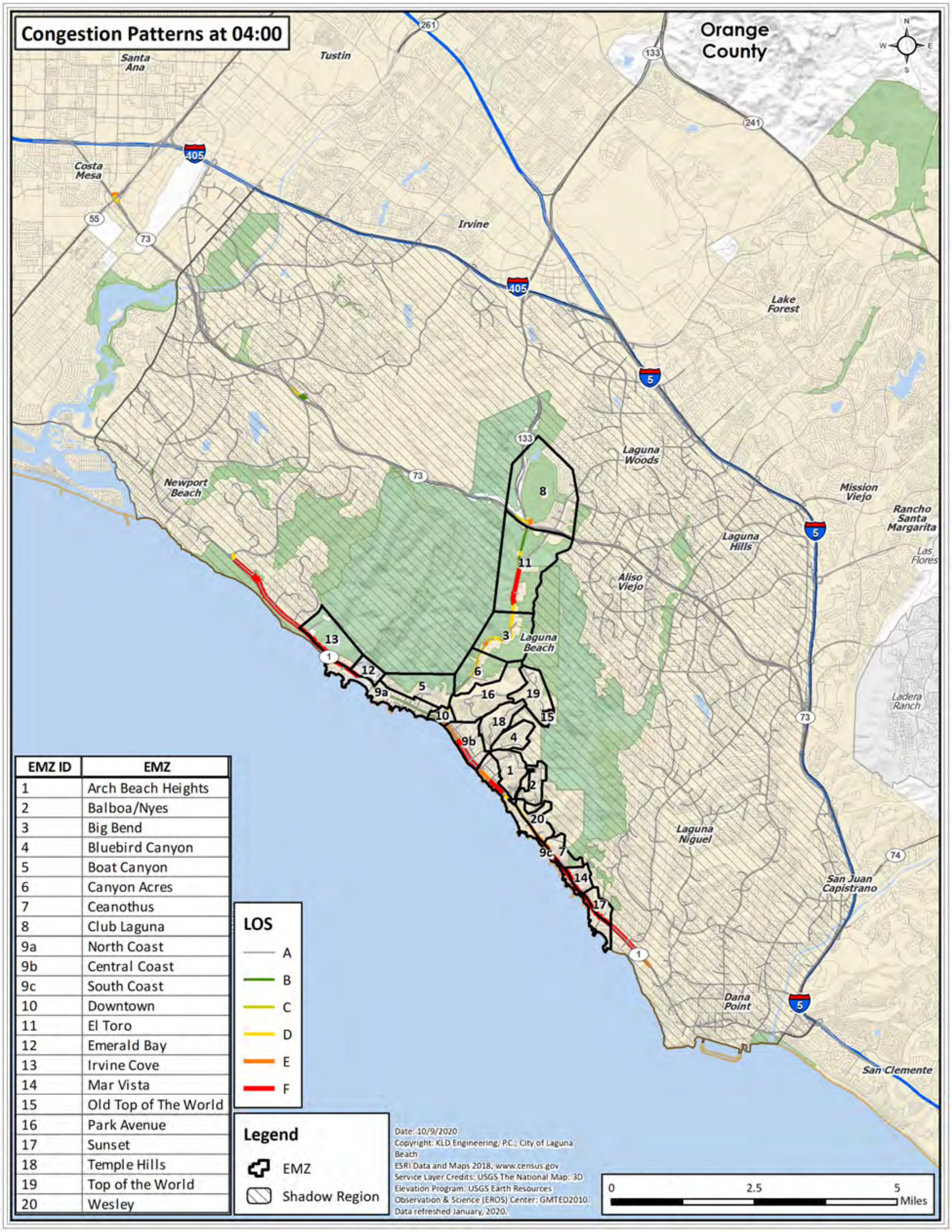


Figure 7-6. Congestion Patterns at 4 Hours after the Advisory to Evacuate

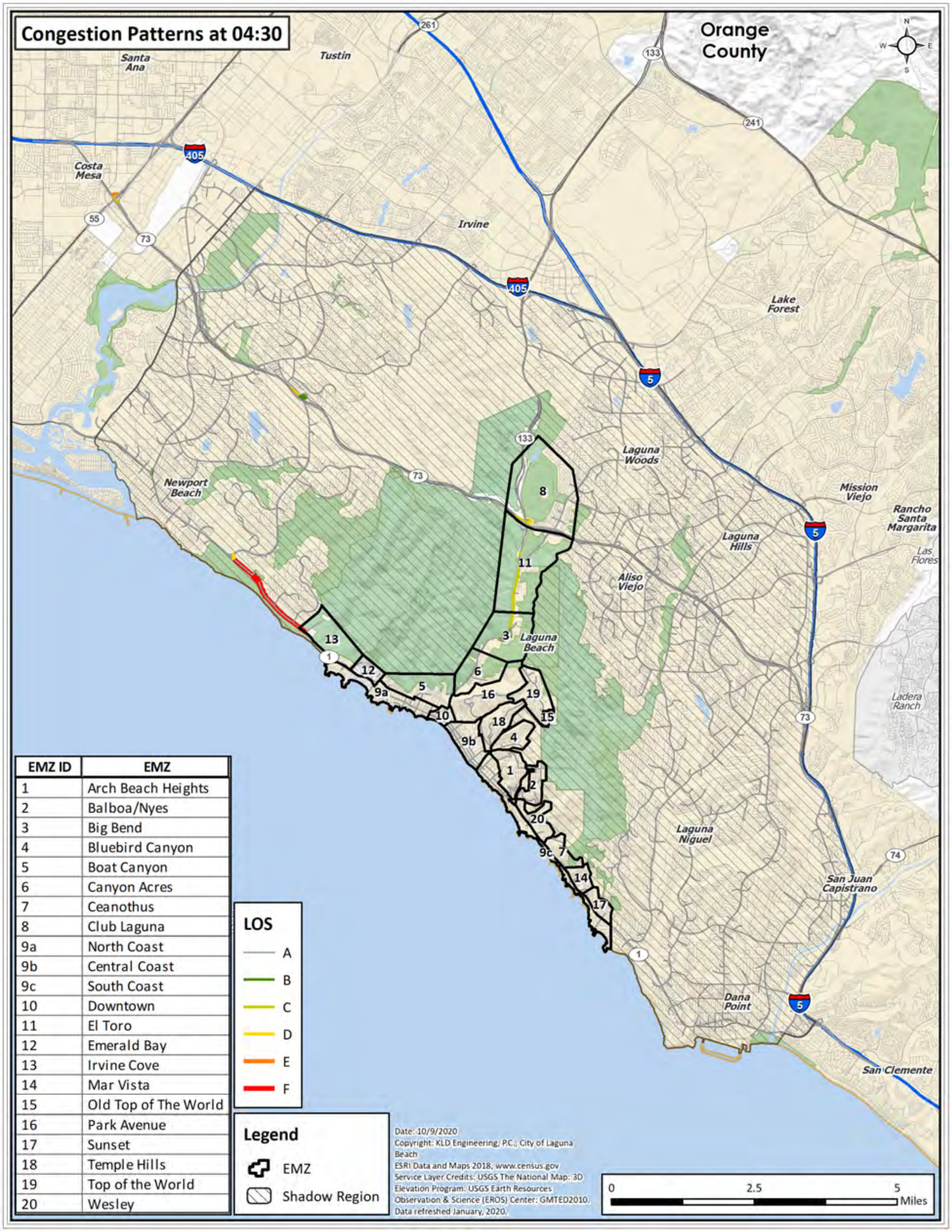


Figure 7-7. Congestion Patterns at 4 Hours and 30 Minutes after the Advisory to Evacuate

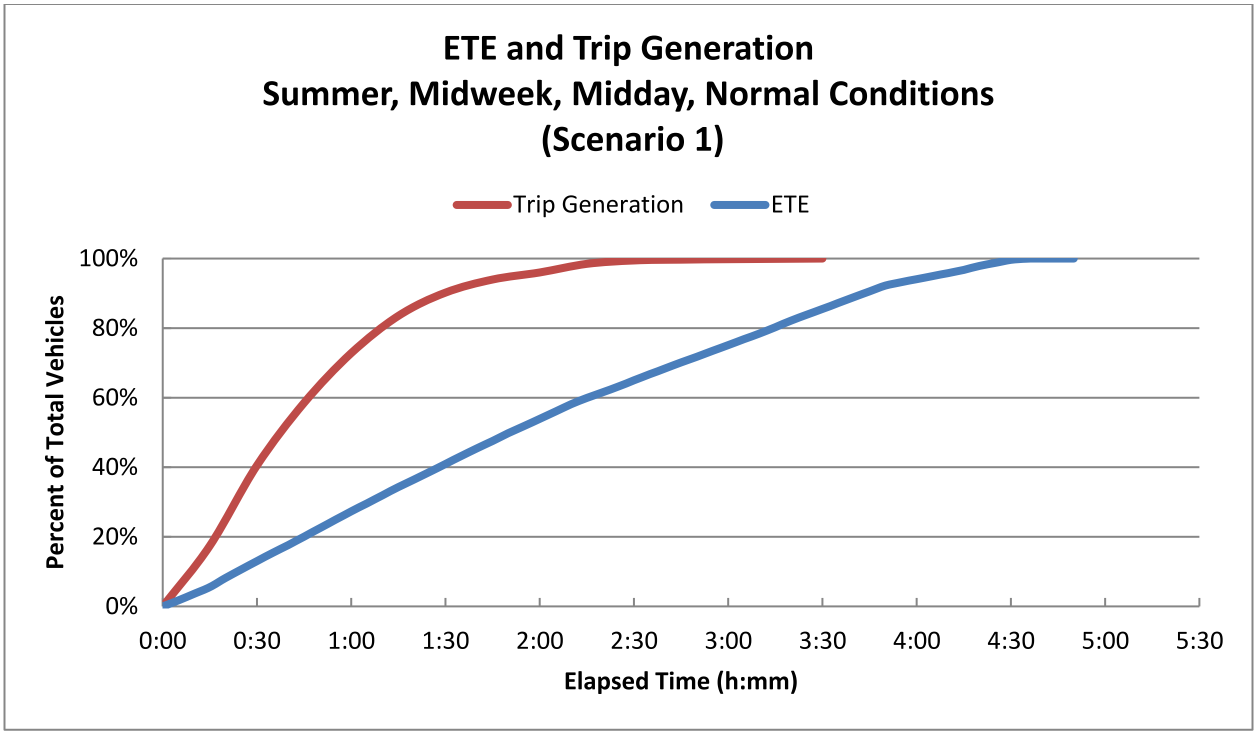


Figure 7-8. Evacuation Time Estimates - Scenario 1 for Region R28

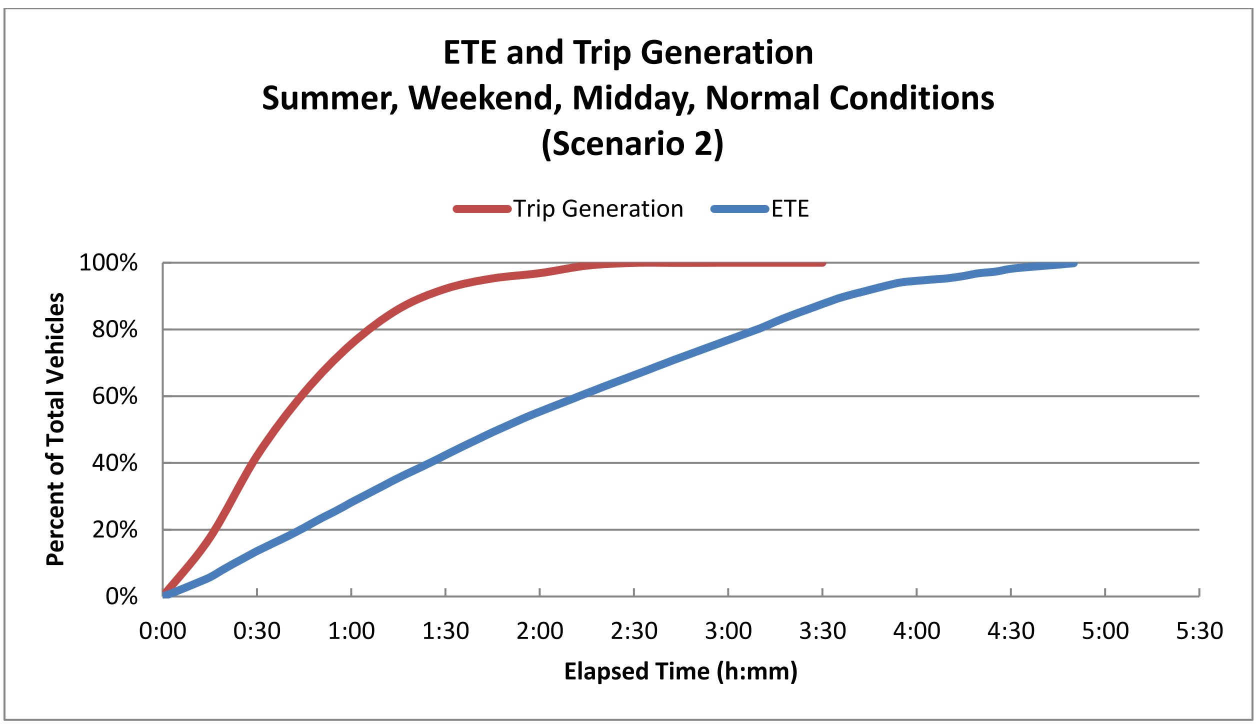


Figure 7-9. Evacuation Time Estimates - Scenario 2 for Region R28

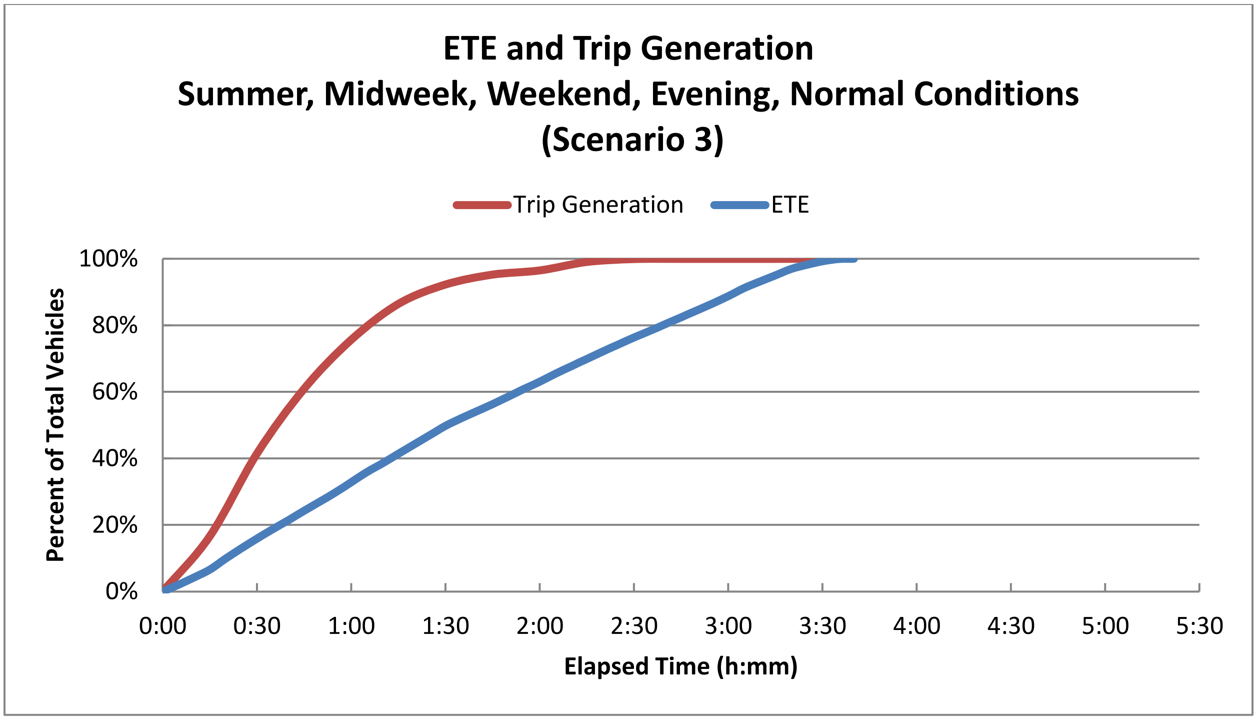


Figure 7-10. Evacuation Time Estimates - Scenario 3 for Region R28

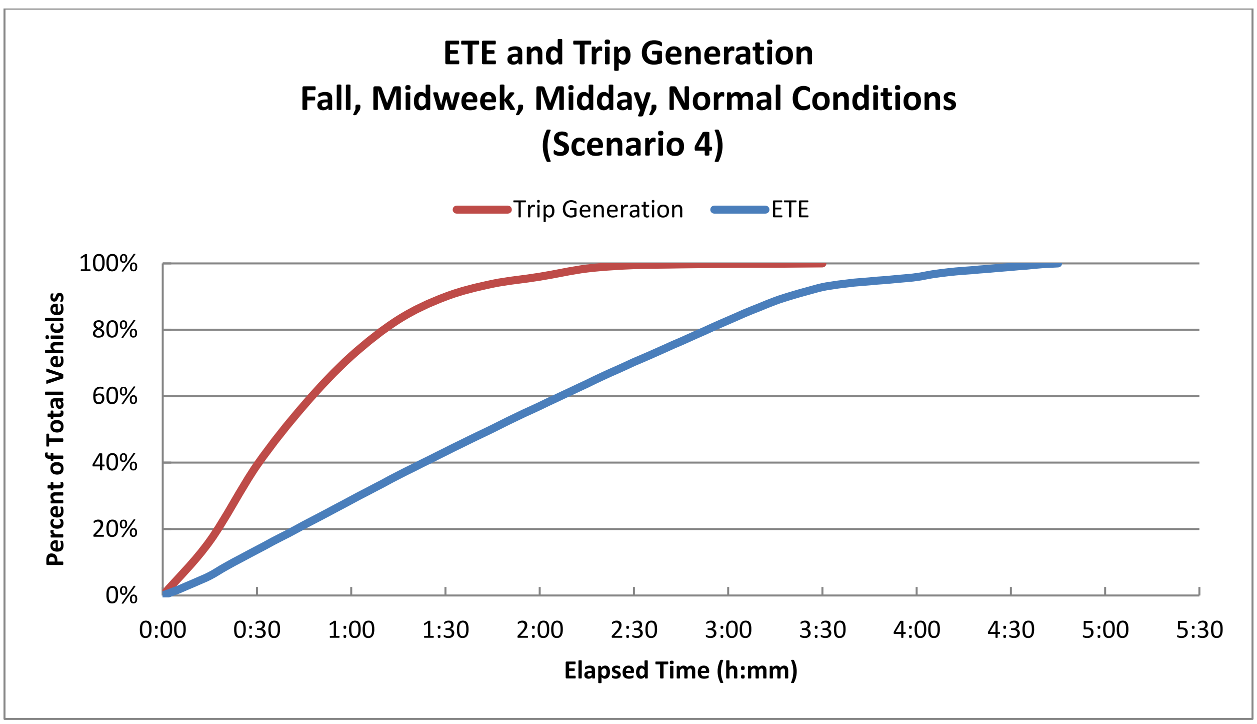


Figure 7-11. Evacuation Time Estimates - Scenario 4 for Region R28

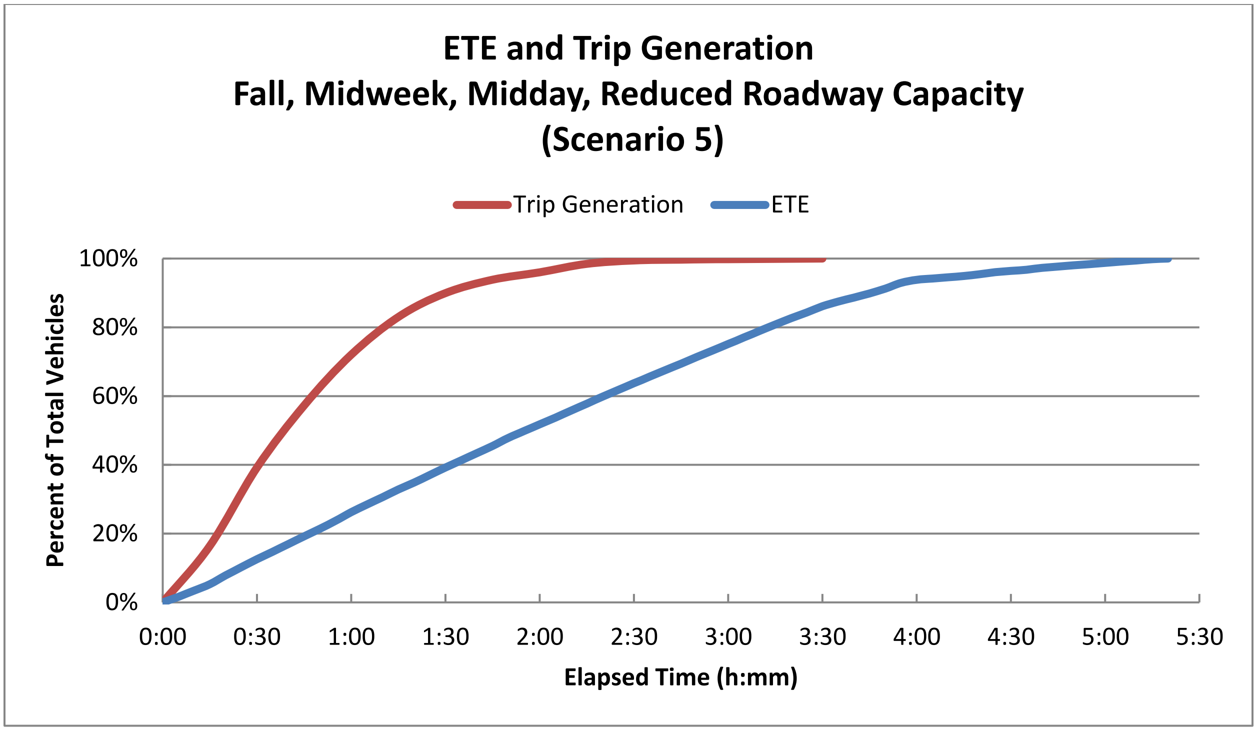


Figure 7-12. Evacuation Time Estimates - Scenario 5 for Region R28

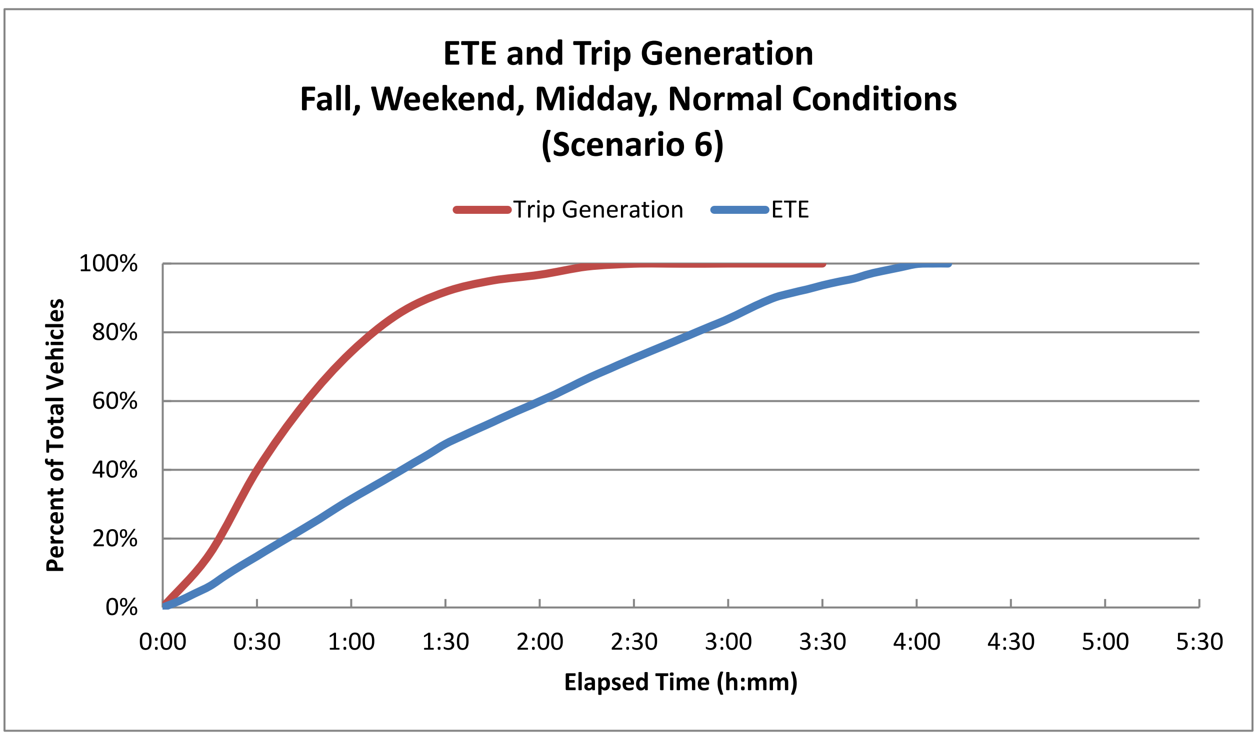


Figure 7-13. Evacuation Time Estimates - Scenario 6 for Region R28

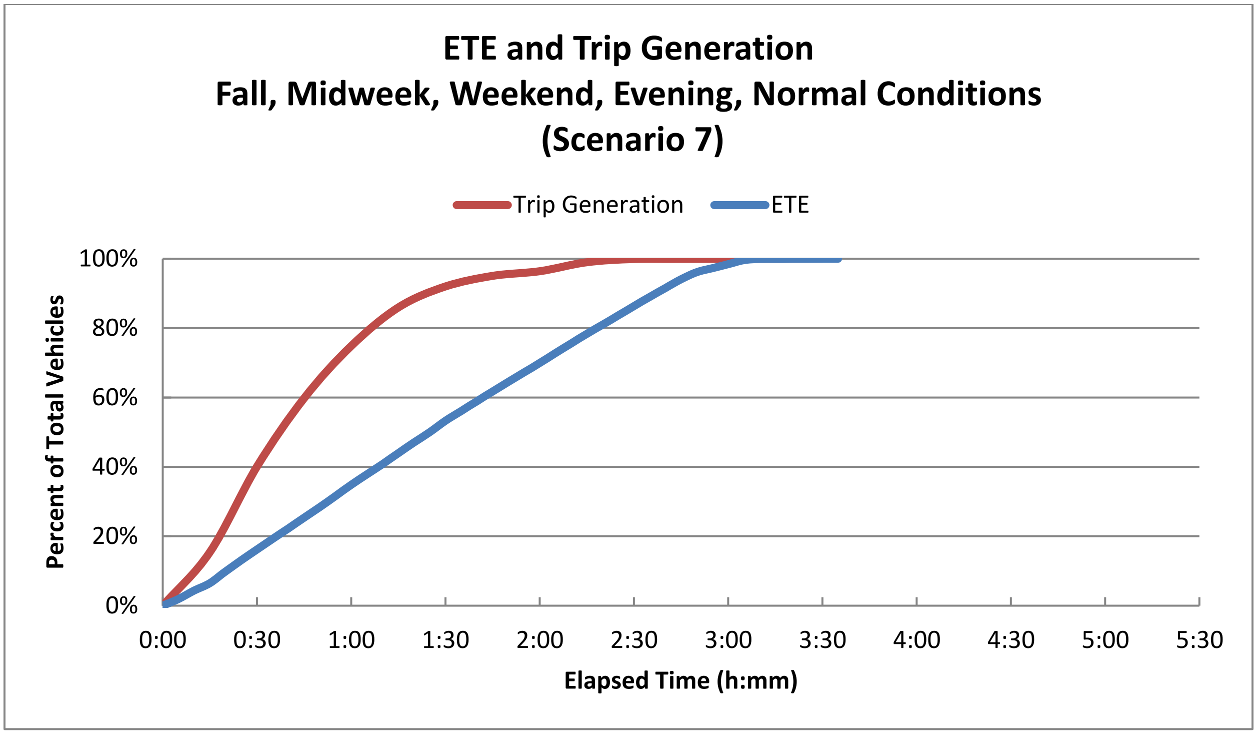


Figure 7-14. Evacuation Time Estimates - Scenario 7 for Region R28

8 ACCESS IMPAIRED NEIGHBORHOODS

This section details the analyses of access impaired neighborhoods within the City of Laguna Beach. Access impaired neighborhoods are areas within the city that could have difficulty evacuating during a wildfire emergency due to limited or narrow evacuation routes, traffic bottlenecks, extremely low traffic flow, etc. These neighborhoods are at a higher risk during an evacuation and should be given special consideration when planning for emergencies that require evacuation.

8.1 Preliminary Analysis

A preliminary analysis was conducted to first locate areas with clusters of households and limited ingress/egress. Using GIS software, Census blocks were overlaid with the EMZ boundaries to locate areas that have a cluster of households within the city limits. Those Census blocks with 350 households per square mile or more were selected. Next, these Census blocks were overlaid with aerial imagery and evacuation routes within the study area. Those Census blocks that had more than one route in/out were removed from the analysis. These areas were considered "Tier 1" and are shown in yellow in Figure 8-1.

Because a very large portion of the study area was identified as access impaired under the Tier 1 criteria, a second level of analysis was then conducted to consider the potential for the ingress/egress route to be blocked by fire. Roadways that were surrounded by fuel or wooded area, were considered to be at risk of being blocked by fire. Areas that fit this criteria were selected as "Tier 2" access impaired neighborhoods. Figure 8-1 displays "Tier 2" access impaired neighborhoods in pink.

This preliminary analysis and list of neighborhoods was discussed with members of the City of Laguna Beach during a project status meeting. Meeting attendees were able to further refine the list of access impaired neighborhoods based on their local knowledge of the area. Those communities that would not require any special precautions during a wildfire emergency were removed from the analysis.

8.2 Field Survey and Refined Analysis

Accompanied with personnel from the City of Laguna Beach Police Department (Laguna PD), KLD surveyed eleven neighborhoods identified as being access impaired in July 2020. Figure 8-2 displays the neighborhoods that were driven during the field survey. The areas that are shown with hatching were deemed access impaired after the survey. Below is a summary of the neighborhoods that were surveyed and noteworthy observations from the field survey.

1. Sunset & Panorama – roadway follows a winding path and is steep. There is fuel, but it's all landscaping on personal property. The fuel is not very tall. Fire would not block this road. There is a locked gate that connects to the Emerald Bay neighborhood (this neighborhood burned in the 1993 fire).

2. Dartmoor & Dunnegan – Dartmoor St is steeply uphill. The road is wide with street parking. All of the fuel is landscaping that is not overly tall. This road would be passable in a fire. Dunnegan Dr is very narrow and uphill with street parking on the left side of the road. The right side of the road is a park. There is fuel in the park, but it is rather sparse and it is not overly tall. This road would be passable in a fire. Also drove Windsor Pl, which is a narrow road. The right side of the road is the park and the fuel here is thicker, though still not very tall. It is a short road with only 6 houses. Residents should be able to get out in a fire.
3. **Canyon Acres Dr** – most of this neighborhood burned in the 1993 fire. There is a lot of fuel. The trees are very tall and are not landscaping. The road is extremely narrow. **This road would not be passable in a fire.**
4. Mystic & Skyline – skyline was recently redone. It is a very good road. It is very steep but not too narrow. Most of the fuel is landscaping and is not overly tall. Neither of these roads would be blocked in a fire.
5. Temple Hills Dr – wide lanes with a 4 foot shoulder for parking towards the top of this road (top of the hill). The road does narrow as you get closer to the water and it follows an increasingly winding path. This road would be passable during a fire
6. **Bluebird Canyon** – a **LOT** of fuel on this road. Goats are brought in to eat some of the brush on this road. The road is pretty good as it is wide with some street parking towards the top of the mountain. The road follows a winding path. There was a landslide along this road recently that destroyed several homes. The road becomes much narrower and follows a winding path as you travel downhill towards the coast. **This road would not be passable in a fire.**
7. Summit Dr – follows a winding path and similar to Lombard St in San Francisco. Very steep. Most of the fuel is landscaping. It is not overly narrow. This road would be passable in a fire.
8. Balboa Ave – good road. Fairly wide. This road would be passable in a fire.
9. Alta Vista – very narrow (street parking exacerbates the problem) and follows a winding path. Several hairpin turns along the road. It is not a good road but there is not much fuel along the road. This road would be passable in a fire.
10. West St – very narrow with a lot of street parking. Moderate amount of fuel. The road is not nearly as steep as some of the other roads we drove. This road would be passable in a fire.
11. **Diamond St and Crestview Dr** – extremely narrow and follows a winding path. Several hairpin turns. Big houses. Lots of landscaping. Lots of fuel (tall trees that have been there for probably hundreds of years). Laguna PD indicated that the fire department will not service this road as they cannot get their equipment up the hill given the roadway width. **This road would not be passable in a fire.**

Overall, Laguna PD indicated traffic volumes and tourist attendance was very light during the survey due to the COVID pandemic. Two additional comments were made:

1. Top of the World Elementary School – located at the end of Temple Hills Drive is a safe haven during fire. There is not a lot of fuel around the school. There is a lot of concrete and pavement around the school. The school has a sprinkler system in the building.
2. Fire road that connects Temple Hills Drive to Balboa Ave is a single paved lane in each direction. It has a secure gate on either end. It is not recommended to use this road as traffic along Balboa Ave would back up and people would be sitting in a queue on the fire road which is completely surrounded by fuel and would likely be covered in flames during a fire.

At the conclusion of the survey, three neighborhoods were deemed to be access impaired: Canyon Acres Drive, Bluebird Canyon, and Diamond Street & Crestview Drive, as shown in Figure 8-3. These neighborhoods share several characteristics in common: they are surrounded by wooded areas (fuel consisting of tall trees that can burn easily), ingress/egress routes are very narrow at sections (often only the width of a single car), and ingress/egress routes follow a winding path with hairpin turns in some sections. These neighborhoods would require early notification during a wildfire emergency as they would be unable to be evacuated if a fire were present.

8.3 ETE Results, Safe Refuge Areas, and Evacuation Signage

8.3.1 Canyon Acres Drive

Canyon Acres Drive clears at 2 hours and 45 minutes after the evacuation advisory during an evacuation of the entire city during a summer, midweek, midday, normal conditions scenario. According to the census data, there are 275 people who live in this neighborhood, and they would evacuate in 190 vehicles.

No safe refuge areas could be identified for this neighborhood. The furthest house is half a mile from SR-133. Assuming a walking speed of 3.5 feet per second (Section 2.3 Assumption 20), this would take approximately 13 minutes at most to walk to SR-133. In a dire situation, everyone could walk or run out of this neighborhood and flag down evacuees along SR-133 to rideshare out of the area.

Evacuation Route signage should be considered along SR-133 in the vicinity of this neighborhood to point evacuees in the right direction in an emergency.

8.3.2 Bluebird Canyon

Bluebird Canyon clears at 2 hours and 45 minutes after the evacuation advisory during an evacuation of the entire city during a summer, midweek, midday, normal conditions scenario. According to the census data, there are about 1,015 people who live in this neighborhood who would evacuate in approximately 700 vehicles.

The tennis court along Bluebird Canyon Drive can be considered as a safe refuge area. The location of the tennis court is shown in Figure 8-3. It is an open space with little flammable materials within the fenced in area. The pedestrian gate is open 24 hours a day, 7 days a week. Consideration should be given regarding placement of evacuation signage, in accordance with the MUTCD (see Section 11.3), along Bluebird Canyon Drive north of Cress St to guide evacuees out of this neighborhood.

8.3.3 Diamond Street and Crestview Drive

Diamond Street and Crestview Drive clears at 2 hours and 15 minutes after the evacuation advisory during an evacuation of the entire city during a summer, midweek, midday, normal conditions scenario According to the census data, there are about 140 people who live in this neighborhood who would evacuate in approximately 95 vehicles.

No safe refuge areas could be identified for this neighborhood. Diamond St has an unpaved connection to the north near 789 Diamond St and 829 Diamond St. This section of roadway is on private property and an agreement would be needed to open the gates during an emergency. For this reason, it cannot be incorporated into the City's emergency plans, but in reality, may likely be used by evacuees in dire situations.

Consideration should be given regarding placement of evacuation signage, in accordance with the MUTCD (see Section 11.3), along Diamond St to guide evacuees out of this neighborhood.

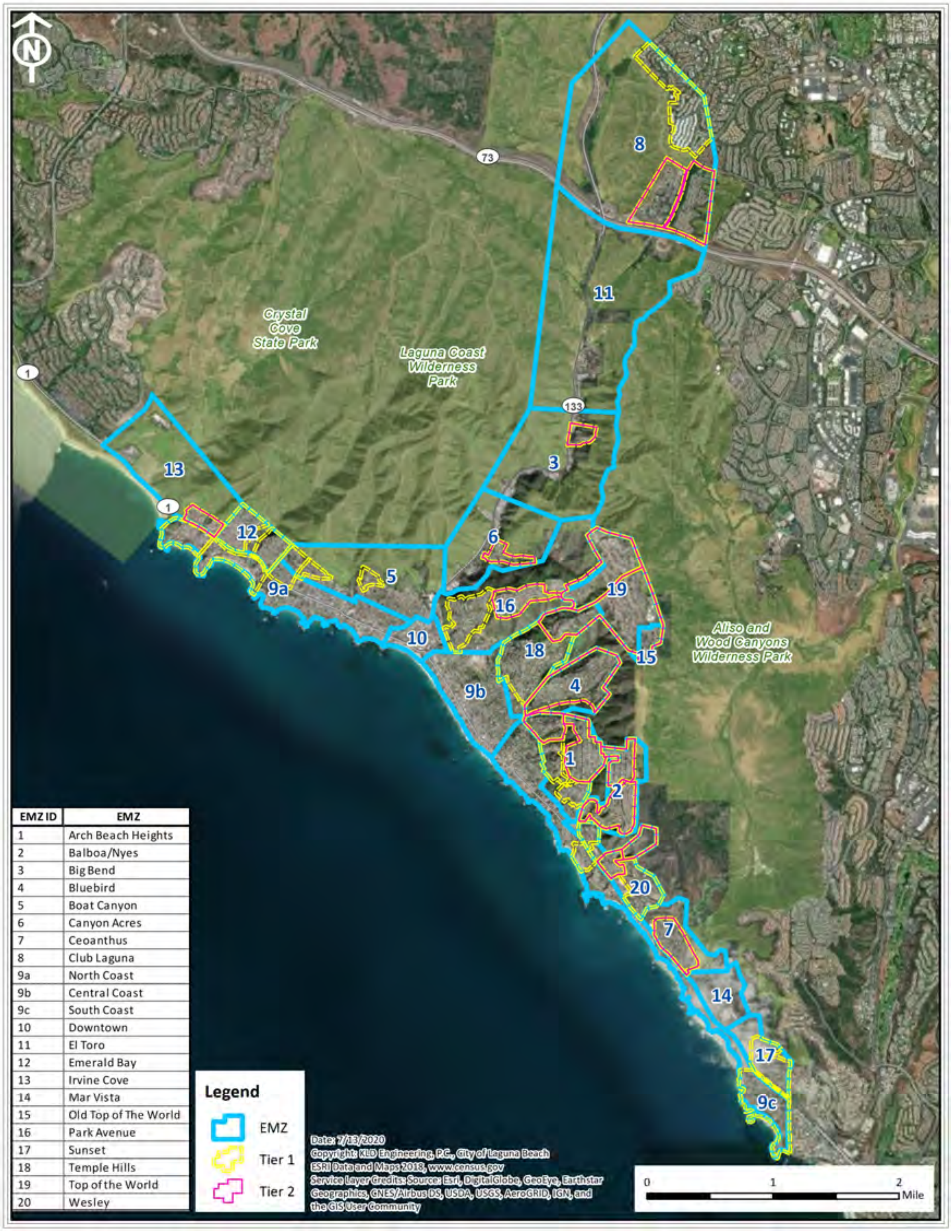
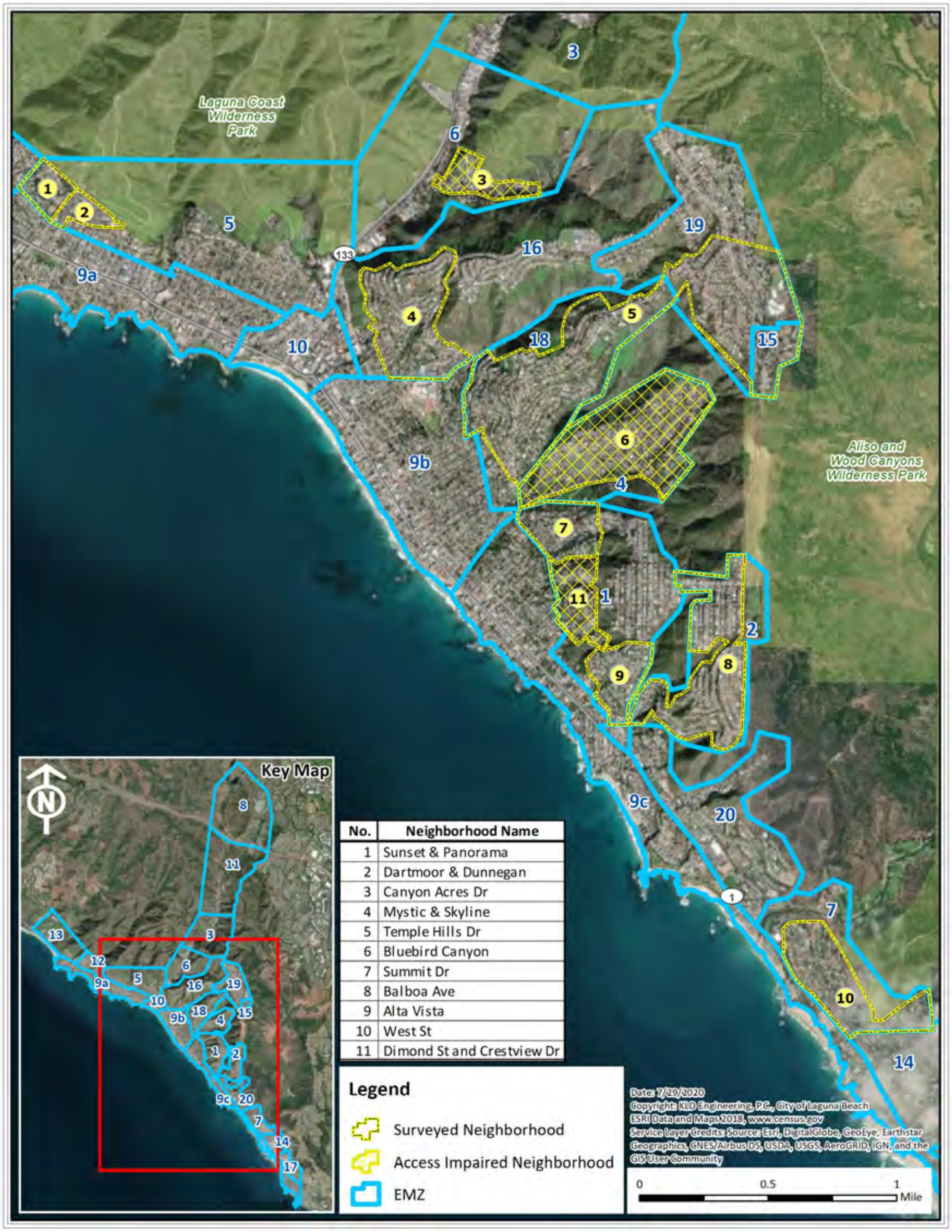


Figure 8-1. Access Impaired Neighborhoods – Preliminary Analysis



No.	Neighborhood Name
1	Sunset & Panorama
2	Dartmoor & Dunnegan
3	Canyon Acres Dr
4	Mystic & Skyline
5	Temple Hills Dr
6	Bluebird Canyon
7	Summit Dr
8	Balboa Ave
9	Alta Vista
10	West St
11	Dimond St and Crestview Dr

Figure 8-2. Access Impaired Neighborhoods – Refined Analysis

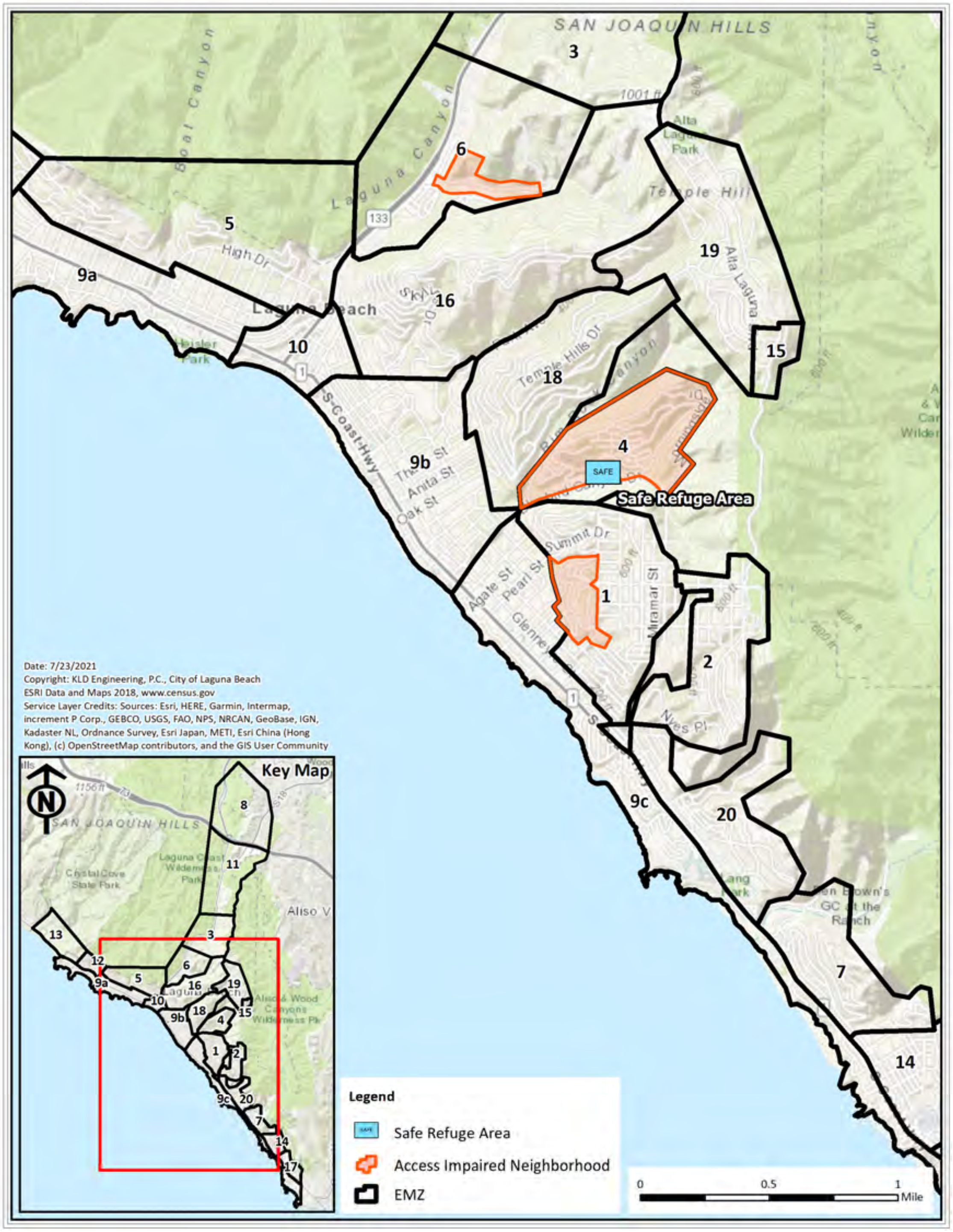


Figure 8-3. Access Impaired Neighborhoods – Final Analysis

9 TRANSIT-DEPENDENT AND SPECIAL FACILITY EVACUATION TIME ESTIMATES

This section details the analyses applied and the results obtained in the form of evacuation time estimates for transit vehicles. The demand for transit service reflects the needs of two population groups:

- residents with no vehicles available; and
- residents of special facilities such as schools and medical facilities.

These transit vehicles mix with the general evacuation traffic that is comprised mostly of "passenger cars" (pc's). The presence of each transit vehicle in the evacuating traffic stream is represented within the modeling paradigm described in Appendix D as equivalent to two pc's. This equivalence factor represents the longer size and more sluggish operating characteristics of a transit vehicle, relative to those of a pc.

Transit vehicles must be mobilized in preparation for their respective evacuation missions. Specifically:

- Bus/trolley drivers must be alerted
- They must travel to the depot
- They must be briefed there and assigned to a route or facility.

These activities consume time. Based on discussions with local stake holders, it is estimated that bus/trolley mobilization time will average approximately 60 minutes, 25 minutes, and 150 minutes extending from the advisory to evacuate to the time when buses first arrive schools, medical facilities, and transit dependent routes, respectively. See assumption 7 in Section 2.3. The City of Laguna Beach Evacuation Plan indicates a majority of the drivers for Laguna Beach Transit are part-time employees and may need to be called from home. It is assumed that these drivers could be contacted, travel to the depot, and briefed within the 150 minute mobilization time for transit dependent routes.

The location of bus/trolley depots impacts the time to travel from the depots to the facilities being evacuated. The City of Laguna Beach Evacuation Plan indicates buses and paratransit vehicles can be requested from Orange County Transit Authority (OCTA). OCTA vehicles will likely be coming from the Sand Canyon yard in Irvine (approximately 10 miles from downtown Laguna Beach). It is assumed the time to travel from these facilities is included in the mobilization time estimates provided by local stakeholders.

During this mobilization period, other mobilization activities are taking place. One of these is the action taken by parents, neighbors, relatives and friends to pick up children from school prior to the arrival of transit vehicles, so that they may join their families. Virtually all studies of evacuations have concluded that this "bonding" process of uniting families is universally prevalent during emergencies and should be anticipated in the planning process. As discussed in Section 2, this study assumes a rapidly escalating wildfire. However, local stakeholders have indicated that children will likely be picked up by parents or guardians at pre-schools and day cares prior to an evacuation. As such, it is assumed that children at pre-schools and day cares are picked up by parents or guardians prior to evacuation and that the time to perform this activity is included in the trip generation times discussed in Section 5. This report provides estimates of buses under the assumption that no children (in elementary, middle, and high schools) will be picked up by their parents, to present an upper bound estimate of buses required.

The procedure for computing transit dependent ETE is to:

- Estimate demand for transit service
- Estimate time to perform all transit functions
- Estimate route travel times out of the area at risk.

9.1 ETEs for Transit Dependent People

As discussed in Section 11, there are nine routes designed to service the transit dependent people residing in the EMZs. During an emergency, buses/trolleys that service these EMZs could be routed according to the routes designed by KLD. The buses or trolleys will start at a designated EMZ and then will be distributed to the congregation points identified in Section 11. If there is a shortfall of transportation resources, buses or trolleys should return to the EMZs after getting their initial passengers to safety. A "second wave" ETE was not considered for this study as no information was received as to where the transit dependent population will be taken in case of an emergency.

When school evacuation needs are satisfied, subsequent assignments of buses to service the transit-dependent population should be sensitive to their mobilization time. Clearly, the buses should be dispatched after people have completed their mobilization activities and are in a position to board the buses when they arrive along the bus transit route.

Evacuation Time Estimates for transit trips were developed using both normal and adverse weather/roadway conditions. Figure 9-1 presents the chronology of events relevant to transit operations. The elapsed time for each activity will now be discussed with reference to Figure 9-1.

Activity: Mobilize Drivers (A→B→C)

Mobilization is the elapsed time from the Advisory to Evacuate until the time the buses/trolleys arrive at the facility to be evacuated. It is assumed that for a rapidly escalating emergency with no observable indication before the fact, drivers would likely require 60, 25 and 150 minutes to be contacted, to travel to the depot, be briefed, and to travel to the transit-dependent facilities/route for schools, medical facilities, and transit dependent individuals, respectively.

Activity: Board Passengers (C→D)

A loading time of 15 minutes (25 minutes for adverse weather conditions) for school buses is used. Loading times of 1 minute, 5 minutes, and 30 minutes per patient are assumed for ambulatory patients, wheelchair bound patients, and bedridden patients, respectively.

For multiple stops along a pick-up route (transit-dependent routes) estimation of travel time must allow for the delay associated with stopping and starting at each pick-up point. The time, t, required for a bus or trolley to decelerate at a rate, "a", expressed in ft/sec/sec, from a speed, "v", expressed in ft/sec, to a stop, is $t = v/a$. Assuming the same acceleration rate and final speed following the stop yields a total time, T, to service boarding passengers:

$$T = t + B + t = B + 2t = B + \frac{2v}{a},$$

Where B = Dwell time to service passengers. The total distance, "s" in feet, travelled during the deceleration and acceleration activities is: $s = v^2/a$. If the bus or trolley had not stopped to service passengers, but had continued to travel at speed, v, then its travel time over the distance, s, would be: s/v = v/a. Then the total delay (i.e. pickup time, P) to service passengers is:

$$P = T - \frac{v}{a} = B + \frac{v}{a}$$

Assigning reasonable estimates:

- B = 50 seconds: a generous value for a single passenger, carrying personal items, to board per stop
- v = 25 mph = 37 ft/sec
- a = 4 ft/sec/sec, a moderate average rate

Then, P ≈ 1 minute per stop. Allowing 30 minutes pick-up time per bus/trolley run implies 30 stops per run, for normal conditions. It is assumed that bus and trolley acceleration and speed are less in an adverse weather/reduced capacity scenario; total loading time is 40 minutes per bus in adverse weather/reduced capacity conditions.

Activity: Travel to EMZ Boundaries (D→E)

Transportation resources available was provided by the city emergency management personnel. Table 9-1 summarizes the information received. Also included in the table are the number of transit vehicles needed to evacuate schools, medical facilities, and transit-dependent population. Orange County Transit Authority (OCTA) was not included in the table based on discussions with emergency management personnel. **These numbers indicate there are not sufficient resources available to evacuate everyone (or even just schools) in a single wave.** There are two ways to handle this shortfall of transportation resources: (1) the same vehicles are used multiple times; passengers are picked up and dropped off outside of the area at risk. The vehicle then returns to the City to pick up additional passengers. (2) Memorandums of Understanding (MOUs) or Mutual Aid Agreements are established with neighboring cities or with the State to provide additional transportation resources to assist with evacuation.

School Evacuation

The buses servicing the schools are ready to begin their evacuation trips at 75 minutes after the advisory to evacuate – 60 minutes mobilization time plus 15 minutes loading time – in normal conditions. The UNITES software, discussed in Section 1.3, was used to define bus routes along the most likely path from a school being evacuated to the evacuation boundary. This is done in UNITES by interactively selecting the series of nodes from the school to the EMZ boundary. Each bus route is given an identification number and is written to the DYNEV II input stream. DYNEV computes the route length and outputs the average speed for each 5-minute interval, for each bus route. The specified bus routes are documented in Table 11-2 (refer to the maps of the link-node analysis network in Appendix H for node locations). Data provided by DYNEV during the appropriate timeframe depending on the mobilization and loading times (i.e., 75 minutes after the advisory to evacuate for normal conditions) were used to compute the average speed for each route, as follows:

$$Average\ Speed\ \left(\frac{mi.}{hr}\right) = \left[\frac{\sum_{i=1}^{n} length\ of\ link\ i\ (mi)}{\sum_{i=1}^{n}\left\{Delay\ on\ link\ i\ (min.) + \frac{length\ of\ link\ i\ (mi.)}{current\ speed\ on\ link\ i\ \left(\frac{mi.}{hr.}\right)} \times \frac{60\ min.}{1\ hr.}\right\}}\right] \times \frac{60\ min.}{1\ hr.}$$

The average speed computed (using this methodology) for the buses servicing each of the schools in the EMZs are shown in Table 9-2 and Table 9-3 for school evacuations under normal conditions and reduced roadway capacity conditions, respectively, and in Table 9-4 and Table 9-5 for the transit vehicles evacuating transit-dependent persons under normal conditions and reduced roadway capacity conditions, respectively, which are discussed later. The travel time to the boundary of the EMZ was computed for each bus using the computed average speed and the distance to the boundary along the most likely route out. The maximum bus speed limit within the study area was assumed to be 55 mph.

Table 9-2 (normal conditions) and Table 9-3 (reduced roadway capacity) present the evacuation time estimates (rounded up to the nearest 5 minutes) for schools in the EMZs. The evacuation time out of the EMZs can be computed as the sum of times associated with Activities A→B→C, C→D, and D→E (For example: 60 min. + 15 + 62 = 2:17 (2:20 round up to the nearest 5 minutes) for Laguna Beach High School under normal conditions).

<u>Evacuation of Transit-Dependent Population</u>

The buses (or trolleys) dispatched from the depots to service the transit-dependent evacuees will be scheduled so that they arrive at their respective routes after their passengers have completed their mobilization. As shown in Figure 5-8 (Residents with no Commuters), nearly all evacuees will complete their mobilization when the buses or trolleys will begin their routes at 150 minutes after the evacuation advisory. Mobilization time is 10 minutes longer in adverse weather/roadway conditions to account for slower travel speeds and reduced roadway capacity.

Those buses or trolleys servicing the transit-dependent evacuees will first travel through the EMZs, then proceed out of the area at risk. It is assumed that residents will walk to and congregate along the roadways these routes traverse or at the congregation points described in Section 11.2, and that they can arrive at the stops within 150 minutes after the evacuation advisory (160 minutes in adverse weather/reduced capacity conditions).

As previously discussed, a pickup time of 30 minutes (normal conditions) is estimated for 30 individual stops to pick up passengers, with an average of one minute of delay associated with each stop. A 40-minute pickup time is estimated for the adverse weather/reduced roadway capacity scenario.

The travel distance along the respective pick-up routes within the EMZs is estimated using the UNITES software. Transit vehicle travel times within the EMZs are computed using average speeds computed by DYNEV, using the aforementioned methodology that was used for school evacuation.

Table 9-4 and Table 9-5 present the transit-dependent population evacuation time estimates for each route calculated using the above procedures for normal conditions and reduced roadway capacity, respectively.

For example, the ETE for the transit vehicle on the route servicing Arch Beach Heights and Balboa Nyes is computed as 150 + 26 + 30 = 3:30 for normal conditions (rounded up to nearest 5 minutes). Here, 26 minutes is the time to travel 5.5 miles at 12.9 mph, the average speed output by the model for this route at 150 minutes.

<u>Evacuation of Medical Facilities</u>

The transit vehicle operations for this group are similar to those for school evacuation except:

- Buses are assigned on the basis of 30 patients to allow for staff to accompany the patients.
- Basic Life Support (BLS) (ambulances) can hold 2 patient per ambulance.
- Wheelchair transport vehicles can accommodate 15 patients per wheelchair bus

Table 3-7 indicates that 8 bus runs, 4 wheelchair bus runs, and 8 ambulance runs are needed to service the fourteen medical facilities within the EMZs.

It is estimated that mobilization time averages 25 minutes. Specially trained medical support staff (working their regular shift) will be on site to assist in the evacuation of patients.

Table 9-6 and Table 9-7 summarize the ETE for medical facilities within the EMZs for normal and adverse conditions, respectively. The distance from each medical facility to the boundary of the EMZs was measured using GIS software and is provided in Table 9-6 and Table 9-7 (Dist. to EMZ Bdry). Average speeds output by the DYNEV model for Scenario 4 (Scenario 5 for adverse weather/reduced roadway capacity) Region R28, capped at 55 mph (50 mph for adverse weather/roadway conditions), are used to compute travel time out of the area at risk. The travel time out of the area at risk (Travel Time to Safety) is computed by dividing the travel distance by the average travel speed. The ETE is the sum of the mobilization time, total passenger loading time, and travel time to safety. Concurrent loading on multiple buses, wheelchair buses, and ambulances at capacity is assumed. All ETE are rounded to the nearest 5 minutes. For example, the calculation of ETE for Providence Mission Hospital Laguna Beach's ambulatory patients during normal conditions is:

ETE: 25 + 30 (1-minute loading time per patient on multiple buses) + 10 = 65 min. or 1:05 rounded to the nearest 5 minutes.

Table 9-1. Summary of Transportation Needs and Resources

Transportation Resource	Buses	Trolleys	Wheelchair Buses	Ambulances
Resources Available				
Laguna Beach Transit	6	25-17[1]	0	0
LBUSD	11	0	0	0
Providence Mission Hospital Laguna Beach	1	0	1	2
Vista Aliso	0	0	1	1
Anneliese's Schools - Willowbrook	1	0	0	0
TOTAL:	**19**	**25-17**	**2**	**3**
Resources Needed				
Medical Facilities (Table 3-7):	8	0	4	8
Schools (Table 3-10):	55	0	0	0
Transit-Dependent Population (Table 11-1):	9		0	0
TOTAL TRANSPORTATION NEEDS:	**72**		**4**	**8**

Note: According to page 17 of the City of Laguna Beach Evacuation Plan, Buses and paratransit vehicles can be requested via OCTA Central Communications at (714) 530-6060. Details on any special needs and how many individuals need transportation must be provided. Vehicles will most likely be coming from the Sand Canyon yard in Irvine.

[1] In July and August, 25 trolleys are available. Seventeen trolleys are available September through June.

Table 9-2. School Evacuation Time Estimates – Normal Conditions

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To Safety (mi)	Average Speed (mph)	Travel Time to Safety (min)	ETE (hr:min)
Laguna Beach, CA						
Laguna College of Art and Design - Big Bend Campus	60	15	2.8	15.0	12	**1:30**
Laguna College of Art and Design - Main Campus	60	15	3.2	15.4	13	**1:30**
Laguna College of Art and Design - South Campus	60	15	4.0	11.9	21	**1:40**
Laguna Beach High School	60	15	5.3	5.2	62	**2:20**
El Morro Elementary School	60	15	0.3	36.8	1	**1:20**
Top of the World Elementary School	60	15	6.9	6.0	70	**2:25**
Thurston Middle School	60	15	6.1	5.0	73	**2:30**
Heidi's Pre-School	60	15	1.2	8.9	9	**1:25**
					Maximum ETE:	**2:30**
					Average ETE:	**1:50**

Table 9-3. School Evacuation Time Estimates – Reduced Roadway Capacity

School	Driver Mobilization Time (min)	Loading Time (min)	Dist. To Safety (mi)	Average Speed (mph)	Travel Time to Safety (min)	ETE (hr:min)
Laguna Beach, CA						
Laguna College of Art and Design - Big Bend Campus	70	25	2.8	13.2	13	**1:50**
Laguna College of Art and Design - Main Campus	70	25	3.2	12.6	16	**1:55**
Laguna College of Art and Design - South Campus	70	25	4.0	11.4	21	**2:00**
Laguna Beach High School	70	25	5.3	4.9	65	**2:40**
El Morro Elementary School	70	25	0.3	37.0	1	**1:40**
Top of the World Elementary School	70	25	6.9	6.2	68	**2:45**
Thurston Middle School	70	25	6.1	5.0	73	**2:50**
Heidi's Pre-School	70	25	1.2	7.9	10	**1:45**
Maximum ETE:						**2:50**
Average ETE:						**2:10**

Table 9-4. Transit-Dependent Evacuation Time Estimates - Normal Conditions

Route Number	Route	Number of Buses/Trolleys	Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
1	**Servicing Irvine Cove, Emerald Bay & Boat Canyon**	1	150	3.6	15.5	12	30	**3:15**
2	**Servicing El Toro, Canyon Acres & Big Bend**	1	150	3.8	13.5	17	30	**3:20**
3	**Servicing Club Laguna**	1	150	0.8	27.8	2	30	**3:05**
4	**Servicing Downtown & North Coast**	1	150	3.4	16.4	13	30	**3:15**
5	**Servicing Mar Vista & Ceanothus**	1	150	1.9	5.8	20	30	**3:20**
6	**Servicing Arch Beach Heights & Balboa Nyes**	1	150	5.5	12.9	26	30	**3:30**
7	**Servicing Bluebird Canyon & South Coast**	1	150	5.4	13.0	26	30	**3:30**
8	**Servicing Central Coast & Temple Hills**	1	150	6.2	12.5	30	30	**3:30**
9	**Servicing Wesley, Top of the World, Old Top of the World, Sunset & Park Avenue**	1	150	7.2	13.0	34	30	**3:35**
							Maximum ETE:	**3:35**
							Average ETE:	**3:25**

Table 9-5. Transit-Dependent Evacuation Time Estimates – Reduced Roadway Capacity

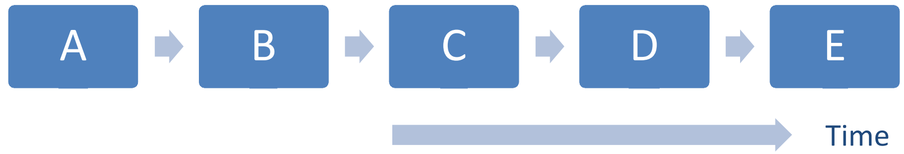
Route Number	Route	Number of Buses/Trolleys	Mobilization (min)	Route Length (miles)	Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE (hr:min)
1	**Servicing Irvine Cove, Emerald Bay & Boat Canyon**	1	160	3.6	11.0	17	40	**3:40**
2	**Servicing El Toro, Canyon Acres & Big Bend**	1	160	3.8	11.4	21	40	**3:45**
3	**Servicing Club Laguna**	1	160	0.8	10.6	5	40	**3:25**
4	**Servicing Downtown & North Coast**	1	160	3.4	11.9	17	40	**3:40**
5	**Servicing Mar Vista & Ceanothus**	1	160	1.9	10.9	11	40	**3:35**
6	**Servicing Arch Beach Heights & Balboa Nyes**	1	160	5.5	11.1	30	40	**3:50**
7	**Servicing Bluebird Canyon & South Coast**	1	160	5.4	10.8	31	40	**3:55**
8	**Servicing Central Coast & Temple Hills**	1	160	6.2	11.1	34	40	**3:55**
9	**Servicing Wesley, Top of the World, Old Top of the World, Sunset & Park Avenue**	1	160	7.2	11.1	40	40	**4:00**
							Maximum ETE:	**4:00**
							Average ETE:	**3:45**

Table 9-6. Special Facility Evacuation Time Estimates - Normal Conditions

Medical Facility	Patient	Mobilization (min)	Loading Rate (min per person)	People	Total Loading Time (min)	Dist. To EMZ Bdry (mi)	Speed (mph)	Travel Time to Safety (min)	ETE (hr:min)
Providence Mission Hospital Laguna Beach	Ambulatory	25	1	37	30	1.4	8.4	10	**1:05**
	Wheelchair Bound	25	5	30	75	1.4	10.8	8	**1:50**
	Bedridden	25	30	8	60	1.4	9.6	8	**1:35**
Vista Aliso	Ambulatory	25	1	37	30	2.7	6.9	23	**1:20**
	Wheelchair Bound	25	5	30	75	2.7	10.7	15	**1:55**
	Bedridden	25	30	8	60	2.7	9.4	17	**1:45**
Spencer Recovery Centers, Coast to Coast Referral Center, Pillars Recover (28772 Top of the World Dr), Oceanfront Recovery (2575 Temple Hills Dr) & Oceanfront Recovery (2808 Zell Dr)	Ambulatory	25	1	30	30	4.3	5.0	52	**1:50**
Sunshine Behavioral Health, Laguna View Center, Complete Resurgency & Oceanfront Recovery (431 Nyes Pl)	Ambulatory	25	1	30	30	3.5	5.4	39	**1:35**
Miramar Health & Pillars Recovery LLC (224 Cliff Dr)	Ambulatory	25	1	16	16	3.1	9.4	20	**1:05**
								Maximum ETE:	**1:55**
								Average ETE:	**1:35**

Table 9-7. Special Facility Evacuation Time Estimates – Reduced Roadway Capacity

Medical Facility	Patient	Mobilization (min)	Loading Rate (min per person)	People	Total Loading Time (min)	Dist. To EMZ Bdry (mi)	Speed (mph)	Travel Time to Safety (min)	ETE (hr:min)
Providence Mission Hospital Laguna Beach	Ambulatory	35	1	37	30	1.4	8.7	9	**1:15**
	Wheelchair Bound	35	5	30	75	1.4	13.6	6	**2:00**
	Bedridden	35	30	8	60	1.4	9.0	9	**1:45**
Vista Aliso	Ambulatory	35	1	37	30	2.7	6.6	24	**1:30**
	Wheelchair Bound	35	5	30	75	2.7	10.0	16	**2:10**
	Bedridden	35	30	8	60	2.7	9.2	17	**1:55**
Spencer Recovery Centers, Coast to Coast Referral Center, Pillars Recover (28772 Top of the World Dr), Oceanfront Recovery (2575 Temple Hills Dr) & Oceanfront Recovery (2808 Zell Dr)	Ambulatory	35	1	30	30	4.3	4.9	53	**2:00**
Sunshine Behavioral Health, Laguna View Center, Complete Resurgency & Oceanfront Recovery (431 Nyes Pl)	Ambulatory	35	1	30	30	3.5	5.4	39	**1:45**
Miramar Health & Pillars Recovery LLC (224 Cliff Dr)	Ambulatory	35	1	16	16	3.1	7.3	26	**1:20**
								Maximum ETE:	**2:10**
								Average ETE:	**1:45**



Event	
A	Advisory to Evacuate
B	Bus/Trolley Dispatched from Depot
C	Bus/Trolley Arrives at Facility/Pick-up Route
D	Bus/Trolley Departs Facility/Pick-up Route
E	Bus/Trolley Exits Area at Risk
Activity	
A→B	Driver Mobilization
B→C	Travel to Facility or to Pick-up Route
C→D	Passengers Board the Bus/Trolley
D→E	Bus/Trolley Travels Toward At-Risk Area Boundary

Figure 9-1. Chronology of Transit Evacuation Operations

10 TRAFFIC MANAGEMENT STRATEGY

This section discusses the suggested Traffic Management Plan (TMP) that is designed to expedite the movement of evacuating traffic. The resources required to implement this strategy include:

- Personnel with the capabilities of performing the planned control functions of traffic guides (preferably, not necessarily, law enforcement officers).
- Guidance is provided by the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration (FHWA) of the U.S.D.O.T. All state and most county transportation agencies have access to the MUTCD, which is available on-line: http://mutcd.fhwa.dot.gov which provides access to the official PDF version.
- A written plan that defines all Traffic Control Point (TCP) and Access Control Point (ACP) locations, provides necessary details and is documented in a format that is readily understood by those assigned to perform traffic control.

The functions to be performed in the field are:

1. Facilitate evacuating traffic movements that safely expedite travel out of the area at risk.
2. Discourage traffic movements that move evacuating vehicles in a direction which takes them significantly closer to the area of risk, or which interferes with the efficient flow of other evacuees.

The terms "facilitate" and "discourage" are employed rather than "enforce" and "prohibit" to indicate the need for flexibility in performing the traffic control function. There are always legitimate reasons for a driver to prefer a direction other than that indicated.

For example:

- A driver may be traveling home from work or from another location, to join other family members prior to evacuating.
- An evacuating driver may be travelling to pick up a relative, or other evacuees.
- The driver may be an emergency worker en route to perform an important activity.

ACPs are established during the evacuation to stop the flow of external traffic through the study area. Doing so reserves the capacity on major through routes for evacuees rather than the traffic that is passing through the area.

The implementation of a TMP must also be flexible enough for the application of sound judgment by the traffic guide.

The TMP for this study is the outcome of the following process:

1. Review existing TMP and model TCPs and ACPs accordingly.
2. Evacuation simulations were run using DYNEV II to predict traffic congestion during evacuation (see Section 7.2 and Figures 7-2 through 7-8).
3. These simulations help to identify the best routing and critical intersections that experience pronounced congestion during evacuation. Any critical intersections that

would benefit from traffic or access control are suggested as TCPs. No additional TCPs were identified which would benefit the evacuation.

4. Prioritization of TCPs and ACPs.
    a. Application of traffic and access control at some TCPs and ACPs will have a more pronounced influence on expediting traffic movements than at other TCPs and ACPs. For example, TCPs controlling traffic originating from areas in close proximity to the wildfire could have a more beneficial effect on minimizing potential exposure to threat than those TCPs located far from the wildfire. These priorities should be assigned by city emergency management representatives and by law enforcement personnel.

10.1 Assumptions

The ETE calculations documented in Sections 7 and 9 assume that the TMP is implemented during evacuation.

The ETE calculations reflect the assumption that all "external-external" trips are interdicted and diverted after 2 hours have elapsed from the Advisory to Evacuate (ATE) to discourage through travelers from using major through routes that traverse the study area. Dynamic and variable message signs should be strategically positioned outside of the study area at logical diversion points to attempt to divert traffic away from the area of risk. As such, it is assumed pass-through traffic that traverses the study area will diminish over the 2-hour period.

All transit vehicles and other responders entering the EMZs to support the evacuation are assumed to be unhindered by personnel manning TCPs and ACPs.

The ETE analysis treated all controlled intersections that are recommended TCP locations as being controlled by actuated signals. In Appendix H, Table H-2 identifies those intersections that were modeled as TCPs.

Study assumptions 12 through 14 in Section 2.3 discuss additional TCP and ACP operational assumptions.

10.2 Additional Considerations

The use of Intelligent Transportation Systems (ITS) technologies can reduce the manpower and equipment needs, while still facilitating the evacuation process. Dynamic Message Signs (DMS) can be placed within the EMZs to provide information to travelers regarding traffic conditions, route selection, congregation point, and reception center information. DMS placed outside of the EMZs will warn motorists to avoid using routes that may conflict with the flow of evacuees away from the wildfire. Highway Advisory Radio (HAR) can be used to broadcast information to evacuees during egress through their vehicles stereo systems. Automated Travel Information Systems (ATIS) can also be used to provide evacuees with information. Internet websites can provide traffic and evacuation route information before the evacuee begins their trip, while the onboard navigation systems (GPS units) and smartphones can be used to provide information during evacuation trip.

There are only several examples of how ITS technologies can benefit the evacuation process. Considerations should be given that ITS technologies can be used to facilitate the evacuation process, and any additional signage placed should consider evacuation needs.

11 EVACUATION ROUTES, CONGREGATION POINTS, AND EVACUATION SIGNAGE

This section documents major evacuation routes within the study area, possible bus routes and suggested local gathering points to collect transit dependent individuals, and suggestions on evacuation signage based on current traffic engineering standards.

11.1 Evacuation Routes

Evacuation routes are responsible for transporting EMZ residents being evacuated and transit dependent evacuees (schools, medical facilities, and residents, employees or tourists who do not own or have access to a private vehicle) to the boundary of the evacuation region.

Evacuees will select routes within the EMZ in such a way as to minimize their exposure to risk. This expectation is met by the DYNEV II model routing traffic away from the location of the wildfire, to the extent practicable. The DTRAD model satisfies this behavior by routing traffic so as to balance traffic demand relative to the available highway capacity to the extent possible. See Appendices B through D for further discussion. The major evacuation routes for the study area are presented in Figure 11-1. These routes will be used by the general population evacuating in private vehicles and by the transit-dependent population evacuating in buses or trolleys. Transit-dependent evacuees will be routed to safety, outside of the evacuation area. General population may evacuate to some alternate destination (e.g., lodging facilities, relative's home, campgrounds) outside the EMZ.

The Orange County Transit Authority (OCTA) has two bus routes that run through the EMZs: Bus Route 1 and Bus Route 89. However, these routes were not used in the study based on discussions with OCTA and City of Laguna Beach emergency management personnel.

The 9 routes shown graphically in Figure 11-2 and described in Table 11-1 were designed by KLD to service the transit dependent population in each EMZ. This does not imply that these exact routes would be used in an emergency. It is assumed that residents will walk to and congregate along the existing evacuation routes to flag down a bus or trolley. KLD also assessed the study area for logical points for the transit dependent population to congregate at to pick up a bus or trolley. Section 11.2 discusses these points further.

The specified routes for all the transit-dependent population are documented in Table 11-2 (refer to the maps of the link-node analysis network in Appendix H for node locations). This study does not consider the transport of evacuees from the boundary of the evacuation region to reception centers or congregate care centers as no information was received on these facilities.

Schools and medical facilities were routed along the most likely path from the facility being evacuated to the boundary of the evacuation region and are shown in Figure 11-3 and Figure 11-4, respectively. A single route was used for facilities that would use a similar path for evacuation.

The City of Laguna Beach should consider identifying safe shelter locations within the EMZ in an event that an evacuation is not feasible (i.e. the fire is moving faster than an evacuation would take). When a wildfire threat is perceived, emergency officials need to make a protective action decision to either evacuate or shelter (at a safe refuge location) the population in imminent danger. Safe refuge areas (i.e. hardened structures, safe open areas, water bodies) should be predetermined and locally known in the case of an emergency.

11.2 Congregation Points

It is important to have predefined and accessible local gathering points for transit dependent individuals to use as a pick-up point during emergencies. In order to service the transit dependent populations within the EMZ, KLD recommends the following congregation points[1] for the transit dependent population to use as pick-up points during an evacuation (shown in Figure 11-2):

1. El Morro Elementary School – Meet at the school parking lot. This pick-up location is located in Irvine Cove. Evacuees from Emerald Bay can also use this pick-up point.
2. Boat Canyon Drive and Pacific Coast Hwy/SR-1 – Meet at the intersection of Boat Canyon Drive and Pacific Coast Hwy. Congregate near The Pavilion. This pick-up location is near the center of the EMZ North Coast. Evacuees from Emerald Bay can also use this pick-up point.
3. Festival of Arts and Pageant of the Masters – Meet along SR-133 outside of the main building. This pick-up location is located between EMZs Boat Canyon and Park Avenue. Evacuees from Canyon Acres can also use this pick-up point.
4. Forest Avenue and Beach Street – Meet at the intersection of Forest Avenue and Beach Street. Congregate near the entrance of the Laguna Beach Visitors Center. This pick-up location is in the center of EMZ Downtown.
5. Laguna College of Art and Design – Big Bend Campus – Meet in parking lot or just outside lot along SR-133 northbound. This pick-up point is located within EMZ Big Bend.
6. Intersection of El Toro Rd and SR-133 - Meet at the intersection of El Toro Rd and SR-133. Congregate along the southeast corner of the intersection. This pick-up point is located in EMZ El Toro.
7. Intersection of El Toro Rd and The Club Dr/Bells Vireo Ln - Meet at the intersection of El Toro Rd and The Club Dr/Bells Vireo Ln. This pick-up point is located in EMZ Club Laguna.
8. Thurston Middle School – Meet just outside of school along the sidewalk along Park Avenue southbound. This pick-up point straddles EMZs Park Avenue and Top of the World.
9. Top of the World Elementary School – Meet near Top of the World Elementary School. Congregate near the intersection of Treetop Ln and Alta Laguna Blvd. This pick-up point is located on the border of Top of the World and Old Top of the World. Evacuees from Temple Hills can also use this pick-up point.
10. Laguna Beach High School – Meet out front of Laguna Beach High School and congregate along Park Avenue. This pick-up point is located between EMZs Central Coast and Park Avenue.

[1] A congregation point was selected based on its accessibility by large buses (i.e. available turn radius, paved roads) and its accessibility to the transit dependent population (i.e. within walking distance (≤ 1.5 mile), located on known roads or at known facilities).

11. Intersection of Oro St and Del Mar Ave – Meet at the intersection of Oro St and Del Mar Ave. Congregate near the Free Trolley Stop sign. This pick-up location borders EMZs Balboa-Nyes and Arch Beach Heights.
12. St. Catherine of Siena Parish School – Meet in front of St Catherine of Siena Parish School near Terry Rd and Pacific Coast Highway/SR-1. This pick-up point is located on the border of EMZs Wesley and South Coast.
13. Aliso Beach County Park – Meet in parking lot of Alisa Beach County Park. This pick-up point is located in EMZ South Coast.
14. Providence Mission Hospital Laguna Beach – Meet in parking lot of Providence Mission Hospital Laguna Beach near the boundary of EMZs of Sunset and Mar Vista and South Coast.
15. Intersection of SR-1 and Cress Street – Meet at the intersection of Pacific Coast Highway/SR-1 and Cress Street. This pick-up point is located in EMZ Central Coast at the border of Ceanothus. Evacuees from Blue Bird Canyon are at most 1.5 miles from this point (~30 minutes). Evacuees from Temple Hills can also use this pick-up point.

The City may want to consider placing "Evacuation Bus Stop" signage at these locations.

See Section 3.6 for more information on the transit dependent population and Section 9 for transit dependent ETE calculations.

11.3 Evacuation Signage

Locations of evacuation signs installed along the routes shown in Figure 11-1 for "straight-ahead" confirmation should be in accordance with Part 2, Chapter 2N, Section 2N.03 of the 2009 MUTCD[2]. These signs should display a blue circular symbol on a white square sign with a white directional arrow and a white legend "EVACUATION ROUTE" within the blue circular symbol, as shown in Figure 11-5. A straight, vertical arrow pointing upward to indicate that evacuees should continue their travel along that route should be placed on SR-1 and SR-133. These evacuation signs should be installed at one-mile spacing along major evacuation routes.

Other signing may be placed on the approaches to major intersections to indicate the direction of evacuation travel through the intersection. The MUTCD states that these signs should be installed 150 to 300 feet in advance of the intersection and should indicate the turn direction required to follow the evacuation route. These signs should display a straight horizontal arrow pointing to the left or right, or a bent arrow pointing to the left or right, depending on the geometrics of the approach and of the intersection, to indicate the appropriate turn movement through the intersection needed to follow the recommended evacuation route. A through movement will be shown as described in the previous paragraph.

[2] Manual on Uniform Traffic Control Devices for Streets and Highways, 2009 Edition, US Department of Transportation, Federal Highway Administration

Such directional signing may also be placed at the exits of special facilities to guide evacuees toward or along recommended evacuation routes. These facilities include schools, medical facilities, and major recreational areas, as specified in Appendix E.

Part 2, Chapter 2N of the 2009 MUTCD presents guidelines for implementing emergency management signs. It states that "emergency management signs shall not permanently displace any of the standard signs that are normally applicable." While this report does not specify the precise locations of every recommended road sign, the installation of every evacuation route sign must comply with the guidance provided in the MUTCD.

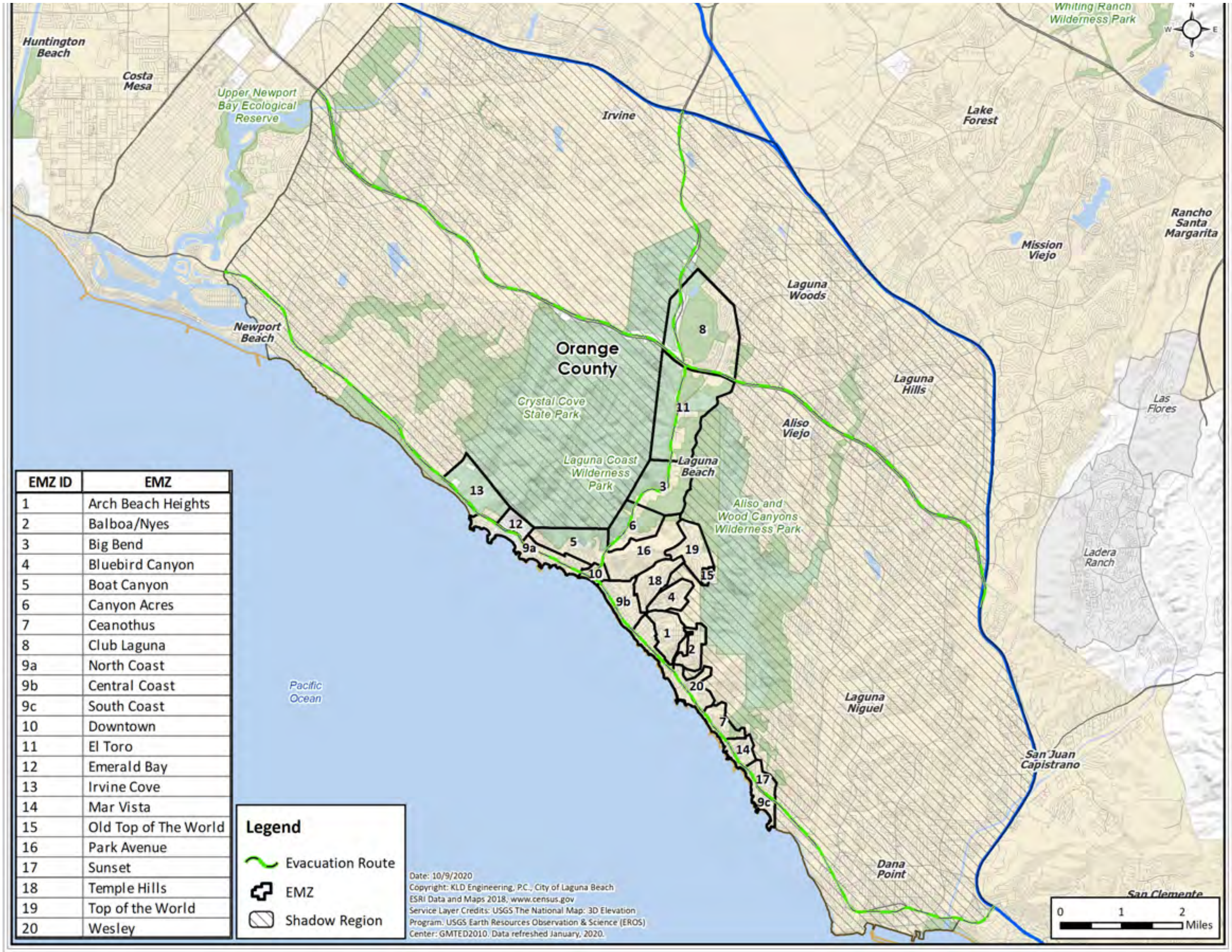
Table 11-1. Summary of Transit-Dependent Routes

Route	No. of Buses/Trolleys	Route Description	Length (mi.)
1	1	Servicing Irvine Cove, Emerald Bay & Boat Canyon	3.6
2	1	Servicing El Toro, Canyon Acres & Big Bend	3.8
3	1	Servicing Club Laguna	0.8
4	1	Servicing Downtown & North Coast	3.4
5	1	Servicing Mar Vista & Ceanothus	1.9
6	1	Servicing Arch Beach Heights & Balboa Nyes	5.5
7	1	Servicing Bluebird Canyon & South Coast	5.4
8	1	Servicing Central Coast & Temple Hills	6.2
9	1	Servicing Wesley, Top of the World, Old Top of the World, Sunset & Park Avenue	7.2
Total:	9		

Table 11-2. Bus Route Description

Route Number	Description	Nodes Traversed from Route Start to Evacuation Region Boundary
1	El Morro Elementary School	902, 897, 903, 904
2	Thurston Middle School	1281, 1297, 1298, 1299, 1300, 1301, 1302, 1303, 1306, 1307, 1315, 1316, 1635, 46, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
3	Top of the World Elementary School	1405, 1404, 1421, 1285, 1279, 1282, 1286, 1287, 1288, 1289, 1290, 1291, 1292, 1293, 1414, 1294, 1295, 47, 1633, 1307, 1315, 1316, 1635, 46, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
4	Laguna Beach High School	1305, 43, 1334, 34, 33, 46, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
5	Heidi's Pre-School	1423, 1422, 20, 19, 18
6	Vista Aliso	57, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
7	Providence Mission Hospital Laguna Beach	62, 21, 1422, 20, 19, 18
8	Laguna College of Art and Design – Main Campus	1627, 1420, 362, 1628, 363, 1630, 364, 365, 366, 367, 368, 369, 371, 381, 382, 383, 774
9	Laguna College of Art and Design – Big Bend Campus	1631, 1630, 364, 365, 366, 367, 368, 369, 371, 381, 382, 383, 774
10	Laguna College of Art and Design – South Campus	361, 1624, 356, 357, 1420, 362, 1628, 363, 1630, 364, 365, 366, 367, 368, 369, 371, 381, 382, 383, 774
11	Downtown & North Coast – Transit Route	1444, 41, 40, 38, 39, 885, 886, 887, 888, 889, 890, 898, 1371, 1407, 899, 900, 901, 897, 903, 904
12	Irvine Cove, Emerald Bay & Boat Canyon – Transit Route	5, 12, 13 1612, 892, 1381, 885, 886, 887, 888, 889, 890, 898, 1371, 1407, 899, 900, 901, 897, 903, 904
13	El Toro, Canyon Acres & Big Bend – Transit Route	1624, 356, 357, 1420, 362, 1628, 363, 1630, 364, 365, 366, 367, 368, 369, 371, 381, 382, 383, 774
14	Club Laguna – Transit Route	1373, 388, 1433, 389, 390
15	Bluebird Canyon & South Coast – Transit Route	1399, 1308, 1309, 1310, 1311, 1313, 49, 1314, 1389, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
16	Wesley, Top of the World, Old Top of the World, Sunset & Park Avenue – Transit Route	1405, 1404, 1421, 1285, 1279, 1278, 1277, 1276, 1281, 1297, 1298, 1317, 1318, 1319, 1320, 1321, 1322, 1323, 1324, 1325, 1326, 1327, 1328, 1304, 1305, 43, 1334, 34, 33, 46, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
17	Central Coast & Temple Hills – Transit Route	1287, 1288, 1289, 1290, 1291, 1292, 1293, 1414, 1294, 1295, 47, 1633, 1307, 1315, 1316, 1635, 46, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
18	Arch Beach Heights & Balboa Nyes – Transit Route	1419, 1418, 1338, 1339, 1340, 1341, 1342, 1343, 1331, 1330, 1329, 51, 1332, 1333, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
19	Mar Vista & Ceanothus – Transit Route	1354, 58, 23, 22, 21, 1422, 20, 19, 18

Route Number	Description	Nodes Traversed from Route Start to Evacuation Region Boundary
20	Spencer Recovery Centers INC., Coast to Coast Referral Center INC., Pillars Recover LLC & Oceanfront Recovery at Laguna Beach LLC	1389, 32, 31, 52, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
21	Sunshine Behavioral Health LLC, Laguna View Center LLC, Complete Resurgency LLC & Oceanfront Recovery at Balboa/Nyes	1428, 1427, 1416, 1425, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 1422, 20, 19, 18
22	Miramar Health INC. & Pillars Recovery LLC	891, 1382, 39, 885, 886, 887, 888, 889, 890, 898, 1371, 1407, 899, 900, 901, 897, 903, 904



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure 11-1. Evacuation Route Map

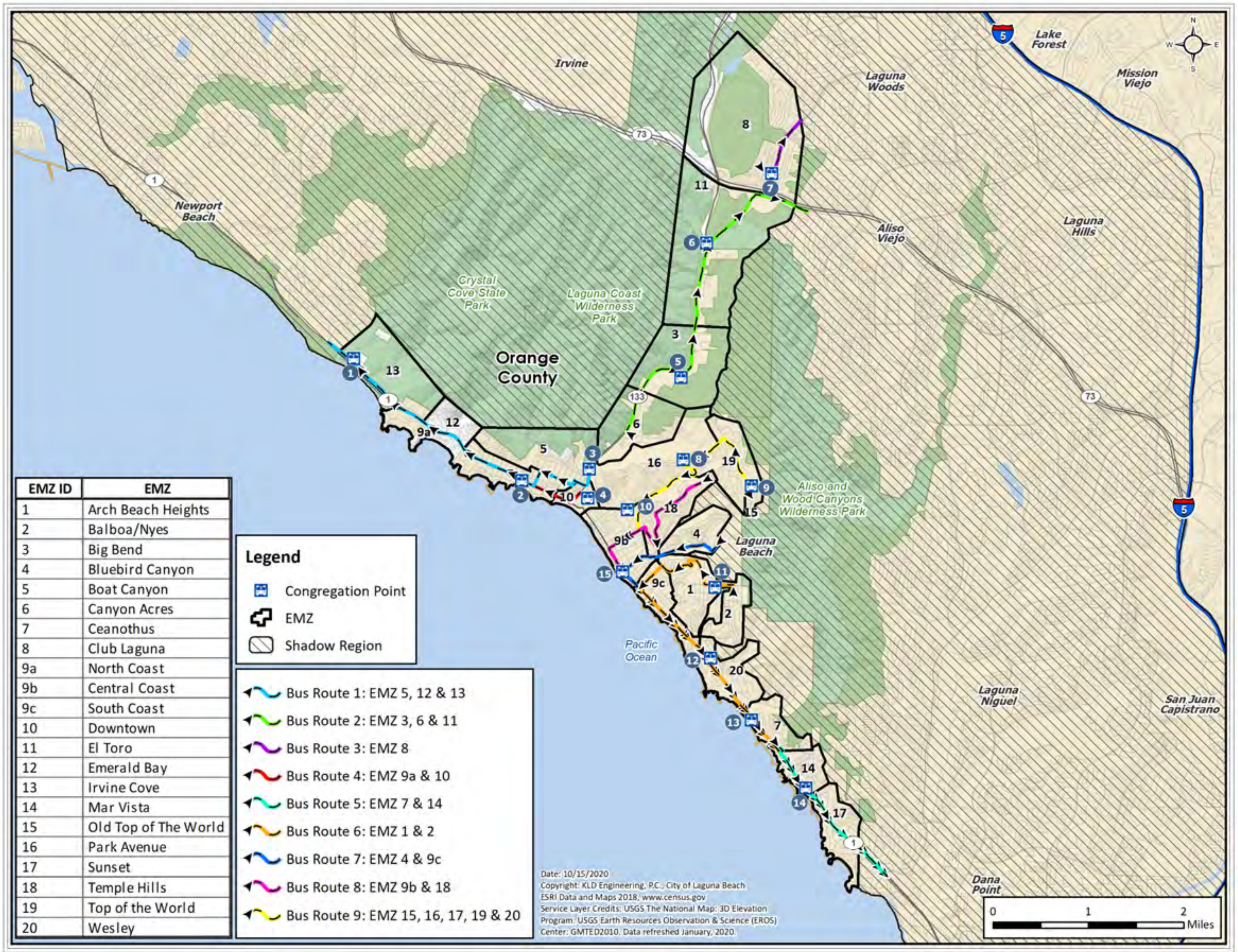


Figure 11-2. Transit-Dependent Routes and Congregation Points Servicing the EMZ

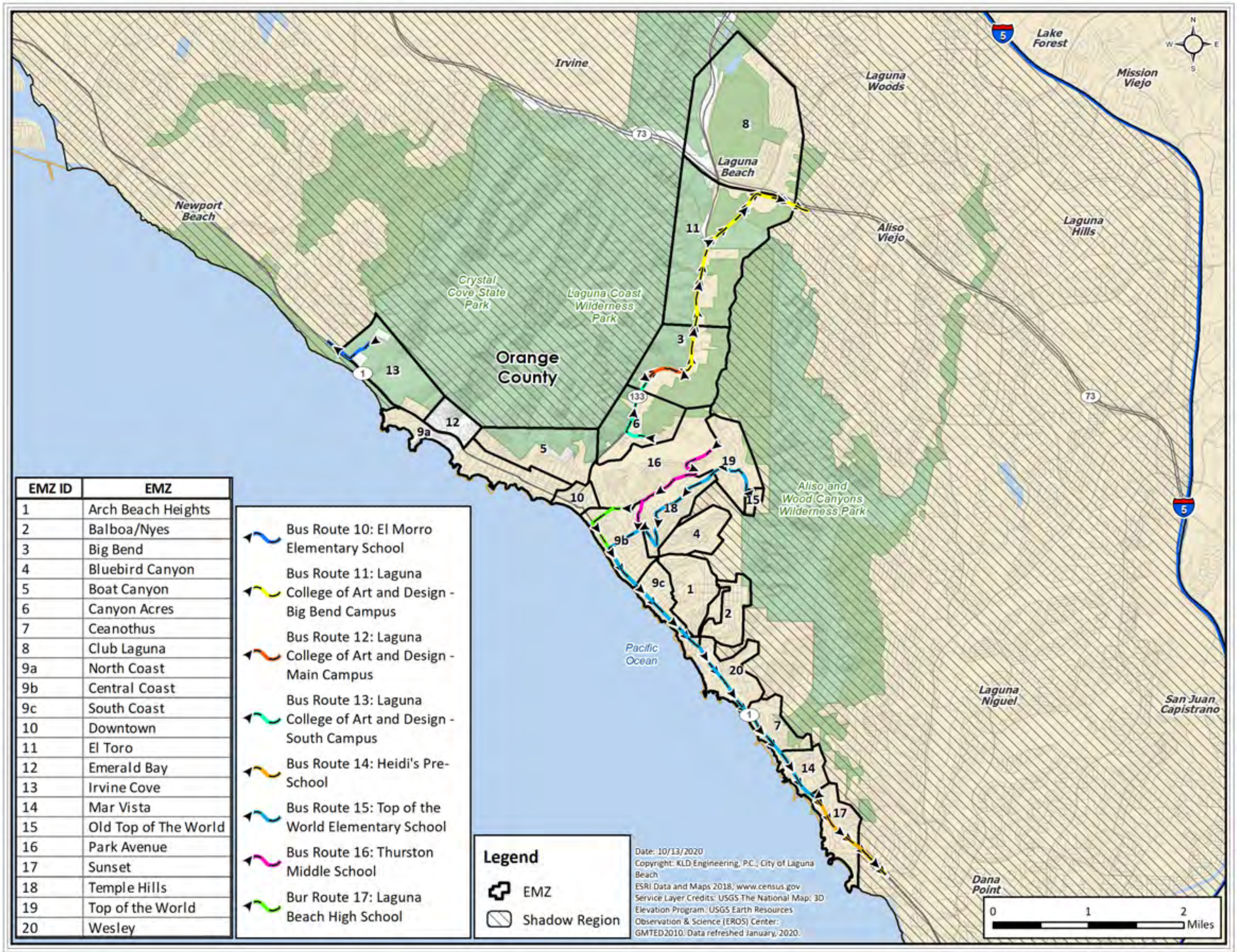


Figure 11-3. Transit-Dependent Routes Servicing Schools

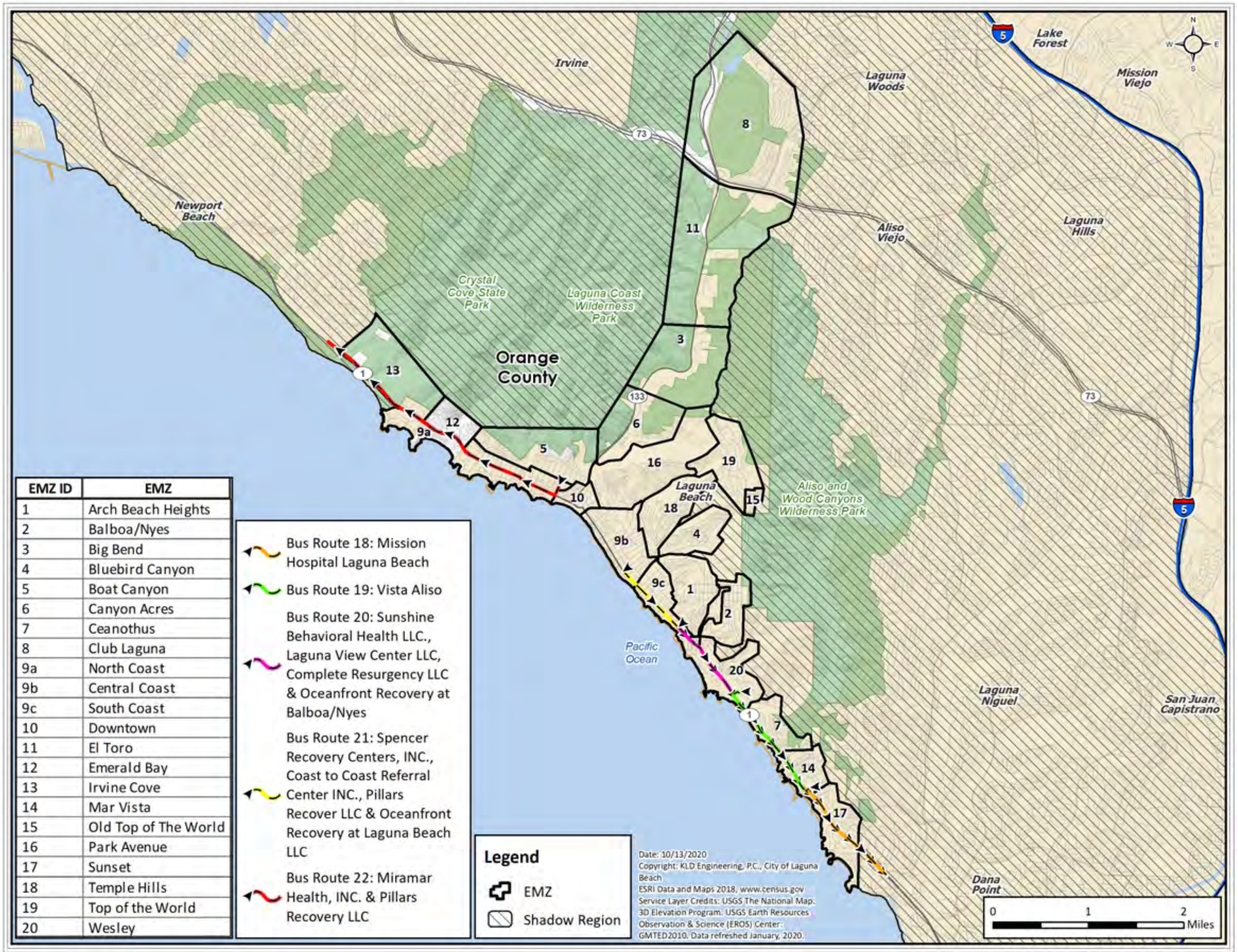


Figure 11-4. Transit-Dependent Routes Servicing Medical Facilities

Figure 11-5. Evacuation Route Sign Example

APPENDIX A

Glossary of Traffic Engineering Terms

A. GLOSSARY OF TRAFFIC ENGINEERING TERMS

This appendix provides a glossary of traffic engineering terms that are used throughout this report.

Table A-1. Glossary of Traffic Engineering Terms

Term	Definition
Analysis Network	A graphical representation of the geometric topology of a physical roadway system, which is comprised of directional links and nodes.
Link	A network link represents a specific, one-directional section of roadway. A link has both physical (length, number of lanes, topology, etc.) and operational (turn movement percentages, service rate, free-flow speed) characteristics.
Measures of Effectiveness	Statistics describing traffic operations on a roadway network.
Node	A network node generally represents an intersection of network links. A node has control characteristics, i.e., the allocation of service time to each approach link.
Origin	A location attached to a network link, within the EMZ or Shadow Region, where trips are generated at a specified rate in vehicles per hour (vph). These trips enter the roadway system to travel to their respective destinations.
Prevailing Roadway and Traffic Conditions	Relates to the physical features of the roadway, the nature (e.g., composition) of traffic on the roadway and the ambient conditions (weather, visibility, pavement conditions, etc.).
Service Rate	Maximum rate at which vehicles, executing a specific turn maneuver, can be discharged from a section of roadway at the prevailing conditions, expressed in vehicles per second (vps) or vehicles per hour (vph).
Service Volume	Maximum number of vehicles which can pass over a section of roadway in one direction during a specified time period with operating conditions at a specified Level of Service (The Service Volume at the upper bound of Level of Service, E, equals Capacity). Service Volume is usually expressed as vehicles per hour (vph).
Signal Cycle Length	The total elapsed time to display all signal indications, in sequence. The cycle length is expressed in seconds.

Term	Definition
Signal Interval	A single combination of signal indications. The interval duration is expressed in seconds. A signal phase is comprised of a sequence of signal intervals, usually green, yellow, red.
Signal Phase	A set of signal indications (and intervals) which services a particular combination of traffic movements on selected approaches to the intersection. The phase duration is expressed in seconds.
Traffic (Trip) Assignment	A process of assigning traffic to paths of travel in such a way as to satisfy all trip objectives (i.e., the desire of each vehicle to travel from a specified origin in the network to a specified destination) and to optimize some stated objective or combination of objectives. In general, the objective is stated in terms of minimizing a generalized "cost". For example, "cost" may be expressed in terms of travel time.
Traffic Density	The number of vehicles that occupy one lane of a roadway section of specified length at a point in time, expressed as vehicles per mile (vpm).
Traffic (Trip) Distribution	A process for determining the destinations of all traffic generated at the origins. The result often takes the form of a Trip Table, which is a matrix of origin-destination traffic volumes.
Traffic Simulation	A computer model designed to replicate the real-world operation of vehicles on a roadway network, so as to provide statistics describing traffic performance. These statistics are called Measures of Effectiveness (MOE).
Traffic Volume	The number of vehicles that pass over a section of roadway in one direction, expressed in vehicles per hour (vph). Where applicable, traffic volume may be stratified by turn movement.
Travel Mode	Distinguishes between private auto, bus, rail, pedestrian and air travel modes.
Trip Table or Origin-Destination Matrix	A rectangular matrix or table, whose entries contain the number of trips generated at each specified origin, during a specified time period, that are attracted to (and travel toward) each of its specified destinations. These values are expressed in vehicles per hour (vph) or in vehicles.

Term	Definition
Turning Capacity	The capacity associated with that component of the traffic stream which executes a specified turn maneuver from an approach at an intersection.

APPENDIX B

DTRAD: Dynamic Traffic Assignment and Distribution Model

B. DYNAMIC TRAFFIC ASSIGNMENT AND DISTRIBUTION MODEL

This appendix describes the integrated dynamic trip assignment and distribution model named DTRAD (Dynamic Traffic Assignment and Distribution) that is expressly designed for use in analyzing evacuation scenarios. DTRAD employs logit-based path-choice principles and is one of the models of the DYNEV II System. The DTRAD module implements path-based *Dynamic Traffic Assignment* (DTA) so that time dependent Origin-Destination (OD) trips are "assigned" to routes over the network based on prevailing traffic conditions.

To apply the DYNEV II System, the analyst must specify the highway network, link capacity information, the time-varying volume of traffic generated at all origin centroids and, optionally, a set of accessible candidate destination nodes on the periphery of the EMZ for selected origins. DTRAD calculates the optimal dynamic trip distribution (i.e., trip destinations) and the optimal dynamic trip assignment (i.e., trip routing) of the traffic generated at each origin node traveling to its set of candidate destination nodes, so as to minimize evacuee travel "cost".

Overview of Integrated Distribution and Assignment Model

The underlying premise is that the selection of destinations and routes is intrinsically coupled in an evacuation scenario. That is, people in vehicles seek to travel out of an area of potential risk as rapidly as possible by selecting the "best" routes. The model is designed to identify these "best" routes in a manner that realistically distributes vehicles from origins to destinations and routes them over the highway network, in a consistent and optimal manner, reflecting evacuee behavior.

For each origin, a set of "candidate destination nodes" is selected by the software logic and by the analyst to reflect the desire by evacuees to travel away from the wildfire and to access major highways. The specific destination nodes within this set that are selected by travelers and the selection of the connecting paths of travel, are both determined by DTRAD. This determination is made by a logit-based path choice model in DTRAD, so as to minimize the trip "cost", as discussed later.

The traffic loading on the network and the consequent operational traffic environment of the network (density, speed, throughput on each link) vary over time as the evacuation takes place. The DTRAD model, which is interfaced with the DYNEV simulation model, executes a succession of "sessions" wherein it computes the optimal routing and selection of destination nodes for the conditions that exist at that time.

Interfacing the DYNEV Simulation Model with DTRAD

The DYNEV II system reflects evacuation behavior wherein evacuees will seek to travel in a general direction away from the location of the hazardous event. An algorithm was developed to support the DTRAD model in dynamically varying the Trip Table (O-D matrix) over time from one DTRAD session to the next. Another algorithm executes a "mapping" from the specified "geometric" network (link-node analysis network) that represents the physical highway system, to a "path" network that represents the vehicle [turn] movements. DTRAD computations are performed on the "path" network: DYNEV simulation model, on the "geometric" network.

DTRAD Description

DTRAD is the DTA module for the DYNEV II System.

When the road network under study is large, multiple routing options are usually available between trip origins and destinations. The problem of loading traffic demands and propagating them over the network links is called Network Loading and is addressed by DYNEV II using macroscopic traffic simulation modeling. Traffic assignment deals with computing the distribution of the traffic over the road network for given O-D demands and is a model of the route choice of the drivers. Travel demand changes significantly over time, and the road network may have time dependent characteristics, e.g., time-varying signal timing or reduced road capacity because of lane closure, or traffic congestion. To consider these time dependencies, DTA procedures are required.

The DTRAD DTA module represents the dynamic route choice behavior of drivers, using the specification of dynamic origin-destination matrices as flow input. Drivers choose their routes through the network based on the travel cost they experience (as determined by the simulation model). This allows traffic to be distributed over the network according to the time-dependent conditions. The modeling principles of DTRAD include:

- It is assumed that drivers not only select the best route (i.e., lowest cost path) but some also select less attractive routes. The algorithm implemented by DTRAD archives several “efficient” routes for each O-D pair from which the drivers choose.
- The choice of one route out of a set of possible routes is an outcome of “discrete choice modeling”. Given a set of routes and their generalized costs, the percentages of drivers that choose each route is computed. The most prevalent model for discrete choice modeling is the logit model. DTRAD uses a variant of Path-Size-Logit model (PSL). PSL overcomes the drawback of the traditional multinomial logit model by incorporating an additional deterministic path size correction term to address path overlapping in the random utility expression.
- DTRAD executes the Traffic Assignment (TA) algorithm on an abstract network representation called "the path network" which is built from the actual physical link-node analysis network. This execution continues until a stable situation is reached: the volumes and travel times on the edges of the path network do not change significantly from one iteration to the next. The criteria for this convergence are defined by the user.
- Travel “cost” plays a crucial role in route choice. In DTRAD, path cost is a linear summation of the generalized cost of each link that comprises the path. The generalized cost for a link, a, is expressed as

  $$c_a = \alpha t_a + \beta l_a + \gamma s_a,$$

  Where c_a is the generalized cost for link a and α, β, and, γ are cost coefficients for link travel time, distance, and supplemental cost, respectively. Distance and supplemental costs are defined as invariant properties of the network model, while travel time is a dynamic property dictated by prevailing traffic conditions. The DYNEV simulation model computes travel times on all edges in the network and DTRAD uses that information to constantly update the costs of paths. The route choice decision model in the next simulation iteration uses these updated values to adjust the route choice behavior. This way, traffic demands are dynamically re-assigned based on time dependent conditions. The interaction between the DTRAD traffic assignment and DYNEV II simulation models is depicted in Figure B-1. Each round of interaction is called a Traffic Assignment Session (TA session). A TA session is composed of multiple iterations, marked as loop B in the figure.

- The supplemental cost is based on the "survival distribution" (a variation of the exponential distribution). The Inverse Survival Function is a "cost" term in DTRAD to represent the potential risk of travel toward the wildfire:

$s_a = - \beta \ln (p), 0 \le p \le l ; \beta > 0$

$p = \frac{d_n}{d_0}$

d_n = Distance of node, n, from the wildfire
d_0 = Distance from the wildfire where there is zero risk
β = Scaling factor

A d_o was chosen such that the EMZs are within the area at risk. Note that the supplemental cost, s_a, of link, a, is (high, low), if its downstream node, n, is (near, far from) the wildfire.

Network Equilibrium

In 1952, John Wardrop wrote:

> *Under equilibrium conditions traffic arranges itself in congested networks in such a way that no individual trip-maker can reduce his path costs by switching routes.*

The above statement describes the "User Equilibrium" definition, also called the "Selfish Driver Equilibrium". It is a hypothesis that represents a [hopeful] condition that evolves over time as drivers search out alternative routes to identify those routes that minimize their respective "costs". It has been found that this "equilibrium" objective to minimize costs is largely realized by most drivers who routinely take the same trip over the same network at the same time (i.e., commuters). Effectively, such drivers "learn" which routes are best for them over time. Thus, the traffic environment "settles down" to a near-equilibrium state.

Clearly, since an emergency evacuation is a sudden, unique event, it does not constitute a long-term learning experience which can achieve an equilibrium state. Consequently, DTRAD was not designed as an equilibrium solution, but to represent drivers in a new and unfamiliar situation, who respond in a flexible manner to real-time information (either broadcast or observed) in such a way as to minimize their respective costs of travel.

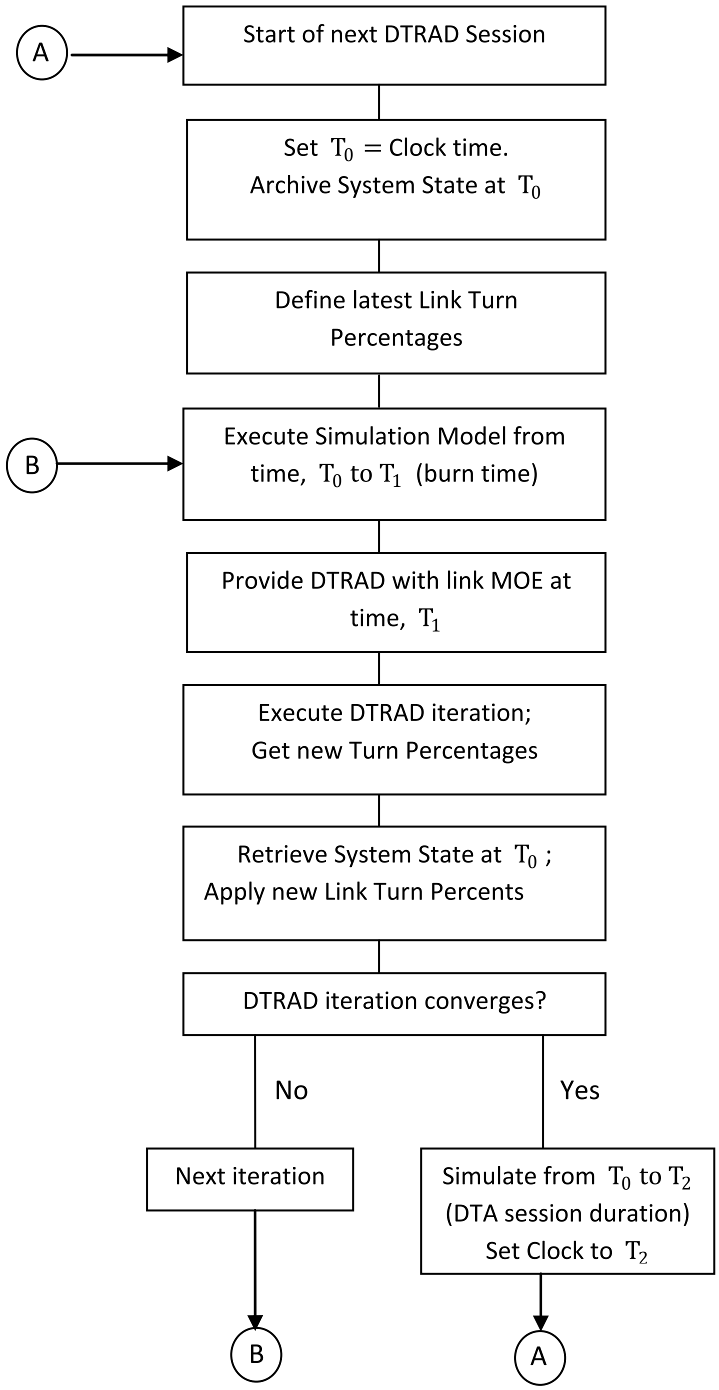


Figure B-1. Flow Diagram of Simulation-DTRAD Interface

APPENDIX C

DYNEV Traffic Simulation Model

C. DYNEV TRAFFIC SIMULATION MODEL

This appendix describes the DYNEV traffic simulation model. The DYNEV traffic simulation model is a *macroscopic* model that describes the operations of traffic flow in terms of aggregate variables: vehicles, flow rate, mean speed, volume, density, queue length, *on each link*, for each turn movement, during each Time Interval (simulation time step). The model generates trips from "sources" and from Entry Links and introduces them onto the analysis network at rates specified by the analyst based on the mobilization time distributions. The model simulates the movements of all vehicles on all network links over time until the network is empty. At intervals, the model outputs Measures of Effectiveness (MOE) such as those listed in Table C-1.

Model Features Include:

- Explicit consideration is taken of the variation in density over the time step; an iterative procedure is employed to calculate an average density over the simulation time step for the purpose of computing a mean speed for moving vehicles.
- Multiple turn movements can be serviced on one link; a separate algorithm is used to estimate the number of (fractional) lanes assigned to the vehicles performing each turn movement, based, in part, on the turn percentages provided by the DTRAD model.
- At any point in time, traffic flow on a link is subdivided into two classifications: queued and moving vehicles. The number of vehicles in each classification is computed. Vehicle spillback, stratified by turn movement for each network link, is explicitly considered and quantified. The propagation of stopping waves from link to link is computed within each time step of the simulation. There is no "vertical stacking" of queues on a link.
- Any link can accommodate "source flow" from zones via side streets and parking facilities that are not explicitly represented. This flow represents the evacuating trips that are generated at the source.
- The relation between the number of vehicles occupying the link and its storage capacity is monitored every time step for every link and for every turn movement. If the available storage capacity on a link is exceeded by the demand for service, then the simulator applies a "metering" rate to the entering traffic from both the upstream feeders and source node to ensure that the available storage capacity is not exceeded.
- A "path network" that represents the specified traffic movements from each network link is constructed by the model; this path network is utilized by the DTRAD model.
- A two-way interface with DTRAD: (1) provides link travel times; (2) receives data that translates into link turn percentages.
- Provides MOE to animation software, EVAN
- Calculates ETE statistics

All traffic simulation models are data-intensive. Table C-2 outlines the necessary input data elements.

To provide an efficient framework for defining these specifications, the physical highway environment is represented as a network. The unidirectional links of the network represent roadway sections: rural, multi-lane, urban streets or freeways. The nodes of the network generally represent intersections or points along a section where a geometric property changes (e.g. a lane drop, change in grade or free flow speed).

Figure C-1 is an example of a small network representation. The freeway is defined by the sequence of links, (20,21), (21,22), and (22,23). Links (8001, 19) and (3, 8011) are Entry and Exit links, respectively. An arterial extends from node 3 to node 19 and is partially subsumed within a grid network. Note that links (21,22) and (17,19) are grade-separated.

C.1 Methodology

C.1.1 The Fundamental Diagram

It is necessary to define the fundamental diagram describing flow-density and speed-density relationships. Rather than "settling for" a triangular representation, a more realistic representation that includes a "capacity drop", (I-R)$Q_{max,}$ at the critical density when flow conditions enter the forced flow regime, is developed and calibrated for each link. This representation, shown in Figure C-2, asserts a constant free speed up to a density, k_f, and then a linear reduction in speed in the range, $k_f \leq k \leq k_c = 45$ vpm, the density at capacity. In the flow-density plane, a quadratic relationship is prescribed in the range, $k_c < k \leq k_s = 95$ vpm which roughly represents the "stop-and-go" condition of severe congestion. The value of flow rate, Q_s, corresponding to k_s, is approximated at $0.7\, RQ_{max}$. A linear relationship between k_s and k_j completes the diagram shown in Figure C-2. Table C-3 is a glossary of terms.

The fundamental diagram is applied to <u>moving</u> traffic on every link. The specified calibration values for each link are: (1) Free speed, v_f ; (2) Capacity, Q_{max} ; (3) Critical density, $k_c = 45$ vpm ; (4) Capacity Drop Factor, R = 0.9 ; (5) Jam density, k_j . Then, $v_c = \frac{Q_{max}}{k_c}$, $k_f = k_c - \frac{(V_f - V_c)\, k_c^2}{Q_{max}}$. Setting $\bar{k} = k - k_c$, then $Q = RQ_{max} - \frac{RQ_{max}}{8333}\, \bar{k}^2$ for $0 \leq \bar{k} \leq \bar{k}_s = 50$. It can be shown that $Q = \left(0.98 - 0.0056\, \bar{k}\right) RQ_{max}$ for $\bar{k}_s \leq \bar{k} \leq \bar{k}_j$, where $\bar{k}_s = 50$ and $\bar{k}_j = 175$.

C.1.2 The Simulation Model

The simulation model solves a sequence of "unit problems". Each unit problem computes the movement of traffic on a link, for each specified turn movement, over a specified time interval (TI) which serves as the simulation time step for all links. Figure C-3 is a representation of the unit problem in the time-distance plane. Table C-3 is a glossary of terms that are referenced in the following description of the unit problem procedure.

The formulation and the associated logic presented below are designed to solve the unit problem for each sweep over the network (discussed below), for each turn movement serviced on each link that comprises the evacuation network, and for each TI over the duration of the evacuation.

Given $= Q_b, M_b, L, TI, E_0, LN, {}^{G}/_{C}, h, L_v, R_0, L_c, E, M$
Compute $= O, Q_e, M_e$
Define $O = O_Q + O_M + O_E$; $E = E_1 + E_2$

1. For the first sweep, s = 1, of this TI, get initial estimates of mean density, k_0, the R – factor, R_0 and entering traffic, E_0, using the values computed for the final sweep of the prior TI. For each subsequent sweep, $s > 1$, calculate $E = \sum_i P_i\ O_i + S$ where P_i, O_i are the relevant turn percentages from feeder link, i , and its total outflow (possibly metered) over this TI; S is the total source flow (possibly metered) during the current TI. Set iteration counter, n = 0, $k = k_0$, and $E = E_0$.

2. Calculate $v(k)$ such that $k \le 130$ using the analytical representations of the fundamental diagram.
   Calculate $\text{Cap} = \frac{Q_{max}(TI)}{3600}\left({}^{G}/_{C}\right) LN$, in vehicles, this value may be reduced due to metering
   Set $R = 1.0$ if ${}^{G}/_{C} < 1$ or if $k \le k_c$; Set $R = 0.9$ only if ${}^{G}/_{C} = 1$ and $k > k_c$
   Calculate queue length, $L_b = Q_b \frac{L_v}{LN}$

3. Calculate $t_1 = TI - \frac{L}{V}$. If $t_1 \prec 0$, set $t_1 = E_1 = O_E = 0$; Else, $E_1 = E\frac{t_1}{TI}$.

4. Then $E_2 = E - E_1$; $t_2 = TI - t_1$

5. If $Q_b \ge \text{Cap}$, then
   $O_Q = \text{Cap}, O_M = O_E = 0$
   If $t_1 > 0$, then
   $Q'_e = Q_b + M_b + E_1 - \text{Cap}$
   Else
   $Q'_e = Q_b - \text{Cap}$
   End if
   Calculate Q_e and M_e using Algorithm A (below)

6. Else $(Q_b \prec \text{Cap})$
   $O_Q = Q_b$, $\text{RCap} = \text{Cap} - O_Q$

7. If $M_b \le \text{RCap}$, then

8. If $t_1 > 0$, $O_M = M_b, O_E = \min\left(\text{RCap} - M_b, \frac{t_1\ \text{Cap}}{TI}\right) \ge 0$
   $Q'_e = E_1 - O_E$
   If $Q'_e > 0$, then

Calculate Q_e, M_e with Algorithm A

Else

$Q_e = 0$, $M_e = E_2$

End if

Else $(t_1 = 0)$

$O_M = \left(\frac{v(TI)-L_b}{L-L_b}\right) M_b$ and $O_E = 0$

$M_e = M_b - O_M + E$; $Q_e = 0$

End if

9. Else $(M_b > RCap)$

$O_E = 0$

If $t_1 > 0$, then

$O_M = RCap$, $Q'_e = M_b - O_M + E_1$

Calculate Q_e and M_e using Algorithm A

10. Else $(t_1 = 0)$

$M_d = \left[\left(\frac{v(TI)-L_b}{L-L_b}\right) M_b\right]$

If $M_d > RCap$, *then*

$O_M = RCap$

$Q'_e = M_d - O_M$

Apply Algorithm A to calculate Q_e and M_e

Else

$O_M = M_d$

$M_e = M_b - O_M + E$ and $Q_e = 0$

End if

End if

End if

End if

11. Calculate a new estimate of average density, $\bar{k}_n = \frac{1}{4}[k_b + 2\,k_m + k_e]$,

where k_b = density at the beginning of the TI

k_e = density at the end of the TI

k_m = density at the mid-point of the TI

All values of density apply only to the moving vehicles.

If $|\bar{k}_n - \bar{k}_{n-1}| > \in$ and $n < N$

where $N = \max$ number of iterations, and ϵ is a convergence criterion, then

12. set $n = n + 1$, and return to step 2 to perform iteration, n, using $k = \bar{k}_n$.

End if

Computation of unit problem is now complete. Check for excessive inflow causing spillback.

13. If $Q_e + M_e > \frac{(L-W)\,LN}{L_v}$, then

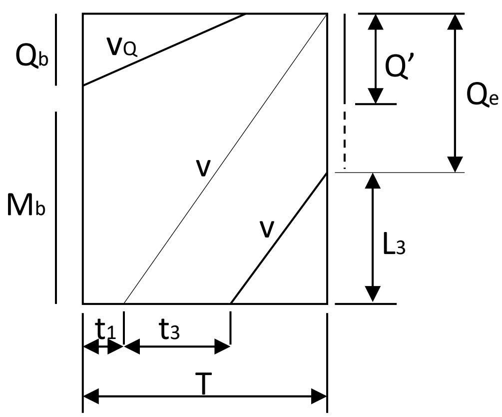
The number of excess vehicles that cause spillback is: $SB = Q_e + M_e - \frac{(L-W)\cdot LN}{L_v}$, where W is the width of the upstream intersection. To prevent spillback, meter the outflow from the feeder approaches and from the source flow, S, during this TI by the amount, SB. That is, set

$$M = 1 - \frac{SB}{(E+S)} \geq 0 \text{, where M is the metering factor (over all movements).}$$

This metering factor is assigned appropriately to all feeder links and to the source flow, to be applied during the next network sweep, discussed later.

Algorithm A

This analysis addresses the flow environment over a TI during which moving vehicles can join a standing or discharging queue. For the case shown, $Q_b \leq Cap$, with $t_1 > 0$ and a queue of length, Q'_e, formed by that portion of M_b and E that reaches the stop-bar within the TI, but could not discharge due to inadequate capacity. That is, $Q_b + M_b + E_1 > Cap$. This queue length, $Q'_e = Q_b + M_b + E_1 - Cap$ can be extended to Q_e by traffic entering the approach during the current TI, traveling at speed, v, and reaching the rear of the queue within the TI. A portion of the entering vehicles, $E_3 = E\,\frac{t_3}{TI}$, will likely join the queue. This analysis calculates t_3, Q_e and M_e for the input values of L, TI, v, E, t, L_v, LN, Q'_e.



When $t_1 > 0$ and $Q_b \leq Cap$:

Define: $L'_e = Q'_e\,\frac{L_v}{LN}$. From the sketch, $L_3 = v(TI - t_1 - t_3) = L - (Q'_e + E_3)\frac{L_v}{LN}$.

Substituting $E_3 = \frac{t_3}{TI}\,E$ yields: $-vt_3 + \frac{t_3}{TI}\,E\,\frac{L_v}{LN} = L - v(TI - t_1) - L'_e$. Recognizing that the first two terms on the right hand side cancel, solve for t_3 to obtain:

$$t_3 = \frac{L'_e}{\left[v - \frac{E}{TI}\,\frac{L_v}{LN}\right]} \qquad \text{such that} \quad 0 \leq t_3 \leq TI - t_1$$

If the denominator, $\left[v - \frac{E}{TI}\,\frac{L_v}{LN}\right] \leq 0$, set $t_3 = TI - t_1$.

Then, $Q_e = Q'_e + E\,\frac{t_3}{TI}$, $M_e = E\left(1 - \frac{t_1 + t_3}{TI}\right)$

The complete Algorithm A considers all flow scenarios; space limitation precludes its inclusion, here.

C.1.3 Lane Assignment

The "unit problem" is solved for each turn movement on each link. Therefore it is necessary to calculate a value, LN_x , of allocated lanes for each movement, x. If in fact all lanes are specified by, say, arrows painted on the pavement, either as full lanes or as lanes within a turn bay, then the problem is fully defined. If however there remain un-channelized lanes on a link, then an analysis is undertaken to subdivide the number of these physical lanes into turn movement specific virtual lanes, LN_x.

C.2 Implementation

C.2.1 Computational Procedure

The computational procedure for this model is shown in the form of a flow diagram as Figure C-4. As discussed earlier, the simulation model processes traffic flow for each link independently over TI that the analyst specifies; it is usually 60 seconds or longer. The first step is to execute an algorithm to define the sequence in which the network links are processed so that as many links as possible are processed after their feeder links are processed, within the same network sweep. Since a general network will have many closed loops, it is not possible to guarantee that every link processed will have all of its feeder links processed earlier.

The processing then continues as a succession of time steps of duration, TI, until the simulation is completed. Within each time step, the processing performs a series of "sweeps" over all network links; this is necessary to ensure that the traffic flow is synchronous over the entire network. Specifically, the sweep ensures continuity of flow among all the network links; in the context of this model, this means that the values of E, M, and S are all defined for each link such that they represent the synchronous movement of traffic from each link to all of its outbound links. These sweeps also serve to compute the metering rates that control spillback.

Within each sweep, processing solves the "unit problem" for each turn movement on each link. With the turn movement percentages for each link provided by the DTRAD model, an algorithm allocates the number of lanes to each movement serviced on each link. The timing at a signal, if any, applied at the downstream end of the link, is expressed as a G/C ratio, the signal timing needed to define this ratio is an input requirement for the model. The model also has the capability of representing, with macroscopic fidelity, the actions of actuated signals responding to the time-varying competing demands on the approaches to the intersection.

The solution of the unit problem yields the values of the number of vehicles, O, that discharge from the link over the time interval and the number of vehicles that remain on the link at the end of the time interval as stratified by queued and moving vehicles: $Q_e \text{ and } M_e$. The procedure considers each movement separately (multi-piping). After all network links are processed for a given network sweep, the updated consistent values of entering flows, E; metering rates, M; and source flows, S are defined so as to satisfy the "no spillback" condition. The procedure then performs the unit problem solutions for all network links during the following sweep.

Experience has shown that the system converges (i.e. the values of E, M and S "settle down" for all network links) in just two sweeps if the network is entirely under-saturated or in four sweeps in the presence of extensive congestion with link spillback. (The initial sweep over each link uses the final values of E and M, of the prior TI). At the completion of the final sweep for a TI, the procedure computes and stores all measures of effectiveness for each link and turn movement for output purposes. It then prepares for the following time interval by defining the values of $\mathrm{Q_b}$ and $\mathrm{M_b}$ for the start of the next TI as being those values of $\mathrm{Q_e}$ and $\mathrm{M_e}$ at the end of the prior TI. In this manner, the simulation model processes the traffic flow over time until the end of the run. Note that there is no space-discretization other than the specification of network links.

C.2.2 Interfacing with Dynamic Traffic Assignment (DTRAD)

The **DYNEV II** system reflects evacuation behavior wherein evacuees will seek to travel in a general direction away from the location of the hazardous event. Thus, an algorithm was developed to identify an appropriate set of destination nodes for each origin based on its location and on the expected direction of travel. This algorithm also supports the DTRAD model in dynamically varying the Trip Table (O-D matrix) over time from one DTRAD session to the next.

Figure B-1 depicts the interaction of the simulation model with the DTRAD model in the **DYNEV II** system. As indicated, **DYNEV II** performs a succession of DTRAD "sessions"; each such session computes the turn link percentages for each link that remain constant for the session duration, $[\mathrm{T_0}, \mathrm{T_2}]$, specified by the analyst. The end product is the assignment of traffic volumes from each origin to paths connecting it with its destinations in such a way as to minimize the network-wide cost function. The output of the DTRAD model is a set of updated link turn percentages which represent this assignment of traffic.

As indicated in Figure B-1, the simulation model supports the DTRAD session by providing it with operational link MOE that are needed by the path choice model and included in the DTRAD cost function. These MOE represent the operational state of the network at a time, $\mathrm{T_1} \leq \mathrm{T_2}$, which lies within the session duration, $[\mathrm{T_0}, \mathrm{T_2}]$. This "burn time", $\mathrm{T_1} - \mathrm{T_0}$, is selected by the analyst. For each DTRAD iteration, the simulation model computes the change in network operations over this burn time using the latest set of link turn percentages computed by the DTRAD model. Upon convergence of the DTRAD iterative procedure, the simulation model accepts the latest turn percentages provided by the Dynamic Traffic Assignment (DTA) model, returns to the origin time, $\mathrm{T_0}$, and executes until it arrives at the end of the DTRAD session duration at time, $\mathrm{T_2}$. At this time the next DTA session is launched and the whole process repeats until the end of the **DYNEV II** run.

Additional details are presented in Appendix B.

Table C-1. Selected Measures of Effectiveness Output by DYNEV II

Measure	Units	Applies To
Vehicles Discharged	Vehicles	Link, Network, Exit Link
Speed	Miles/Hours (mph)	Link, Network
Density	Vehicles/Mile/Lane	Link
Level of Service	LOS	Link
Content	Vehicles	Network
Travel Time	Vehicle-hours	Network
Evacuated Vehicles	Vehicles	Network, Exit Link
Trip Travel Time	Vehicle-minutes/trip	Network
Capacity Utilization	Percent	Exit Link
Attraction	Percent of total evacuating vehicles	Exit Link
Max Queue	Vehicles	Node, Approach
Time of Max Queue	Hours:minutes	Node, Approach
Route Statistics	Length (mi); Mean Speed (mph); Travel Time (min)	Route
Mean Travel Time	Minutes	Evacuation Trips; Network

Table C-2. Input Requirements for the DYNEV II Model

HIGHWAY NETWORK

- Links defined by upstream and downstream node numbers
- Link lengths
- Number of lanes (up to 9) and channelization
- Turn bays (1 to 3 lanes)
- Destination (exit) nodes
- Network topology defined in terms of downstream nodes for each receiving link
- Node Coordinates (X,Y)
- Wildfire Coordinates (X,Y)

GENERATED TRAFFIC VOLUMES

- On all entry links and source nodes (origins), by Time Period

TRAFFIC CONTROL SPECIFICATIONS

- Traffic signals: link-specific, turn movement specific
- Signal control treated as fixed time or actuated
- Location of traffic control points (these are represented as actuated signals)
- Stop and Yield signs
- Right-turn-on-red (RTOR)
- Route diversion specifications
- Turn restrictions
- Lane control (e.g. lane closure, movement-specific)

DRIVER’S AND OPERATIONAL CHARACTERISTICS

- Driver’s (vehicle-specific) response mechanisms: free-flow speed, discharge headway
- Bus route designation.

DYNAMIC TRAFFIC ASSIGNMENT

- Candidate destination nodes for each origin (optional)
- Duration of DTA sessions
- Duration of simulation “burn time”
- Desired number of destination nodes per origin

INCIDENTS

- Identify and Schedule of closed lanes
- Identify and Schedule of closed links

Table C-3. Glossary

Cap	The maximum number of vehicles, of a particular movement, that can discharge from a link within a time interval.
E	The number of vehicles, of a particular movement, that enter the link over the time interval. The portion, E_{TI}, can reach the stop-bar within the TI.
G/C	The green time: cycle time ratio that services the vehicles of a particular turn movement on a link.
h	The mean queue discharge headway, seconds.
k	Density in vehicles per lane per mile.
$\bar{k}$	The average density of <u>moving</u> vehicles of a particular movement over a TI, on a link.
L	The length of the link in feet.
L_b , L_e	The queue length in feet of a particular movement, at the [beginning, end] of a time interval.
LN	The number of lanes, expressed as a floating point number, allocated to service a particular movement on a link.
L_v	The mean effective length of a queued vehicle including the vehicle spacing, feet.
M	Metering factor (Multiplier): 1.
M_b , M_e	The number of moving vehicles on the link, of a particular movement, that are moving at the [beginning, end] of the time interval. These vehicles are assumed to be of equal spacing, over the length of link upstream of the queue.
O	The total number of vehicles of a particular movement that are discharged from a link over a time interval.
O_Q , O_M , O_E	The components of the vehicles of a particular movement that are discharged from a link within a time interval: vehicles that were Queued at the beginning of the TI; vehicles that were Moving within the link at the beginning of the TI; vehicles that Entered the link during the TI.
P_x	The percentage, expressed as a fraction, of the total flow on the link that executes a particular turn movement, x.

Q_b , Q_e	The number of queued vehicles on the link, of a particular turn movement, at the [beginning, end] of the time interval.
Q_{max}	The maximum flow rate that can be serviced by a link for a particular movement in the absence of a control device. It is specified by the analyst as an estimate of link capacity, based upon a field survey, with reference to the HCM.
R	The factor that is applied to the capacity of a link to represent the "capacity drop" when the flow condition moves into the forced flow regime. The lower capacity at that point is equal to RQ_{max} .
RCap	The remaining capacity available to service vehicles of a particular movement after that queue has been completely serviced, within a time interval, expressed as vehicles.
S_x	Service rate for movement x, vehicles per hour (vph).
t_1	Vehicles of a particular turn movement that enter a link over the first t_1 seconds of a time interval, can reach the stop-bar (in the absence of a queue down-stream) within the same time interval.
TI	The time interval, in seconds, which is used as the simulation time step.
v	The mean speed of travel, in feet per second (fps) or miles per hour (mph), of moving vehicles on the link.
v_Q	The mean speed of the last vehicle in a queue that discharges from the link within the TI. This speed differs from the mean speed of moving vehicles, v.
W	The width of the intersection in feet. This is the difference between the link length which extends from stop-bar to stop-bar and the block length.

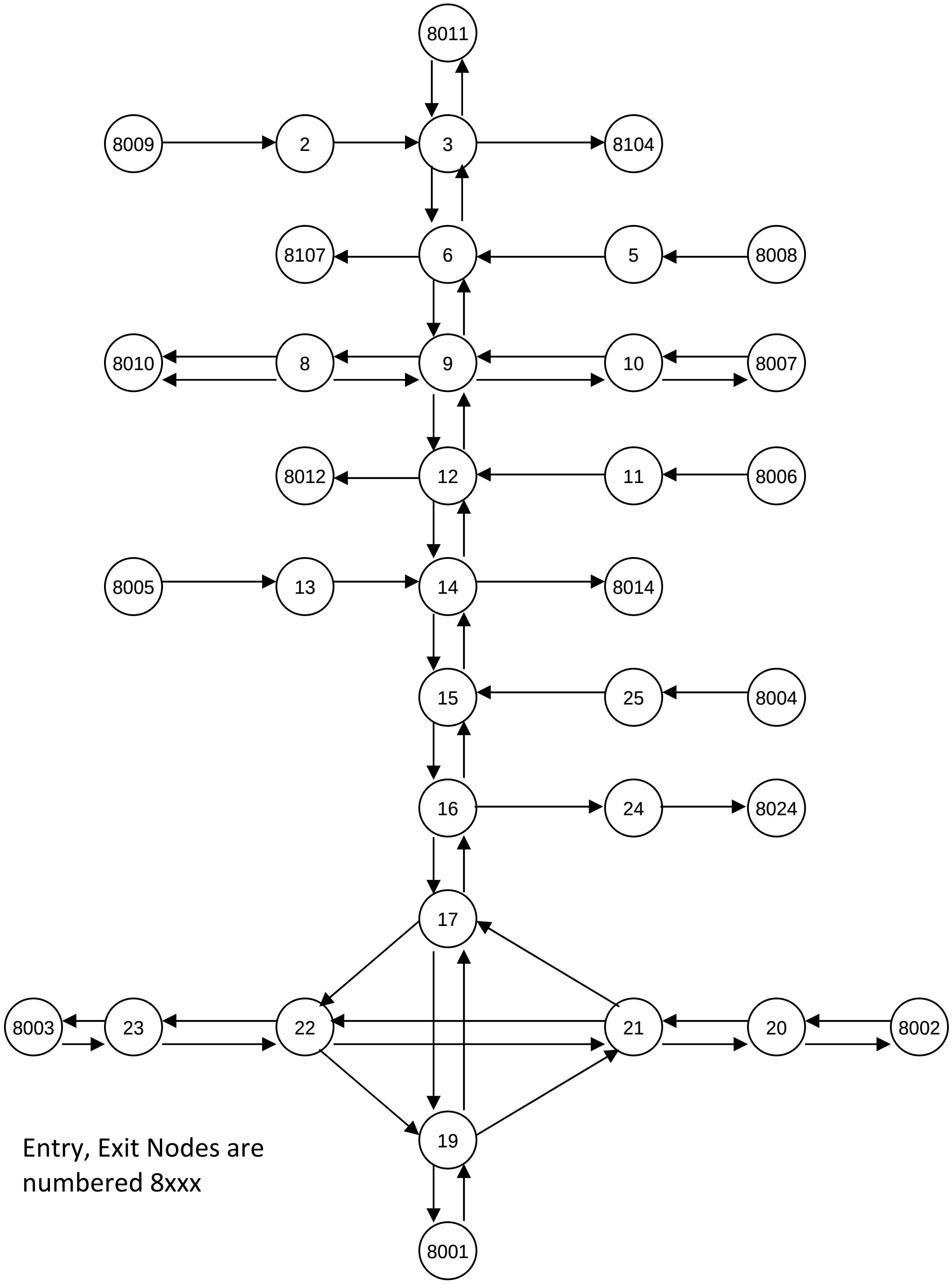


Figure C-1. Representative Analysis Network

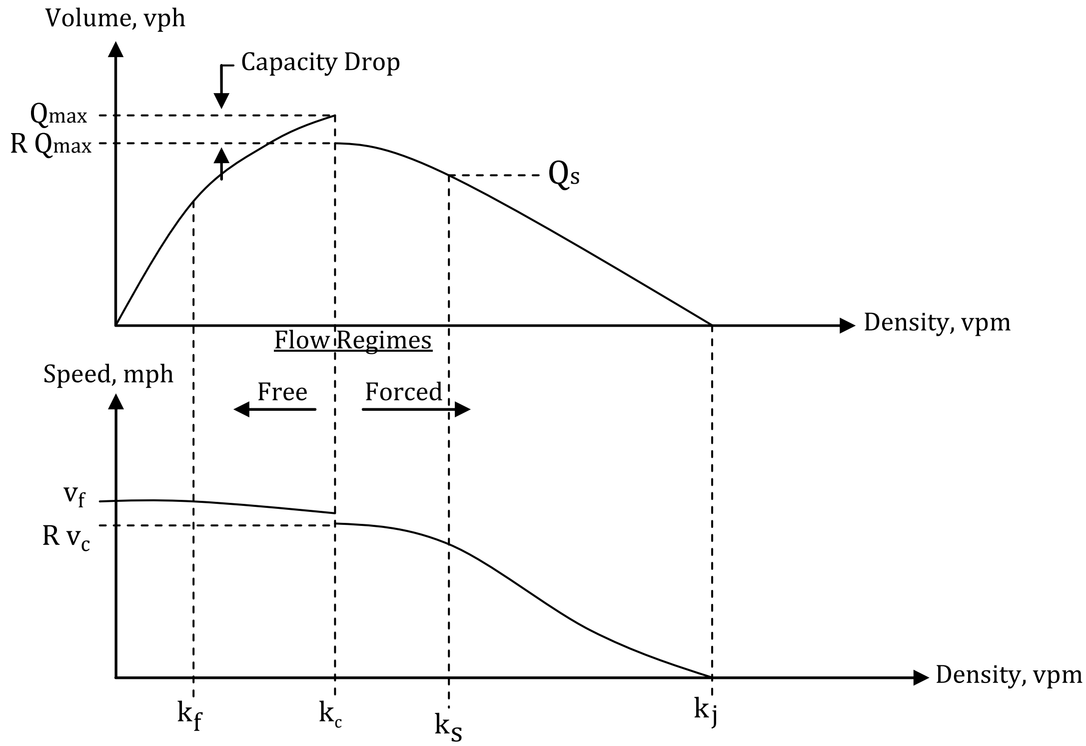


Figure C-2. Fundamental Diagrams

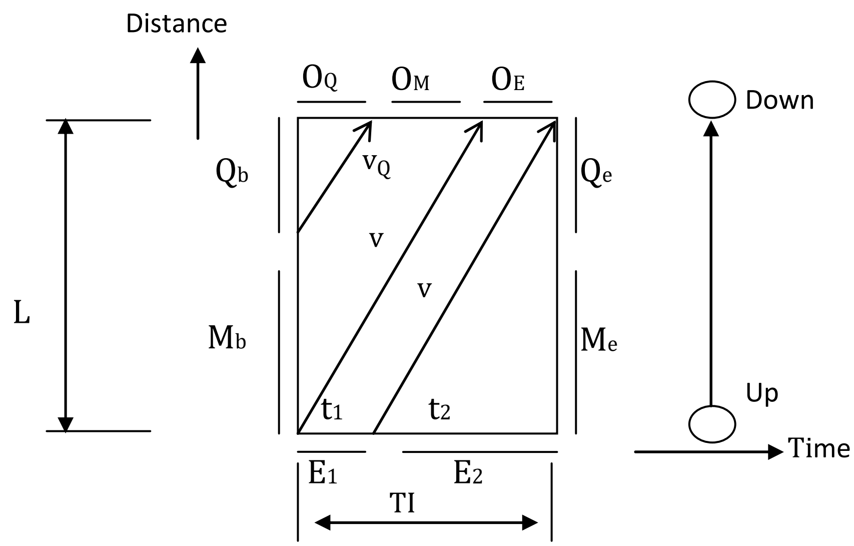


Figure C-3. A UNIT Problem Configuration with $t_1 > 0$

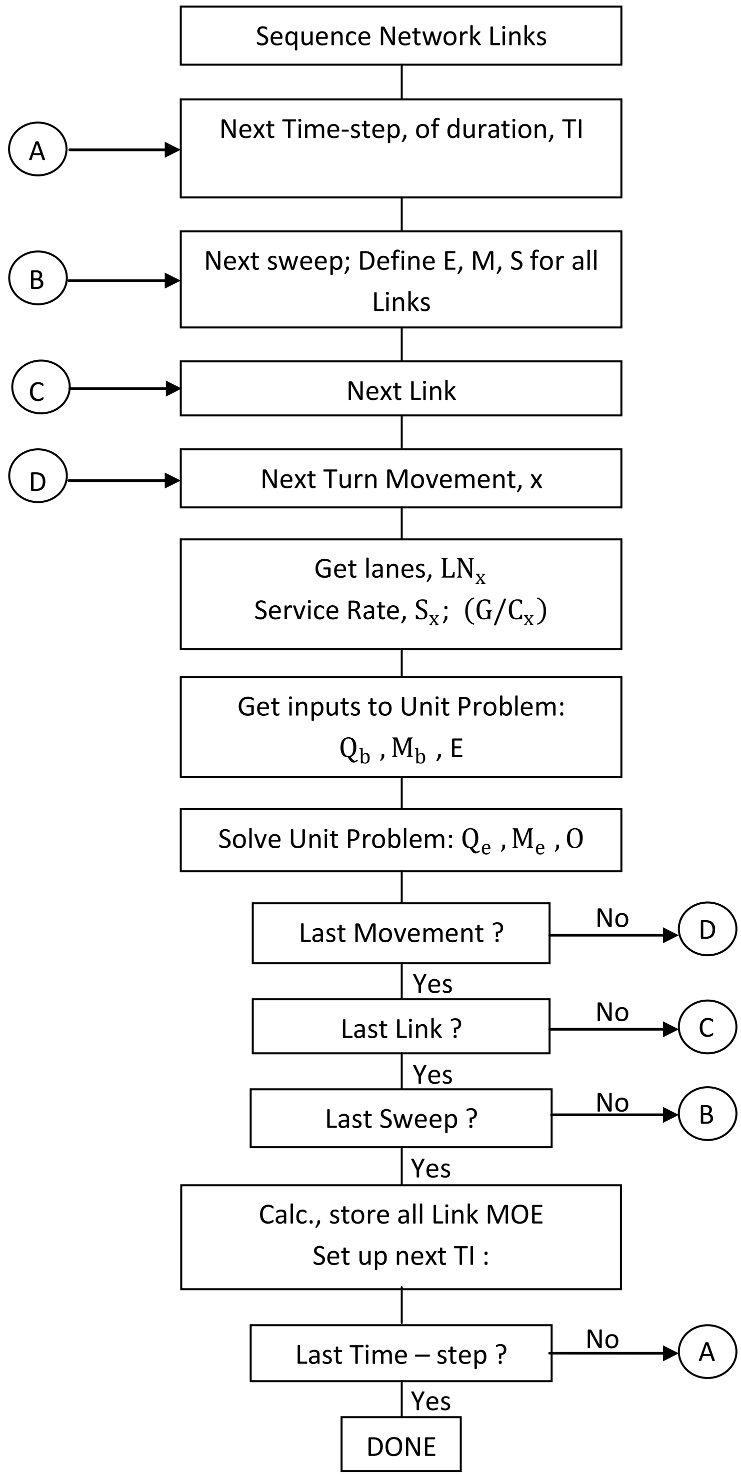


Figure C-4. Flow of Simulation Processing (See Glossary: Table C-3)

APPENDIX D

Detailed Description of Study Procedure

D. DETAILED DESCRIPTION OF STUDY PROCEDURE

This appendix describes the activities that were performed to compute Evacuation Time Estimates. The individual steps of this effort are represented as a flow diagram in Figure D-1. Each numbered step in the description that follows corresponds to the numbered element in the flow diagram.

Step 1

The first activity was to obtain EMZ information and create a GIS base map. The base map extends beyond the EMZ into the Shadow Region which is bounded by I-405 and I-5 to the North, Jamboree Road to the West, and I-5 and Pacific Coast Highway to the East. The base map incorporates the local roadway topology, a suitable topographic background and the EMZ boundaries.

Step 2

2010 Census block information was obtained in GIS format. This information was used to estimate the resident population within the EMZ and the Shadow Region and to define the spatial distribution and demographic characteristics of the population within the study area. Year-round employee data were estimated using the U.S. Census Longitudinal Employer-Household Dynamics from the OnTheMap Census analysis tool[1]. Tourist information, schools, medical and other types of special facilities data were provided by the City of Laguna Beach supplemented with internet searches.

Step 3

A kickoff meeting was conducted with major stakeholders (city emergency managers, the California Department of Transportation and county transit managers). The purpose of the kickoff meeting was to present an overview of the work effort, identify key agency personnel, and indicate the data requirements for the study. Specific requests for information were presented to the city. Unique features of the study area were discussed to identify the local concerns that should be addressed by the ETE study.

Step 4

Next, a physical survey of the roadway system in the study area was conducted to determine the geometric properties of the highway sections, the channelization of lanes on each section of roadway, whether there are any turn restrictions or special treatment of traffic at intersections, the type and functioning of traffic control devices, gathering signal timings for pre-timed traffic signals, and to make the necessary observations needed to estimate realistic values of roadway capacity.

[1] https://onthemap.ces.census.gov/

Step 5

A demographic survey of households within the EMZ was conducted to identify household dynamics, trip generation characteristics, and evacuation-related demographic information of the EMZ population. This information was used to determine important study factors including the average number of evacuating vehicles used by each household, and the time required to perform pre-evacuation mobilization activities.

Step 6

A computerized representation of the physical roadway system, called a link-node analysis network, was developed using the UNITES software developed by KLD. Once the geometry of the network was completed, the network was calibrated using the information gathered during the road survey (Step 4). Estimates of highway capacity for each link and other link-specific characteristics were introduced to the network description. Traffic signal timings were input accordingly. The link-node analysis network was imported into a GIS map. Census data was overlaid in the map, and origin centroids where trips would be generated during the evacuation process were assigned to appropriate links.

Step 7

Regions (groupings of EMZ) that may be advised to evacuate, were developed.

The need for evacuation can occur over a range of time-of-day, day-of-week, seasonal and weather-related conditions. Scenarios were developed to capture the variation in evacuation demand, highway capacity and mobilization time, for different time of day, day of the week, time of year, and weather/roadway conditions.

Step 8

Access impaired neighborhoods were identified and classified based on specific evacuation criteria. Two classification tiers for neighborhoods were created. Neighborhoods falling into the first tier were classified as having limited ingress/egress routes and containing a cluster of houses. Neighborhoods falling into the second tier were classified as having limited ingress/egress routes, containing a cluster of houses, and having evacuation routes that could potentially be blocked by fires in wooded areas. These two tiers were then analyzed to create recommendations for safe refuge areas as well as evacuation signage for these neighborhoods.

Step 9

The input stream for the DYNEV II model, which integrates the dynamic traffic assignment and distribution model, DTRAD, with the evacuation simulation model, was created for a prototype evacuation case – the evacuation of the entire EMZ for a representative scenario.

Step 10

After creating this input stream, the DYNEV II System was executed on the prototype evacuation case to compute evacuating traffic routing patterns. DYNEV II contains an extensive suite of data diagnostics which check the completeness and consistency of the input data specified. The analyst reviews all warning and error messages produced by the model and then corrects the database to create an input stream that properly executes to completion.

The model assigns destinations to all origin centroids consistent with a (general) radial evacuation of the EMZ and Shadow Region, away from the hazard. The analyst may optionally supplement and/or replace these model-assigned destinations, based on professional judgment, after studying the topology of the analysis highway network. The model produces link and network-wide measures of effectiveness as well as estimates of evacuation time.

Step 11

The results generated by the prototype evacuation case are critically examined. The examination includes observing the animated graphics (using the EVAN software which operates on data produced by DYNEV II) and reviewing the statistics output by the model. This is a labor-intensive activity, requiring the direct participation of skilled engineers who possess the necessary practical experience to interpret the results and to determine the causes of any problems reflected in the results.

Essentially, the approach is to identify those bottlenecks in the network that represent locations where congested conditions are pronounced and to identify the cause of this congestion. This cause can take many forms, either as excess demand due to high rates of trip generation, improper routing, a shortfall of capacity, or as a quantitative flaw in the way the physical system was represented in the input stream. This examination leads to one of two conclusions:

- The results are satisfactory; or
- The input stream must be modified accordingly.

This decision requires, of course, the application of the user's judgment and experience based upon the results obtained in previous applications of the model and a comparison of the results of the latest prototype evacuation case iteration with the previous ones. If the results are satisfactory in the opinion of the user, then the process continues with Step 14. Otherwise, proceed to Step 12.

Step 12

There are many "treatments" available to the user in resolving apparent problems. These treatments range from decisions to reroute the traffic by assigning additional evacuation destinations for one or more sources, imposing turn restrictions where they can produce significant improvements in capacity, changing the control treatment at critical intersections so as to provide improved service for one or more movements, or in prescribing specific treatments for channelizing the flow so as to expedite the movement of traffic along major roadway systems. Such "treatments" take the form of modifications to the original prototype evacuation case input stream. All treatments are designed to improve the representation of evacuation behavior.

Step 13

As noted above, the changes to the input stream must be implemented to reflect the modifications undertaken in Step 12. At the completion of this activity, the process returns to Step 10 where the DYNEV II System is again executed.

Step 14

Evacuation of transit-dependent evacuees and special facilities are included in the evacuation analysis. Fixed routing for transit buses and for school buses, ambulances, and other transit vehicles are introduced into the final prototype evacuation case data set. DYNEV II generates route-specific speeds over time for use in the estimation of evacuation times for the transit dependent and special facility population groups.

Step 15

The prototype evacuation case was used as the basis for generating all region and scenario-specific evacuation cases to be simulated. This process was automated through the UNITES user interface. For each specific case, the population to be evacuated, the trip generation distributions, the highway capacity and speeds, and other factors are adjusted to produce a customized case-specific data set.

Step 16

All evacuation cases are executed using the DYNEV II System to compute ETE. Once results were available, quality control procedures were used to assure the results were consistent, dynamic routing was reasonable, and traffic congestion/bottlenecks were addressed properly.

Step 17

Once vehicular evacuation results are accepted, average travel speeds for transit and special facility routes were used to compute evacuation time estimates for transit-dependent permanent residents, schools, hospitals, and other special facilities.

Step 18

Several ETE sensitivity studies were conducted to consider the impact on ETE based on “what if” scenarios. These scenarios include changes to roadway closures, mobilization time, number of evacuating vehicles per household, number of vehicles evacuating from the shadow region, contraflow, reducing special facility transportation resources and potential implementation of traffic management plans by the City of Laguna Beach. These scenarios were then compared to the baseline ETE to test if certain tactics could be used to reduce evacuation time.

Step 19

The simulation results are analyzed, tabulated and graphed. The results were then documented.

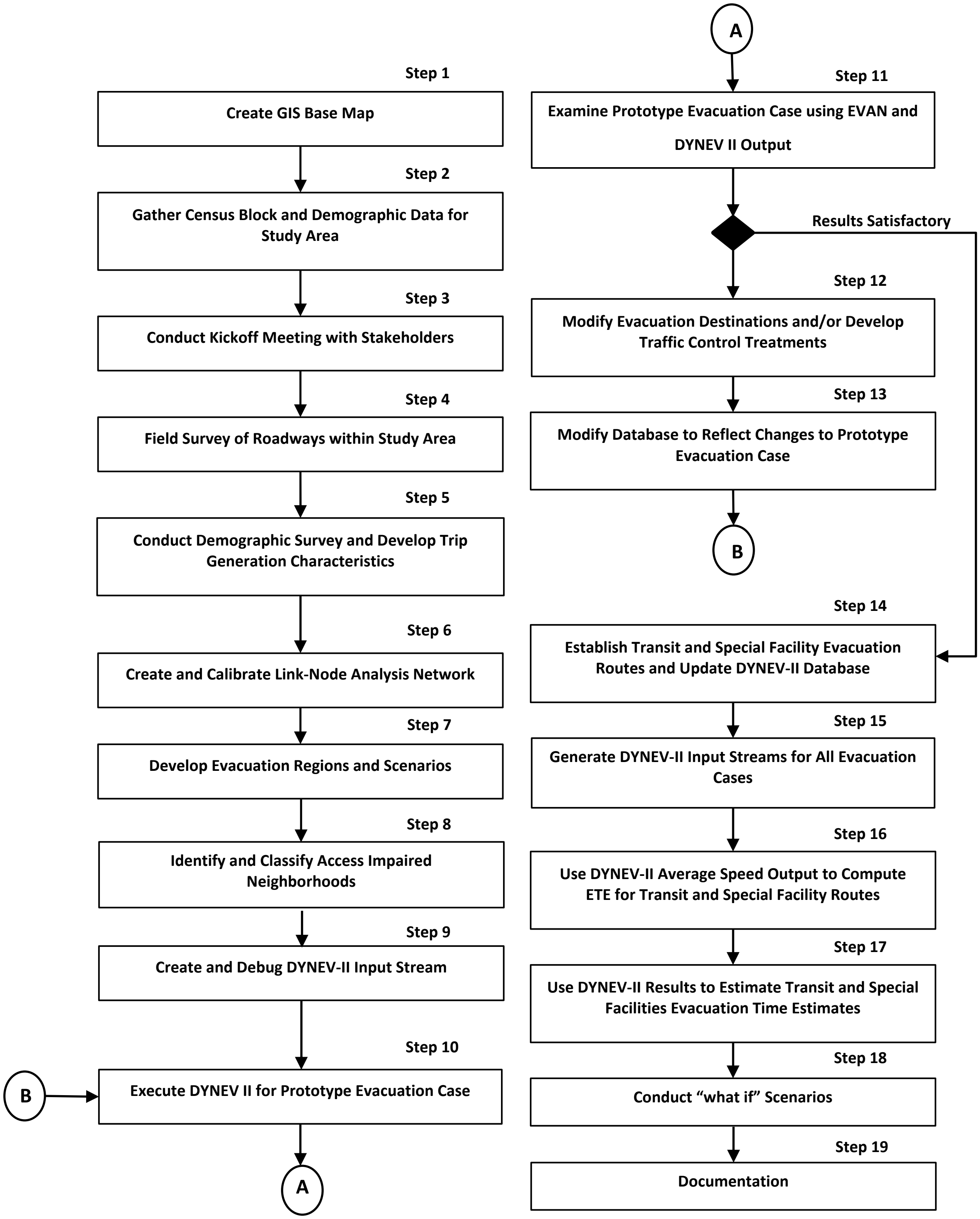


Figure D-1. Flow Diagram of Activities

APPENDIX E

Facility Data

E. FACILITY DATA

This appendix lists population information, as of September 2020, for special facilities that are located within the study area that were used in this study. Special facilities are defined as schools, preschools and medical facilities. Tourist and seasonal worker population is included in the tables for recreation centers, parks, museums, theaters, and lodging facilities. OnTheMap employment data (see Section 3, sub-section 3.4) is summarized in the table for year-round major employers. Maps of each school, preschool, medical facility, major employer, recreation center, park, beach parking lot, museum, theater, and lodging facility are also provided.

Table E-1. Schools and Preschools within the EMZ

EMZ ID	EMZ	Facility Name	Facility Type	Street Address	Municipality	Enroll-ment
3	Big Bend	Laguna College of Art and Design - Big Bend Campus	School	2825 Laguna Canyon Rd	Laguna Beach	250
3	Big Bend	Laguna College of Art and Design - Main Campus	School	2222 Laguna Canyon Rd	Laguna Beach	500
3	Big Bend	Laguna College of Art and Design - MFA Campus	School	2633 Laguna Canyon Rd	Laguna Beach	15
6	Canyon Acres	Laguna College of Art and Design - South Campus	School	787 Laguna Canyon Rd	Laguna Beach	60
9b	Central Coast	Montessori School-Laguna Beach	Preschool	340 St Ann's Dr	Laguna Beach	75
9b	Central Coast	Laguna Beach High School	School	625 Park Ave	Laguna Beach	1,116
10	Downtown	Laguna Presbyterian Pre-School	Preschool	415 Forest Ave	Laguna Beach	50
11	El Toro	Anneliese's Schools - Willowbrook	School	20062 Laguna Canyon Rd	Laguna Beach	250
13	Irvine Cove	El Morro Elementary School	School	8681 N Coast Hwy	Laguna Beach	524
15	Old Top of The World	Top of the World Elementary School	School	21601 Treetop Ln	Laguna Beach	669
16	Park Avenue	Anneliese's Schools - Manzanita	School	758 Manzanita Dr	Laguna Beach	50
16	Park Avenue	Thurston Middle School	School	2100 Park Ave	Laguna Beach	762
17	Sunset	Heidi's Pre-School	Preschool	31866 8th Ave	Laguna Beach	25
20	Wesley	Anneliese's Schools - Aliso	Preschool	21542 Wesley Dr	Laguna Beach	50
20	Wesley	St. Catherine of Siena Parish School	School	30516 S Coast Hwy	Laguna Beach	173
					TOTAL:	**4,569**

Table E-2. Medical Facilities within the EMZ

EMZ ID	EMZ	Facility Name	Street Address	Municipality	Cap-acity	Current Census	Ambul-atory Patients	Wheel-chair Patients	Bed-ridden Patients
2	Balboa/Nyes	Oceanfront Recovery at Laguna Beach, LLC	431 Nyes Pl	Laguna Beach	6	6	6	0	0
7	Ceanothus	Laguna View Center, LLC	31305 Ceanothus Dr	Laguna Beach	6	6	6	0	0
9a	North Coast	Miramar Health, INC.	339 Jasmine St	Laguna Beach	6	6	6	0	0
9b	Central Coast	Coast to Coast Referral Center, INC.	1337 Gaviota Dr	Laguna Beach	6	6	6	0	0
9b	Central Coast	Spencer Recovery Centers, INC.	1316 S Coast Hwy	Laguna Beach	28	28	28	0	0
9b	Central Coast	Spencer Recovery Centers, INC.	1337 Gaviota Dr	Laguna Beach	6	6	6	0	0
9c	South Coast	Sunshine Behavioral Health LLC	283 Upland Rd	Laguna Beach	6	6	6	0	0
10	Downtown	Pillars Recovery, LLC	224 Cliff Dr	Laguna Beach	10	10	10	0	0
14	Mar Vista	Providence Mission Hospital Laguna Beach	31872 Coast Hwy	Laguna Beach	178	75	37	30	8
15	Old Top of The World	Pillars Recovery, LLC	28772 Top of the World Dr	Laguna Beach	6	6	6	0	0
17	Sunset	Complete Resurgency, LLC	31957 Virginia Way	Laguna Beach	12	12	12	0	0
19	Top of The World	Oceanfront Recovery at Laguna Beach, LLC	2575 Temple Hills Dr	Laguna Beach	6	6	6	0	0
19	Top of The World	Oceanfront Recovery at Laguna Beach, LLC	2808 Zell Dr	Laguna Beach	6	6	6	0	0
20	Wesley	Vista Aliso	21544 Wesley Dr	Laguna Beach	75	75	37	30	8
				TOTAL:	**357**	**254**	**178**	**60**	**357**

Table E-3. Major Employers within the EMZ

EMZ ID	EMZ	Facility Name	Street Address	Municipality	Employees (Max Shift)	Employees Commuting into the EMZ	Employee Vehicles Commuting into the EMZ
5	Boat Canyon	Various locations throughout the EMZ			176	160	154
6	Canyon Acres				154	140	135
7	Ceanothus				98	89	86
10	Downtown				797	722	695
11	El Toro				32	29	28
14	Mar Vista				57	52	50
16	Park Avenue				139	126	121
17	Sunset				34	31	30
9a	North Coast				358	325	312
9b	Central Coast				884	802	773
9c	South Coast				432	392	377
				TOTAL[1]:	**3,161**	**2,868**	**2,761**

[1] The major employer locations identified by the Census Bureau are shown in Figure E-3. The locations are represented by circles which increase in size proportional to the number of non-EMZ employees present in each Census Block.

Table E-4. Recreation Centers and Parks within the Study Area

EMZ ID	EMZ	Facility Name	Facility Type	Street Address	Municipality	Tourists	Vehicles
6	Canyon Acres	Boys & Girls Club of Laguna Beach	Recreation Center	1085 Laguna Canyon Rd	Laguna Beach	225	90
8	Club Laguna	Laguna Coast Wilderness Park	Park	18751 Laguna Canyon Rd	Laguna Beach	135	45
10	Downtown	Main Beach Park[2]	Park	Broadway St & Pacific Coast Hwy	Laguna Beach	5,000	755
9a	North Coast	Crescent Bay Point Park	Park	Crescent Bay Dr	Laguna Beach	13	5
9a	North Coast	Heisler Park	Park	375 Cliff Dr	Laguna Beach	13	5
9c	South Coast	Aliso Beach County Park[3]	Park	31131 Coast Hwy	Laguna Beach	1,500	196
N/A	Shadow	Aliso and Wood Canyons Wilderness Park	Park	28373 Alicia Pkwy	Aliso Viejo	300	100
N/A	Shadow	Crystal Cove State Park	Park	8471 N Coast Hwy	Laguna Beach	300	100
Various locations		Main Beach Parking Lots[2]	Park	-	Laguna Beach	0	1,647
					TOTAL:	**7,486**	**2,943**

Table E-5. Museums and Theaters within the EMZ

EMZ ID	EMZ	Facility Name	Facility Type	Street Address	Municipality	Tourists	Vehicles
5	Boat Canyon	Festival of Arts and Pageant of the Masters	Theater	650 Laguna Canyon Rd	Laguna Beach	2,340	875
5	Boat Canyon	The Laguna Playhouse	Theater	606 Laguna Canyon Rd	Laguna Beach	450	228
6	Canyon Acres	7 Degrees[4]	Museum	891 Laguna Canyon Rd	Laguna Beach	350	0
10	Downtown	Laguna Art Museum[4]	Museum	307 Cliff Dr	Laguna Beach	225	0
					TOTAL:	**3,365**	**1,103**

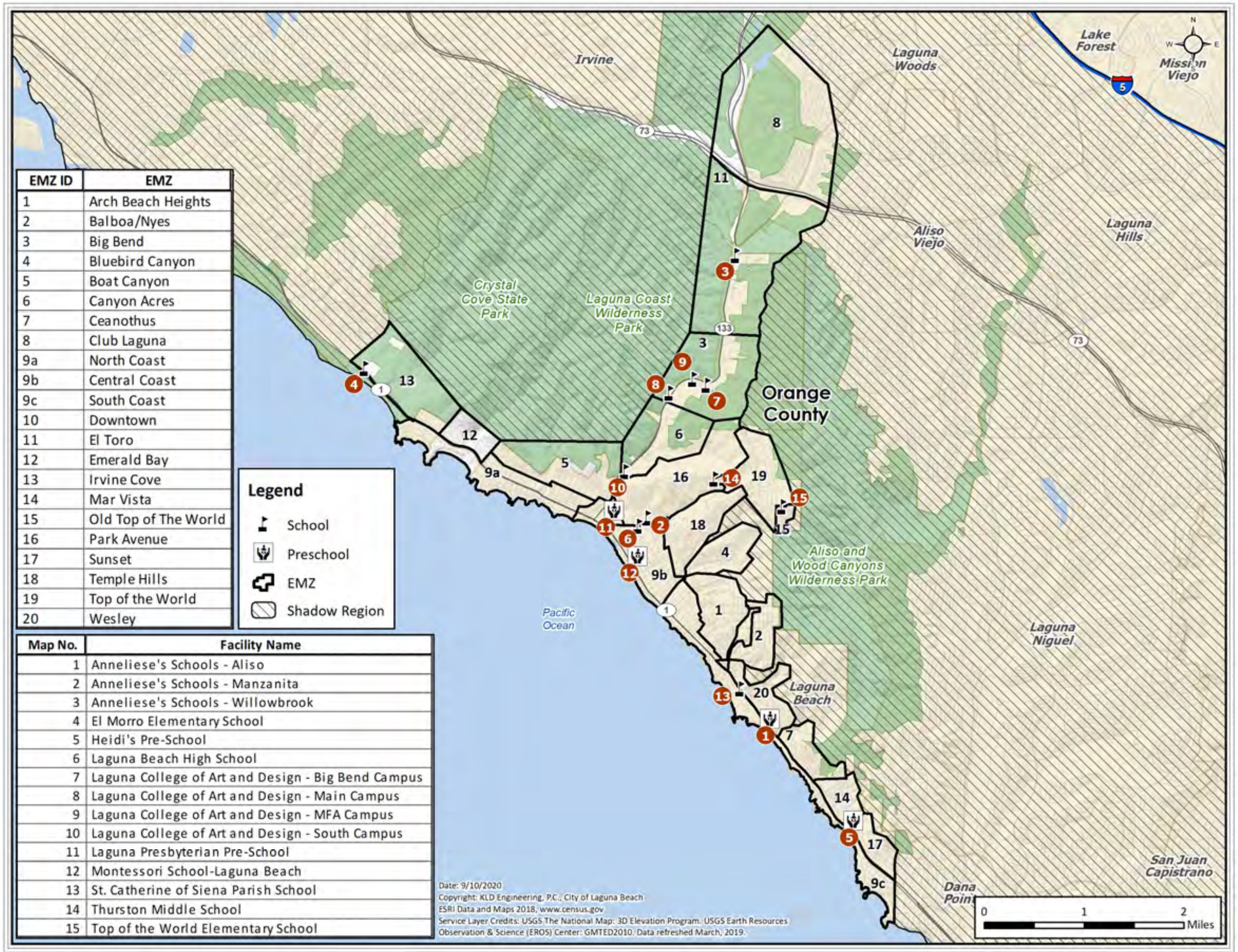
[2] Main Beach Park attracts a large number of visitors and seasonal workers on a daily basis. Due to the high demand for visitation, the city provides various parking lots in the surrounding EMZs, as shown in Figure E-5. The number of additional parking spaces is estimated based on aerial imagery.

[3] The average daily peak attendance of the non-EMZ visitors at Aliso Beach County Park is 1,500; however, parking at this park is limited. It is assumed that 25% of the vehicles are parked in the parking lots nearby and the rest are parked at nearby lodging facilities, see Table E-6. The vehicles at this facility were adjusted to avoid double counting. It should be noted that the population, however, is double counted.

[4] The non-EMZ tourists visiting 7 Degrees and Laguna Art Museum are likely to visit other tourist attractions in the city. Therefore, the vehicles for those two museums are adjusted to 0 to avoid double counting. It should be noted that the population, however, is double counted.

Table E-6. Lodging Facilities within the EMZ

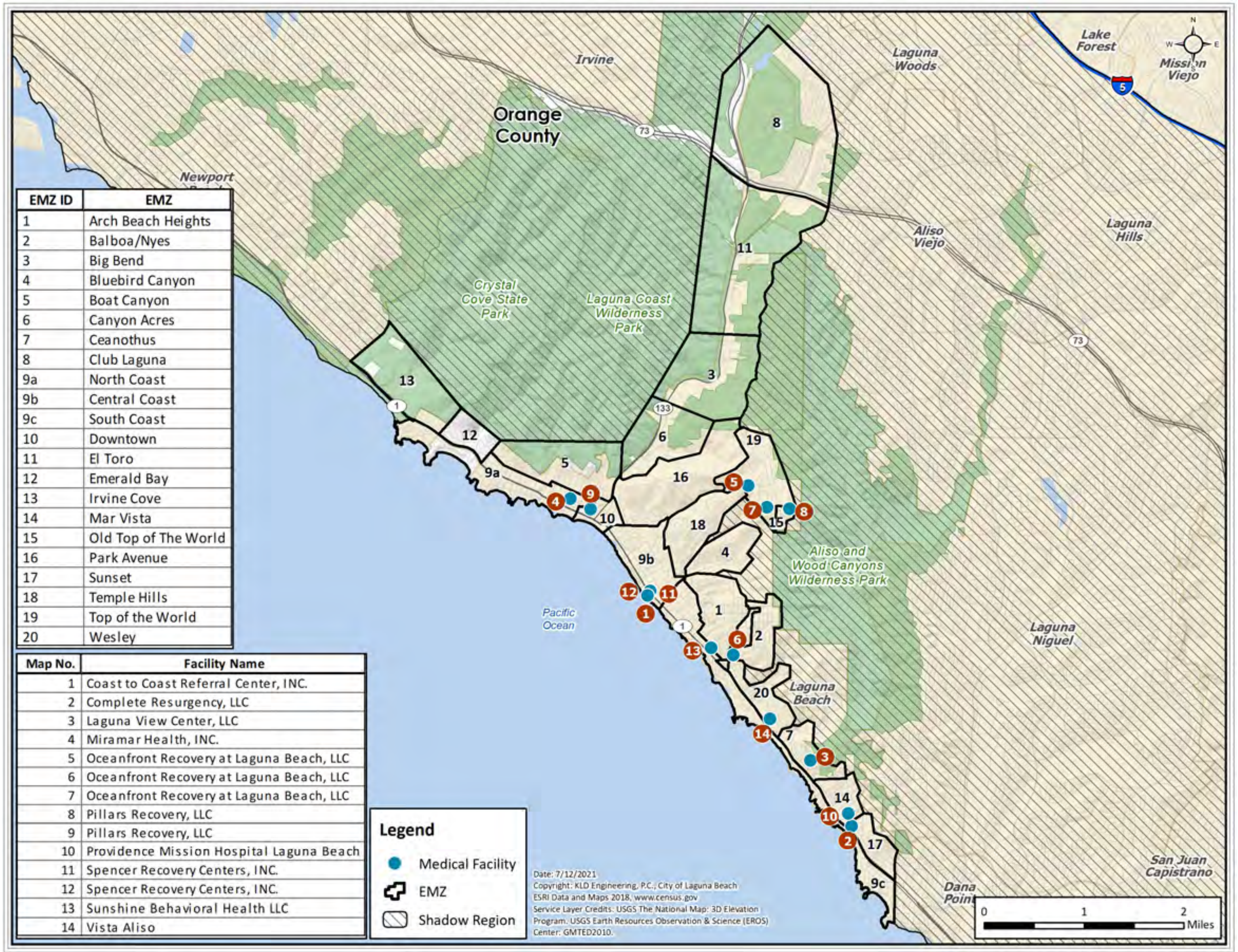
EMZ ID	EMZ	Facility Name	Street Address	Municipality	Tourists	Vehicles
9b	Central Coast	14 West Boutique Hotel	690 S Coast Hwy	Laguna Beach	40	16
9b	Central Coast	Capri Laguna	1441 S Coast Hwy	Laguna Beach	113	45
9b	Central Coast	Holiday Inn Laguna Beach	696 S Coast Hwy	Laguna Beach	189	54
9b	Central Coast	Hotel Seven4one	741 S Coast Hwy	Laguna Beach	25	7
9b	Central Coast	La Casa Del Camino	1289 S Coast Hwy	Laguna Beach	112	32
9b	Central Coast	Laguna Riviera Beach Resort	825 S Coast Hwy	Laguna Beach	147	42
9b	Central Coast	Laguna Surf	611 S Coast Hwy	Laguna Beach	66	33
9b	Central Coast	Pacific Edge Hotel	647 S Coast Hwy	Laguna Beach	634	181
9b	Central Coast	Surf and Sand Resort	1555 S Coast Hwy	Laguna Beach	560	160
9b	Central Coast	The Retreat In Laguna Beach	729 Gaviota Dr	Laguna Beach	20	8
7	Ceanothus	The Ranch at Laguna Beach	31106 Coast Hwy	Laguna Beach	567	162
10	Downtown	The Inn at Laguna Beach	211 N Pacific Coast Hwy	Laguna Beach	245	70
9a	North Coast	Art Hotel Laguna Beach	1404 N Pacific Coast Hwy	Laguna Beach	95	27
9a	North Coast	Crescent Bay Inn Laguna Beach	1435 N Coast Hwy	Laguna Beach	70	28
9a	North Coast	Laguna Beach House	475 N Coast Hwy	Laguna Beach	144	41
9a	North Coast	Laguna Shores	419 N Coast Hwy	Laguna Beach	50	20
9a	North Coast	The Tides Laguna Beach	460 N Coast Hwy	Laguna Beach	53	21
9c	South Coast	Casa Laguna Hotel & Spa	2510 S Coast Hwy	Laguna Beach	35	14
9c	South Coast	Laguna Beach Inn	2020 S Coast Hwy	Laguna Beach	65	26
9c	South Coast	Laguna Brisas Hotel	1600 S Coast Hwy	Laguna Beach	245	70
9c	South Coast	Montage Laguna Beach	30801 S Coast Hwy	Laguna Beach	1,050	300
9c	South Coast	Seaside Laguna Inn & Suites	1661 S Coast Hwy	Laguna Beach	73	29
20	Wesley	Laguna Beach Lodge	30806 Coast Hwy	Laguna Beach	140	40
				TOTAL:	**4,738**	**1,426**



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Map No.	Facility Name
1	Anneliese's Schools - Aliso
2	Anneliese's Schools - Manzanita
3	Anneliese's Schools - Willowbrook
4	El Morro Elementary School
5	Heidi's Pre-School
6	Laguna Beach High School
7	Laguna College of Art and Design - Big Bend Campus
8	Laguna College of Art and Design - Main Campus
9	Laguna College of Art and Design - MFA Campus
10	Laguna College of Art and Design - South Campus
11	Laguna Presbyterian Pre-School
12	Montessori School-Laguna Beach
13	St. Catherine of Siena Parish School
14	Thurston Middle School
15	Top of the World Elementary School

Figure E-1. Schools and Preschools within the EMZ



EMZ ID	EMZ
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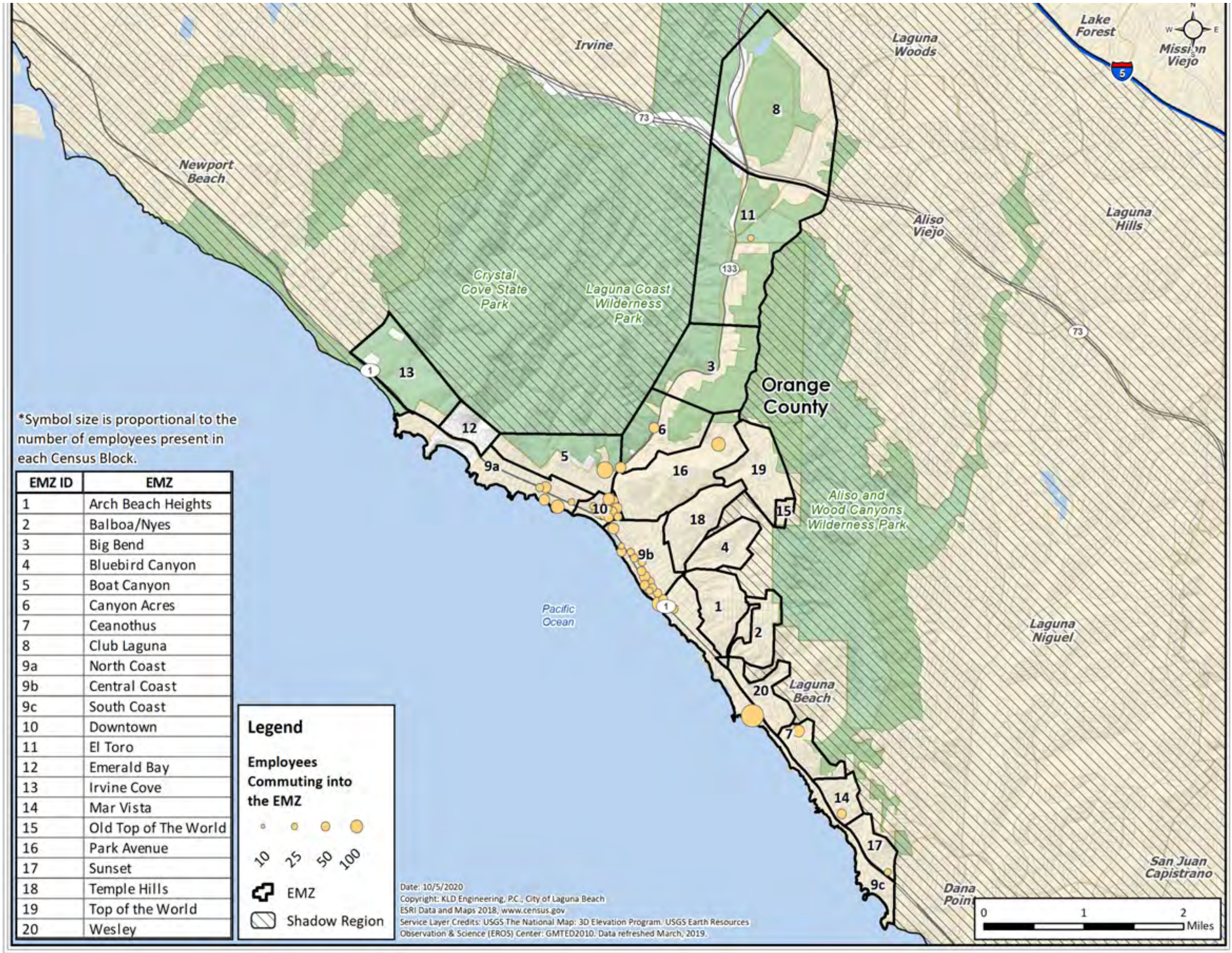
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Map No.	Facility Name
1	Coast to Coast Referral Center, INC.
2	Complete Resurgency, LLC
3	Laguna View Center, LLC
4	Miramar Health, INC.
5	Oceanfront Recovery at Laguna Beach, LLC
6	Oceanfront Recovery at Laguna Beach, LLC
7	Oceanfront Recovery at Laguna Beach, LLC
8	Pillars Recovery, LLC
9	Pillars Recovery, LLC
10	Providence Mission Hospital Laguna Beach
11	Spencer Recovery Centers, INC.
12	Spencer Recovery Centers, INC.
13	Sunshine Behavioral Health LLC
14	Vista Aliso

Figure E-2. Medical Facilities within the EMZ



EMZ ID	EMZ
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3	Big Bend
4	Bluebird Canyon
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6	Canyon Acres
7	Ceanothus
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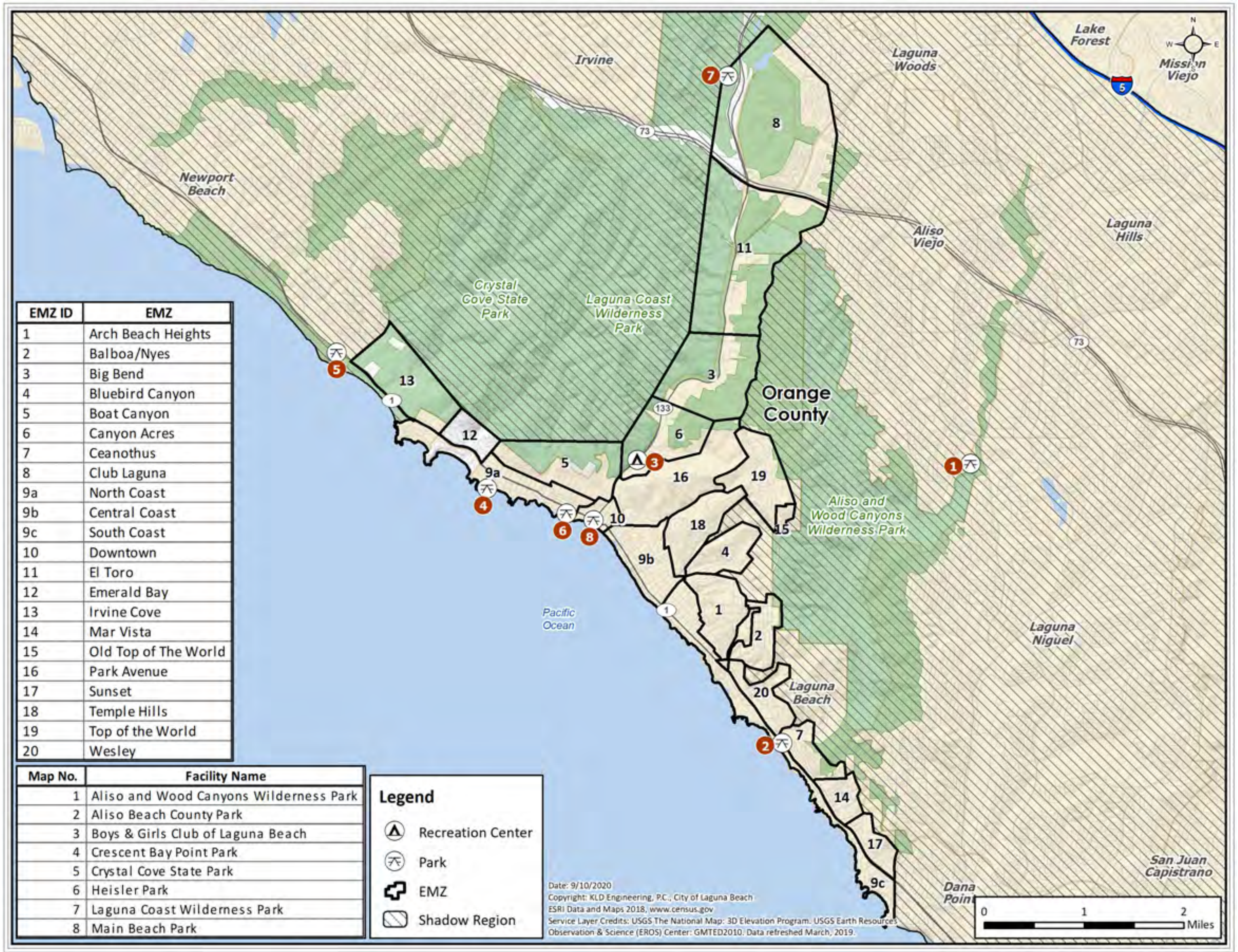
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure E-3. Major Employers within the EMZ



EMZ ID	EMZ
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10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Map No.	Facility Name
1	Aliso and Wood Canyons Wilderness Park
2	Aliso Beach County Park
3	Boys & Girls Club of Laguna Beach
4	Crescent Bay Point Park
5	Crystal Cove State Park
6	Heisler Park
7	Laguna Coast Wilderness Park
8	Main Beach Park

Figure E-4. Recreation Centers and Parks within the Study Area

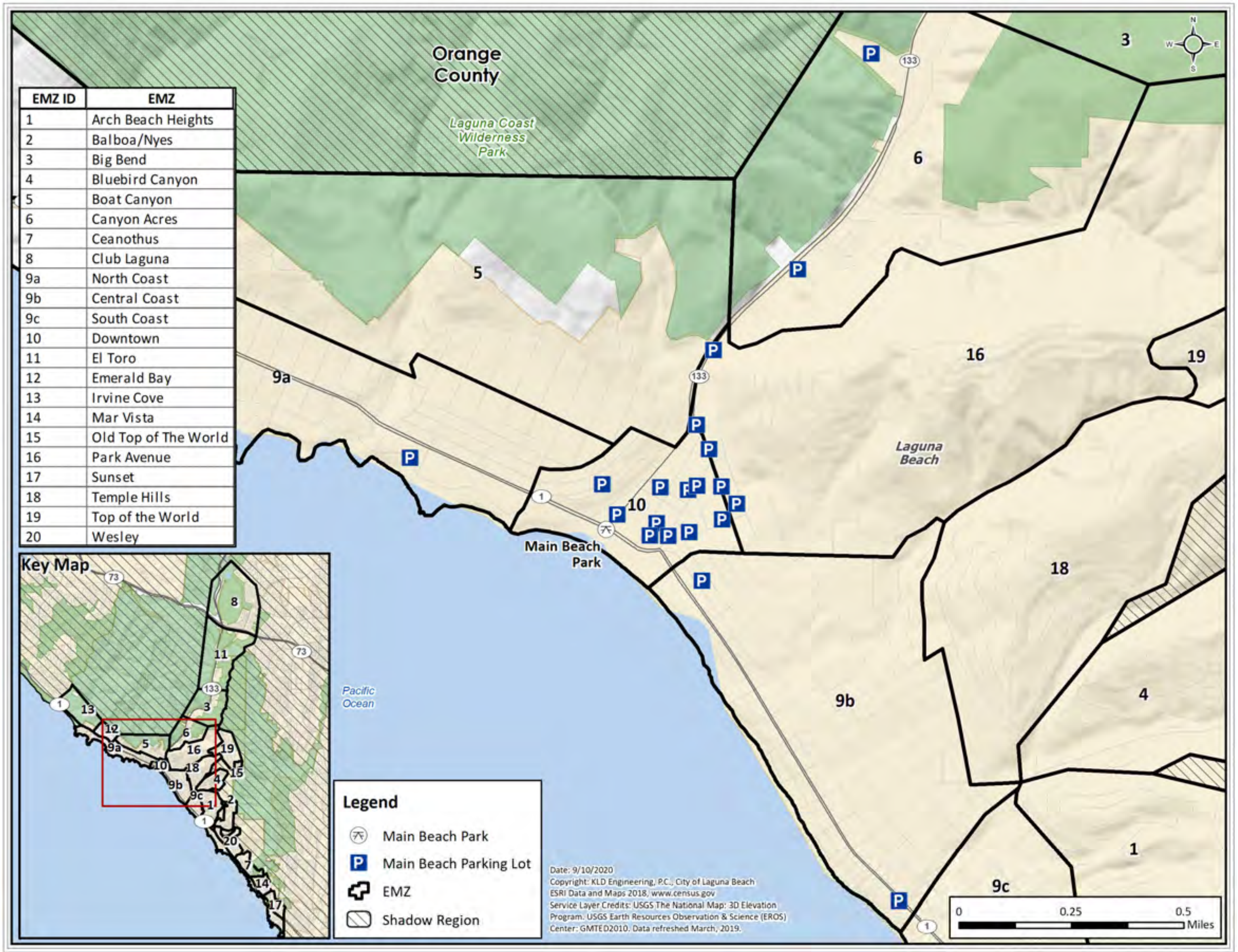


Figure E-5. Main Beach Parking Lots within the EMZ

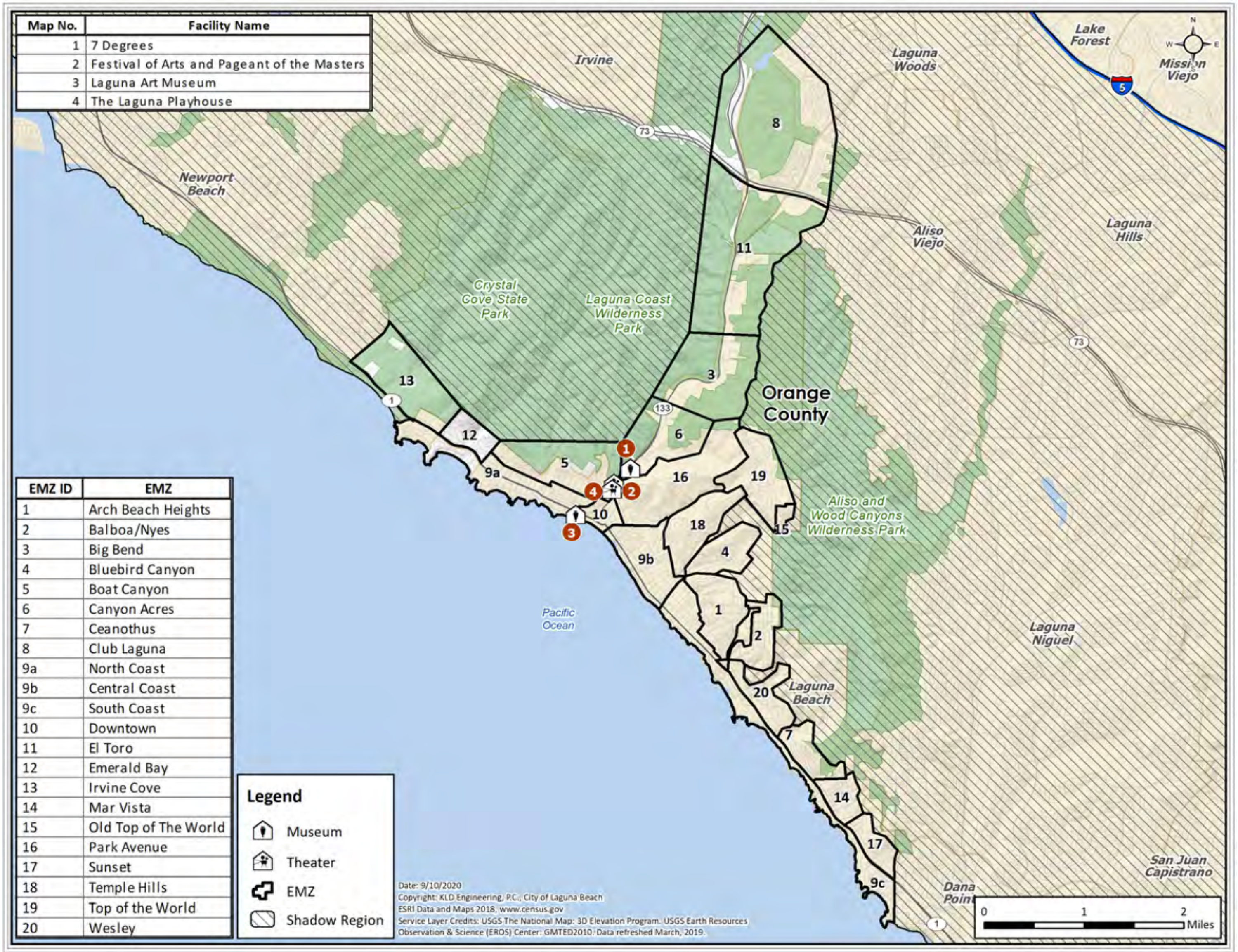
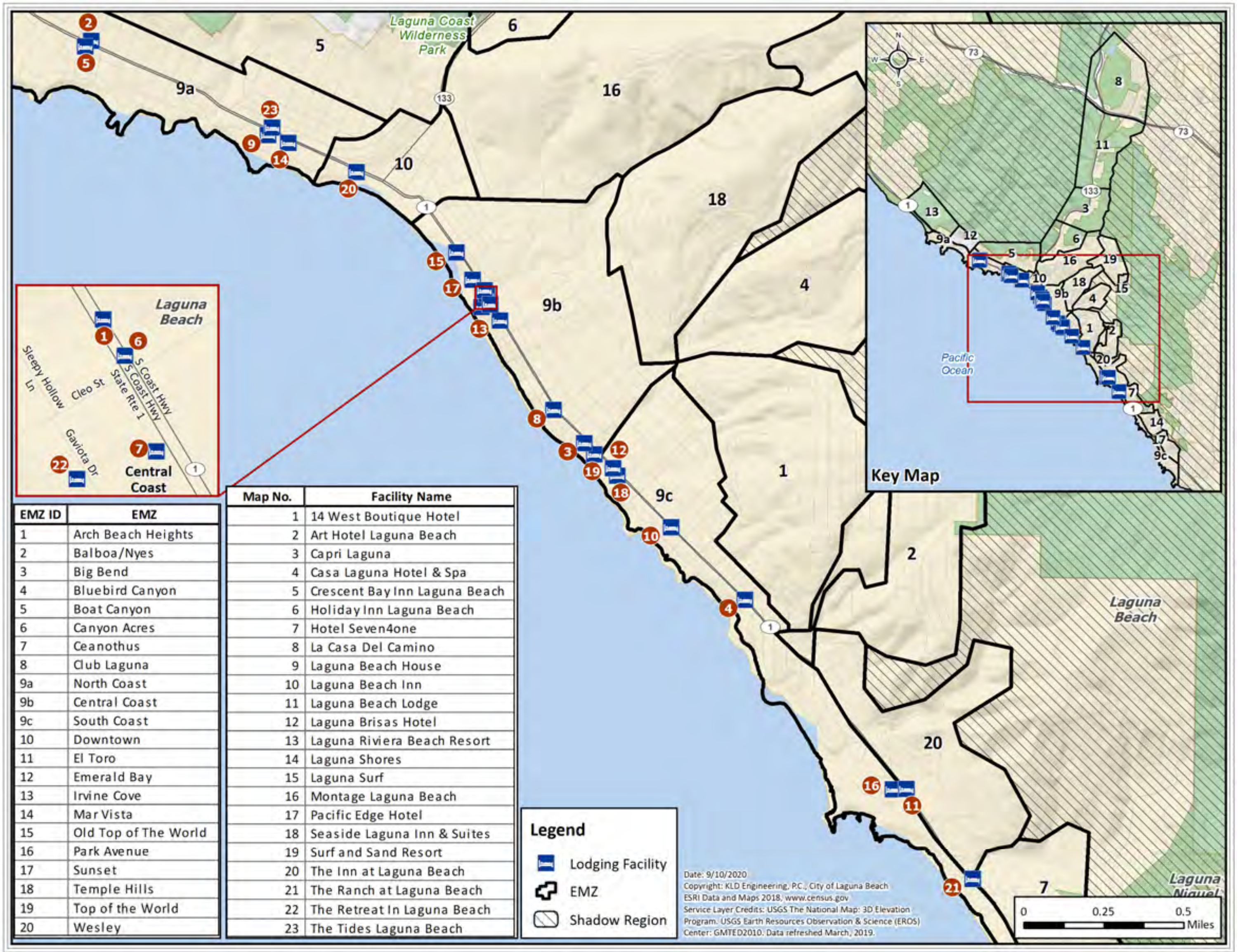


Figure E-6. Museums and Theaters within the EMZ



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Map No.	Facility Name
1	14 West Boutique Hotel
2	Art Hotel Laguna Beach
3	Capri Laguna
4	Casa Laguna Hotel & Spa
5	Crescent Bay Inn Laguna Beach
6	Holiday Inn Laguna Beach
7	Hotel Seven4one
8	La Casa Del Camino
9	Laguna Beach House
10	Laguna Beach Inn
11	Laguna Beach Lodge
12	Laguna Brisas Hotel
13	Laguna Riviera Beach Resort
14	Laguna Shores
15	Laguna Surf
16	Montage Laguna Beach
17	Pacific Edge Hotel
18	Seaside Laguna Inn & Suites
19	Surf and Sand Resort
20	The Inn at Laguna Beach
21	The Ranch at Laguna Beach
22	The Retreat In Laguna Beach
23	The Tides Laguna Beach

Figure E-7. Lodging Facilities within the EMZ

APPENDIX F

Demographic Survey

F. DEMOGRAPHIC SURVEY

This appendix presents the results obtained from a Demographic Survey that was conducted in support of this study. Outlined below is the survey sampling plan, results obtained, and survey instrument (See Attachment A).

F.1 Introduction

The development of evacuation time estimates for the City of Laguna Beach Emergency Management Zones (EMZ) requires the identification of travel patterns, car ownership and household size of the population. Demographic information can be obtained from Census data, however, the use of this data has several limitations when applied to emergency planning. First, the Census data do not encompass the range of information needed to identify the time required for preliminary activities (mobilization) that must be undertaken prior to evacuating the area. Secondly, Census data do not contain attitudinal responses needed from the population of the EMZ and consequently may not accurately represent the anticipated behavioral characteristics of the evacuating populace.

These concerns are addressed by conducting a demographic survey of a representative sample of the study area population. The survey is designed to elicit information from the public concerning family demographics and estimates of response times to well defined events. The design of the survey includes a limited number of questions of the form “What would you do if …?” and other questions regarding activities with which the respondent is familiar (“How long does it take you to …?”).

F.2 Survey Instrument and Sampling Plan

Attachment A presents the final survey instrument used for the demographic survey. A draft of the instrument was submitted to stakeholders for comment. Comments were received and the survey instrument was modified accordingly, prior to conducting the survey.

Following the completion of the instrument, a sampling plan was developed. A sample size of 409 **completed** survey forms yields results with a sampling error of approximately ±4.81 at the 95% confidence level. The sample must be drawn from the study population (see Section 3.1). A list of zip codes in the study area was developed using geographic information system (GIS) software.

The demographic survey was conducted in front of local supermarkets and through an online form. Surveys completed in person were conducted outside of stores where local residents could use a tablet or a printed-out paper version to answer the survey questions. Out of town shoppers also completed surveys, however their responses are not included in the survey sample. The survey sample only includes respondents whose zip code is located inside the study area. The demographic survey was also posted electronically on the city’s website and social media accounts and as a press release from the Laguna Beach Police Department.

F.3 Survey Results

The results of the survey fall into three categories. The first category is household demographic results. Household demographic information includes such factors as household size, automobile ownership, automobile availability, commuters, and certain technology uses in the household. The second category of survey results is about evacuation responses. This section contains results regarding how residents in the study area would respond to an evacuation. The third category of results contains time distributions for performing certain pre-evacuation activities. These data are processed to develop the trip generation distributions used in the evacuation modeling effort, as discussed in Section 5.

A review of the survey instrument reveals that several questions have a "Don't Know" (DK) or "Decline to State" option for a response. It is accepted practice in conducting surveys of this type to accept the answers of a respondent who offers a DK or "Decline to State" response for a few questions. To address the issue of occasional DK/declined responses from a large sample, the practice is to assume that the distribution of these responses is the same as the underlying distribution of the positive responses. In effect, the DK/declined responses are ignored, and the distributions are based upon the positive data that is acquired.

F.3.1 Household Demographic Results

<u>Household Size</u>

Figure F-1 presents the distribution of household size within the EMZ based on the responses to the demographic survey. The average household contains 2.39 people.

<u>Automobile Ownership</u>

The average number of automobiles available per household in the study area is 2.21. The distribution of automobile ownership is presented in Figure F-2. It should be noted that less than 1% of people do not have access to a vehicle. Figure F-3 and Figure F-4 present the automobile availability by household size. As expected, all households of 2 or more people have access to at least one vehicle. Figure F-5 shows the percent of households that own an electric vehicle. Approximately 18 percent of households own at least one electric vehicle.

<u>Ridesharing</u>

An overwhelming proportion (76%) of the households surveyed responded that they could share a ride with a neighbor, relative, or friend if a car was not available to them when advised to evacuate.

<u>Commuters</u>

Figure F-6 presents the distribution of the number of commuters in each household. Commuters are defined as household members who travel to work or college on a daily basis. The data shows an average of 0.87 commuters per household in the study area, and approximately 56% of households have at least one commuter.

Commuter Travel Modes

Figure F-7 presents the mode of travel that commuters use on a daily basis. The vast majority of commuters use their private automobiles to travel to work. The data shows an average of 1.04 employees per vehicle, assuming 2 people per vehicle – on average – for carpools.

F.3.2 Evacuation Response

Several questions were asked to gauge the population's response to an emergency. These are now discussed:

"How many vehicles would your household use during a wildfire evacuation?" The response is shown in Figure F-8. On average, evacuating households would use 1.64 vehicles.

"Would your family await the return of other family members prior to evacuating the area?" Of the survey participants who responded, approximately 18% said they would await the return of other family members before evacuating and 82% indicated they would not await the return of other family members.

"What type of pet(s) and/or animal(s) do you have?" Based on the responses, approximately 57% of the households have pets and/or animals. Of the households that own pets and/or animals, 95% of them indicated that they own a domesticated animal (or household pet). This category includes dogs, cats, birds, reptiles, and fish. Approximately 4% of households own farm animals like horses, chickens, goats, and pigs. Less than one percent of households indicated that they own other small pets/animals but did not specify. Figure F-9 presents these percentages.

"If you have a household pet and/or an animal, would you take your pet with you if you were asked to evacuate the area?" Based on the responses to the survey 99% of households that own pets and/or animals would take them during an evacuation. Of the households with pets and/or animals, 99% indicated that they have sufficient room in their vehicles to evacuate with them. Less than 1% would take their animals using a trailer. Approximately 1% of respondents who have pets and/or animals would leave them at home during an evacuation. Of the respondents who would elect to take their animals with them during an evacuation, 27.5% would take them to a shelter, and 71.5% would take them somewhere else. These percentages are displayed in Figure F-10.

"Emergency officials advise you to take shelter at home in an emergency. Would you?" This question is designed to elicit information regarding compliance with instructions to shelter-in-place. The results indicate that 86% of households who are advised to shelter-in-place would do so; the remaining 14% would choose to evacuate the area. Therefore, 14% of the population within the shadow region and within the EMZ not advised to evacuate will voluntarily evacuate.

"Emergency officials advise you to take shelter at home now in an emergency and possibly evacuate later while people in other areas are advised to evacuate now. Would you?" This question is designed to elicit information specifically related to the possibility of a staged evacuation. That is, asking a population to shelter-in-place now and then to evacuate after a specified period of time. The results indicate that 74% of households would follow instructions and delay the start of evacuation until so advised, while 26% of respondents would choose to begin evacuating immediately.

"Emergency officials advise you to evacuate due to a wildfire. Where would you evacuate to?" Based on the responses, approximately 49% would evacuate to a friend/relative's home. Approximately 22% would evacuate to a hotel, motel, or campground. Approximately 4% of the study area households would evacuate to a second home. Three percent of respondents would evacuate to a beach. One percent would choose not to evacuate. See Figure F-11 for complete results.

"Emergency officials advise you to evacuate. Would you notify a neighbor or friend to evacuate as well?" This question is designed to elicit information regarding notification between residents in the study area. Based on the respondents who elected to answer, approximately 94% said they would notify a neighbor or a friend.

"How would you notify a neighbor or friend to evacuate during an emergency?" This question is designed to see how respondents in the study area would notify neighbors or friends during an evacuation. From the respondents who elected to notify a neighbor or friend during an evacuation, 46% would choose to notify them in person. From the remaining respondents, 27% would notify neighbors or friends using a text message, 24% would notify them over the phone, and 3% would notify them using some form of social media. Figure F-12 displays these results.

"How would you rate the cell phone coverage in your area?" Figure F-13 presents how the respondents rated cell phone coverage in their area. The purpose of this question was to gain insight into how well a cell phone based alert and/or notification would be received. This question was added for informational purposes only and was not used in this study. As shown in the figure, the data is normally distributed with 74% of respondents rating cell phone coverage as fair, good, or very good in their area. Nine percent of respondents rated their cell phone coverage as excellent, and 17% rated cell phone coverage as poor or very poor in their area.

"Would members of your household require Functional or Transportation needs during an evacuation?" Of those who responded to the survey, 7.82% would need transportation assistance to evacuate. Approximately 38% of people who require transportation assistance would require a bus, 9% would require a medical bus/van, and 6% would require a wheelchair accessible vehicle. The remaining 47% of people indicated that they would require some other form of transportation, as shown in Figure F-14.

"Have you opted into your local Emergency Alert and Warning systems?" Figure F-15 displays the percentages of respondents who have opted into their local emergency alert and warning systems by method. From the respondents, approximately 90 percent indicated that they are opted into their local emergency alert systems. Of the residents that are opted in, 45 percent indicated that they registered using their residential phone number, 90 percent using their cell phone number, 61 percent using their email address and/or 86 percent opted in by text message. It should be noted some people are opted into multiple methods of notification. The majority of the study area residents who are registered are opted into both NIXLE and AlertOC (99 percent) while a few indicated they are opted into other emergency alert systems (one percent).

F.3.3 Time Distribution Results

The survey asked several questions about the amount of time it takes to perform certain pre-evacuation activities. These activities involve actions taken by residents during the course of their day-to-day lives. Thus, the answers fall within the realm of the responder's experience.

The mobilization distributions provided below are the result of having applied the analysis described in Section 5.4.1 on the component activities of the mobilization.

"How long would it take you to notify a neighbor or friend to evacuate?" This question is designed to see how long it would take respondents to notify a neighbor or friend should they choose to do so. From the respondents who elected to notify a neighbor or friend during an evacuation, 70% responded they would notify them in 5 minutes or less. Twenty percent said it would take them between 6 and 10 minutes to notify a neighbor or friend, and 6% said it would take them between 11 and 15 minutes. The remaining said it would take them 20 minutes or more to notify a neighbor or friend during an evacuation. This distribution is displayed in Figure F-16.

"How long does it take the commuter to complete preparation for leaving work?" Figure F-17 presents the cumulative distribution; in all cases, the activity is completed by 45 minutes. Approximately, 90% can leave in less than 25 minutes.

"How long would it take the commuter to travel home?" Figure F-18 presents the work to home travel time for the EMZ. Approximately 50% of commuters can arrive home within 25 minutes of leaving work; all within 105 minutes.

"How long would it take the family to pack clothing, secure the house, and load the car?" Figure F-19 presents the time required to prepare for leaving on an evacuation trip. In many ways this activity mimics a family's preparation for a short holiday or weekend away from home. Hence, the responses represent the experience of the responder in performing similar activities.

The distribution shown in Figure F-19 has a long "tail." Approximately 82% of households can be ready to leave home within 60 minutes; the remaining households require up to an additional 90 minutes.

F.4 Conclusions

The demographic survey provides valuable, relevant data associated with the study area population. This data is used to quantify demographics specific to the study area and "mobilization time", which can influence evacuation time estimates.

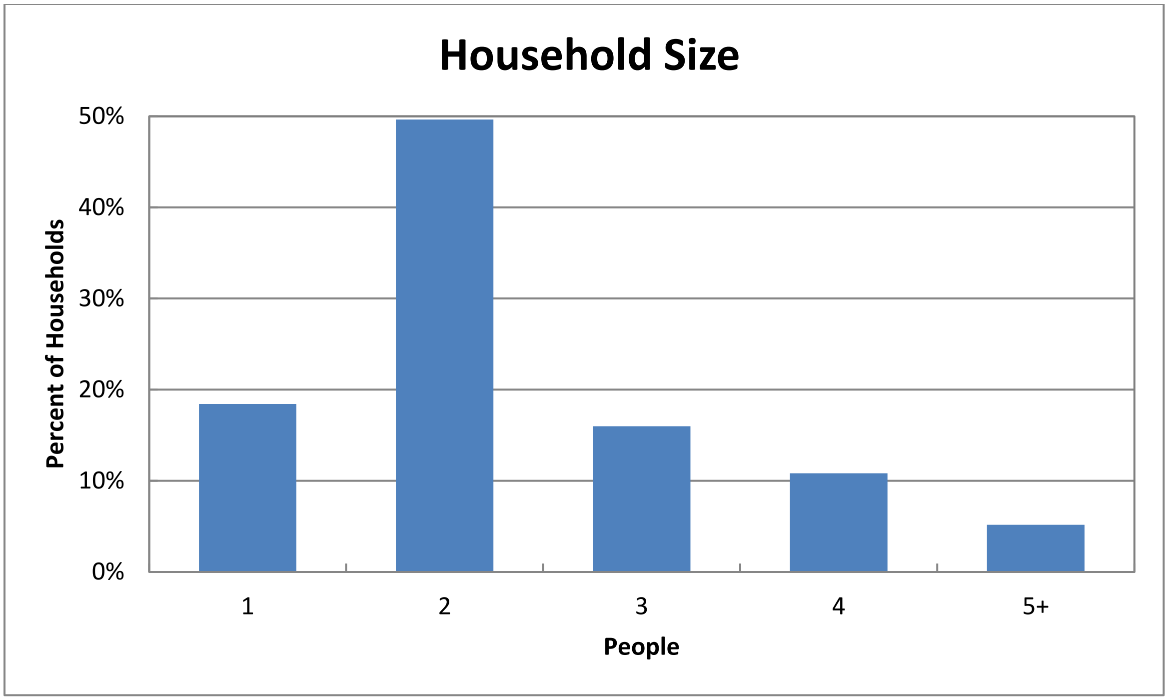


Figure F-1. Household Size in the Study Area

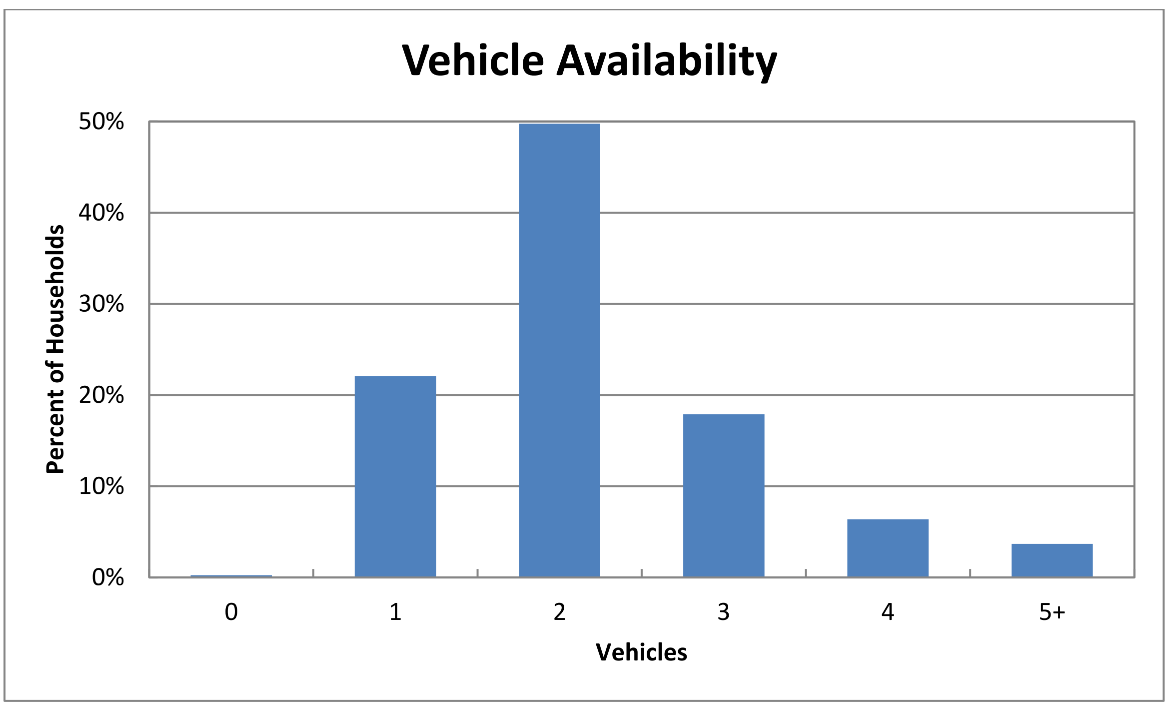


Figure F-2. Vehicle Availability

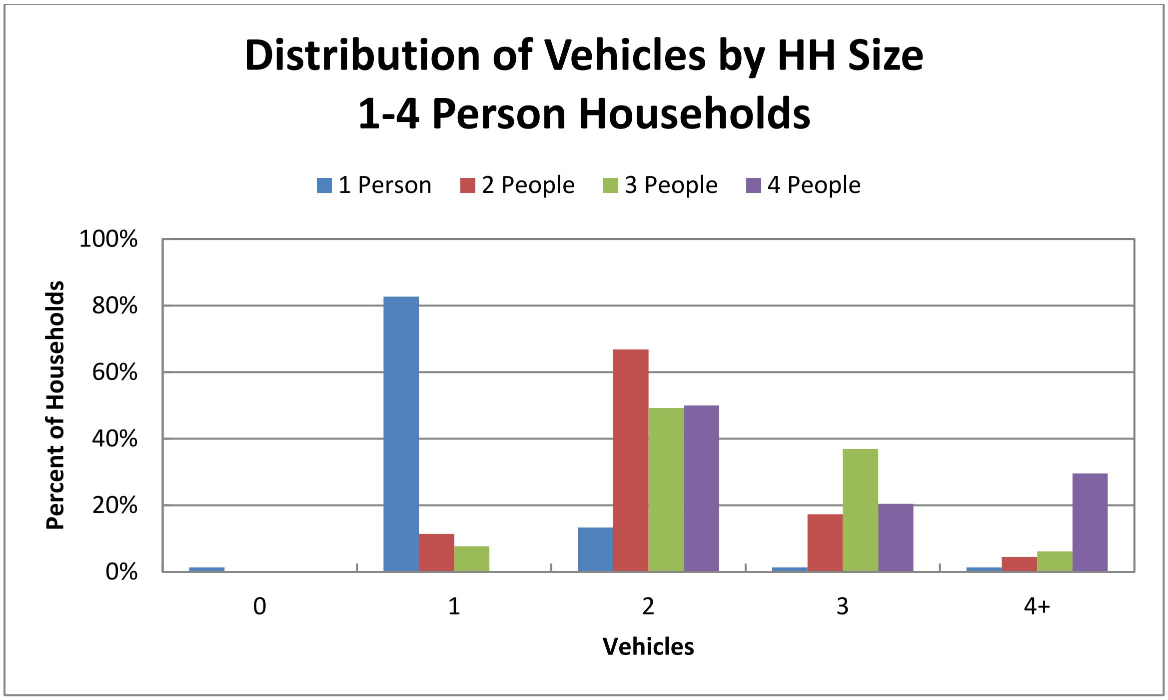


Figure F-3. Vehicle Availability - 1 to 4 Person Households

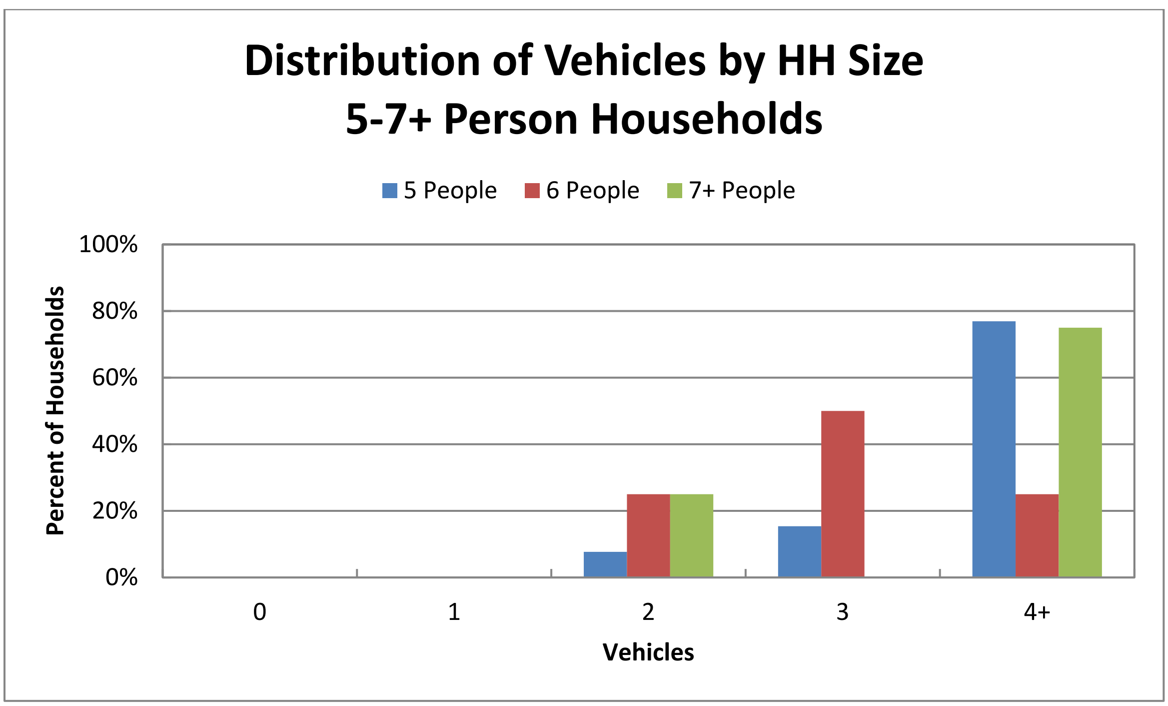


Figure F-4. Vehicle Availability – 5 to 7+ Person Households

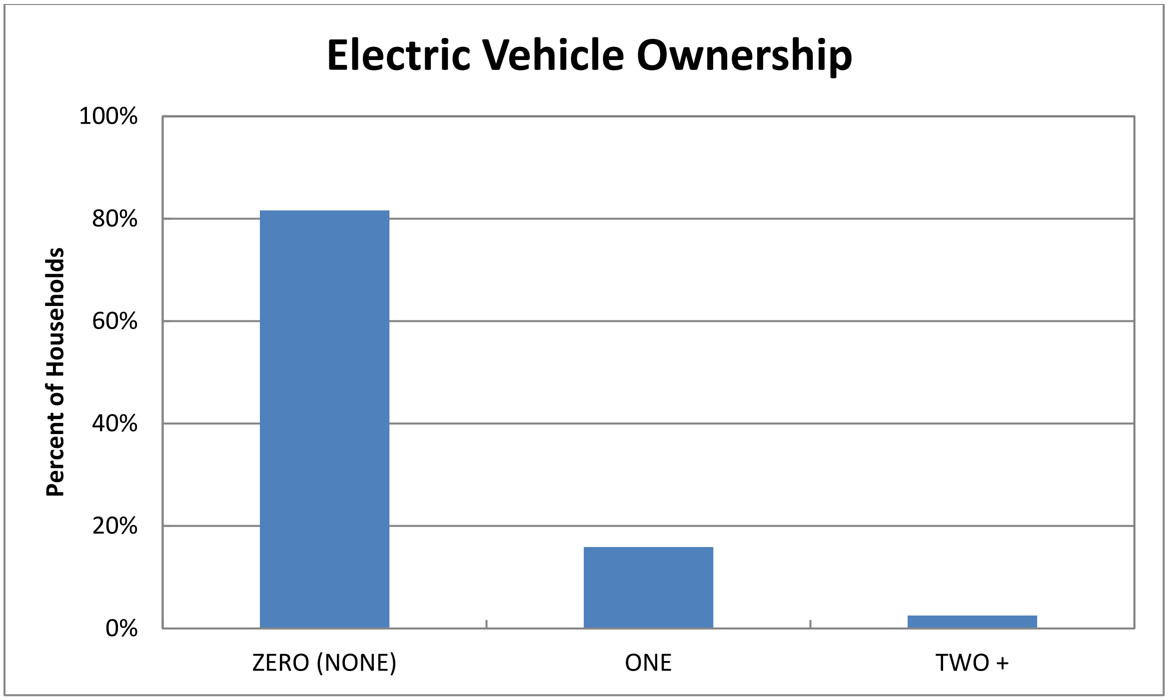


Figure F-5. Electric Vehicle Ownership

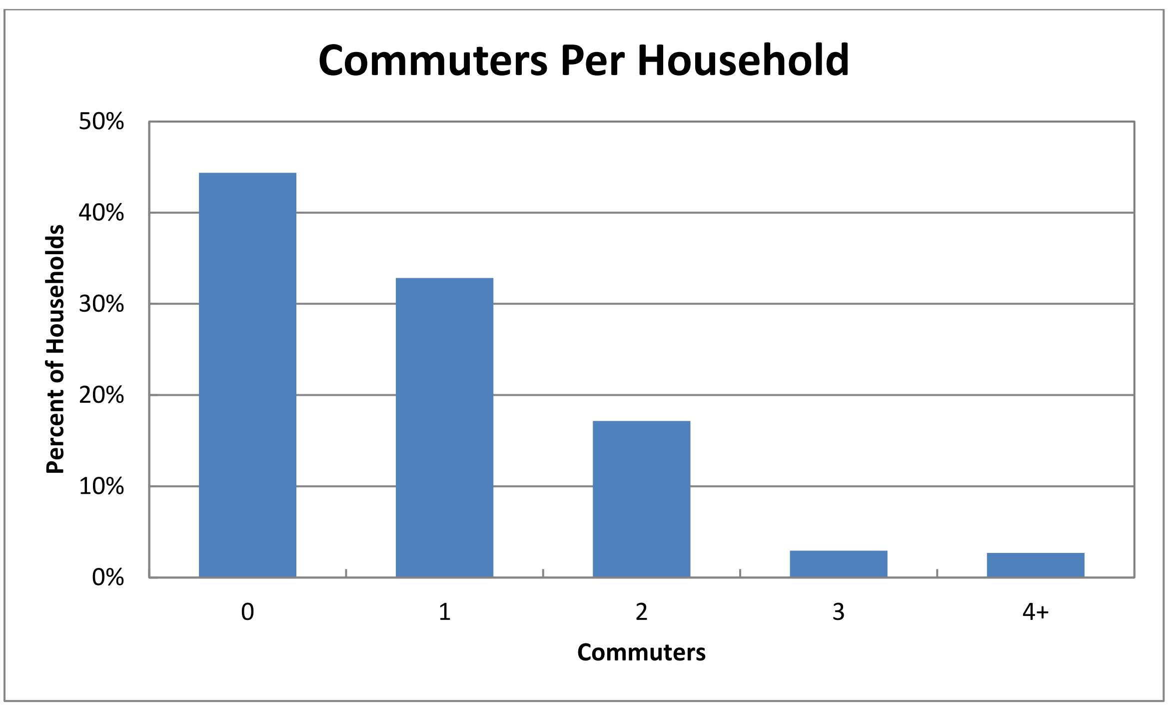


Figure F-6. Commuters in Households in the Study Area

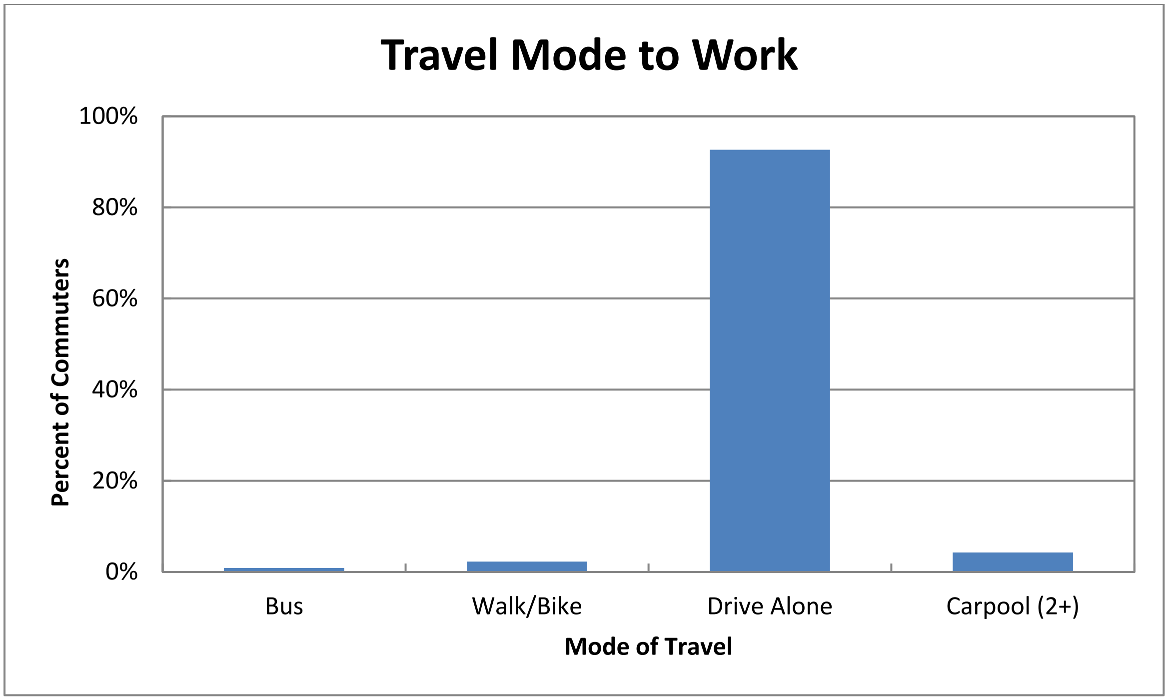


Figure F-7. Modes of Travel in the Study Area

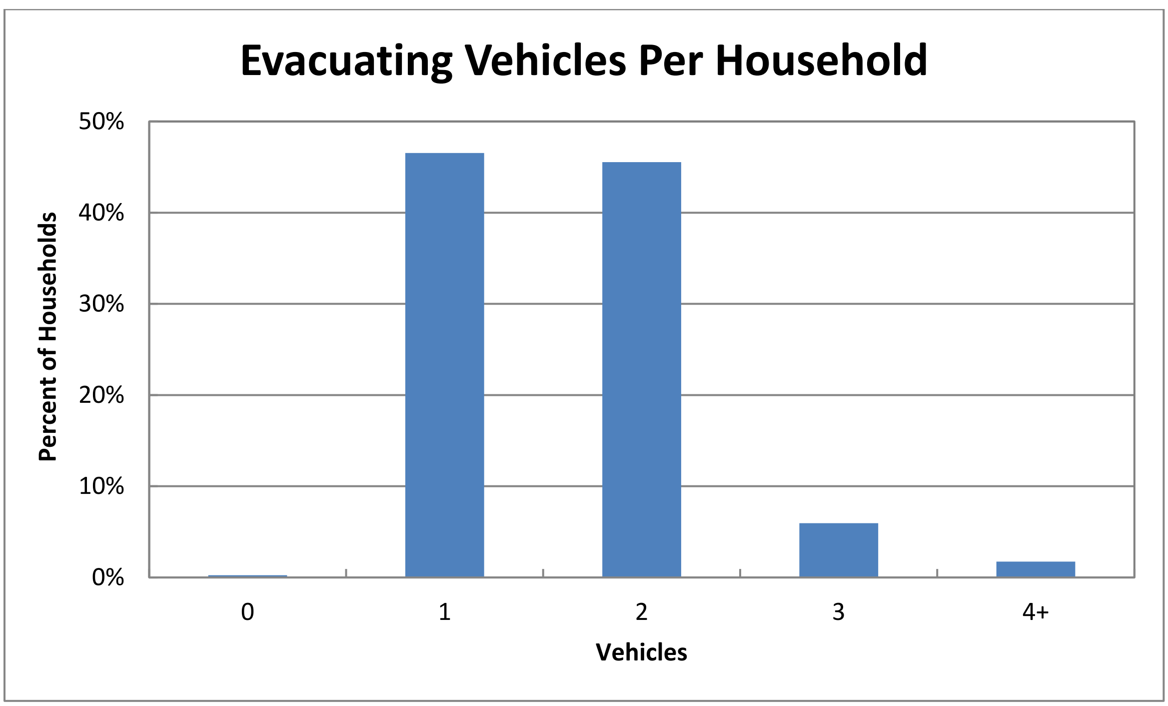


Figure F-8. Number of Vehicles Used for Evacuation

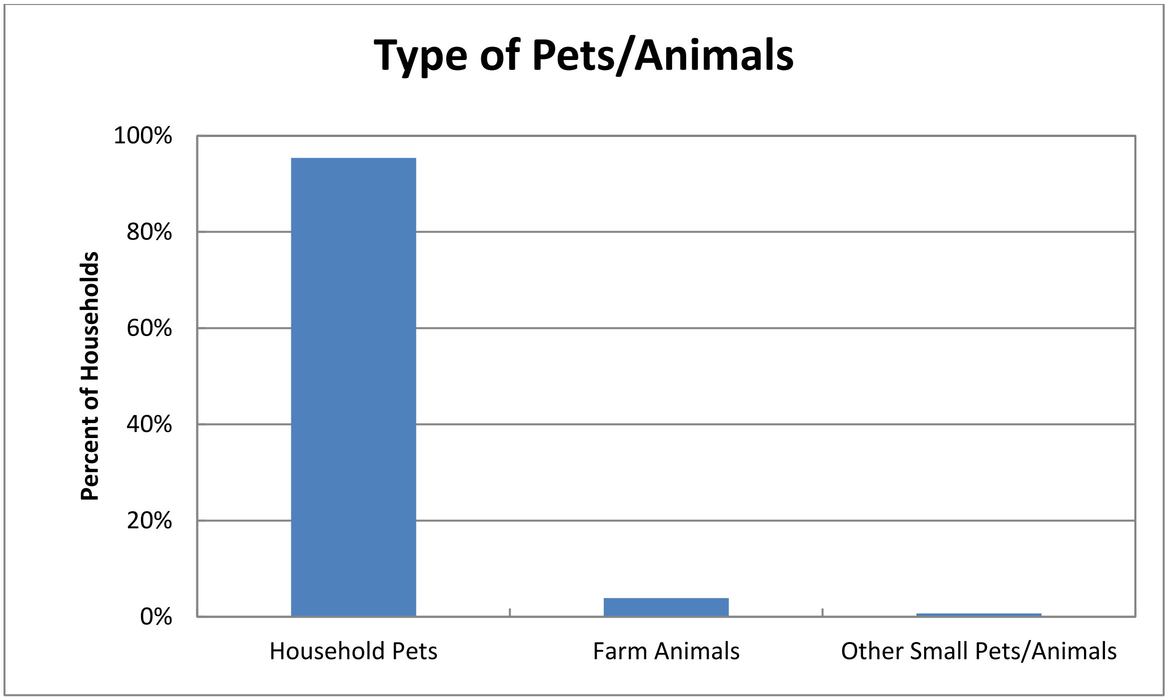


Figure F-9. Types of Pets/Animals

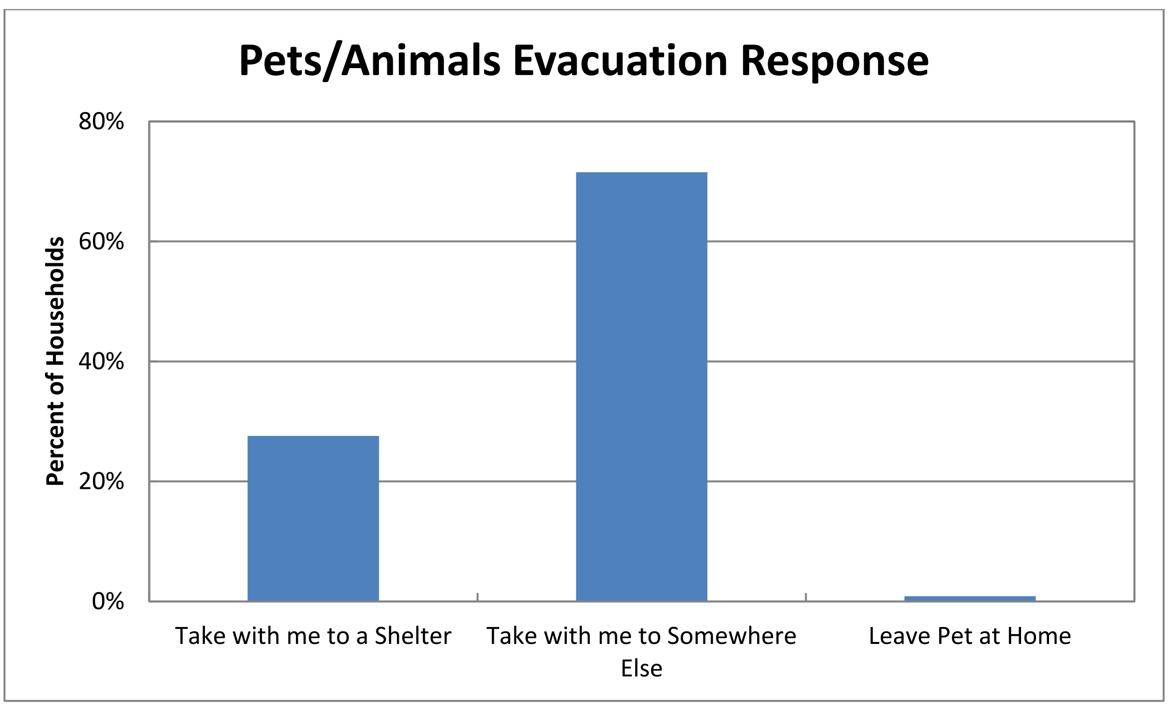


Figure F-10. Pets/Animals Evacuation Response

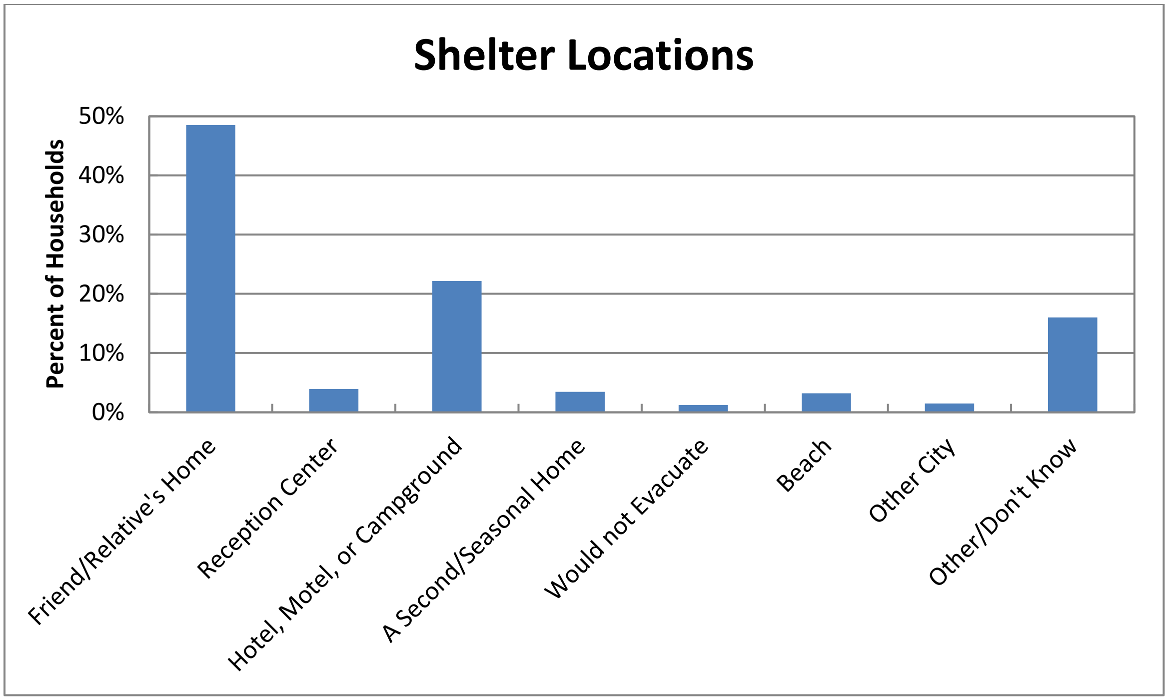


Figure F-11. Study Area Shelter Locations

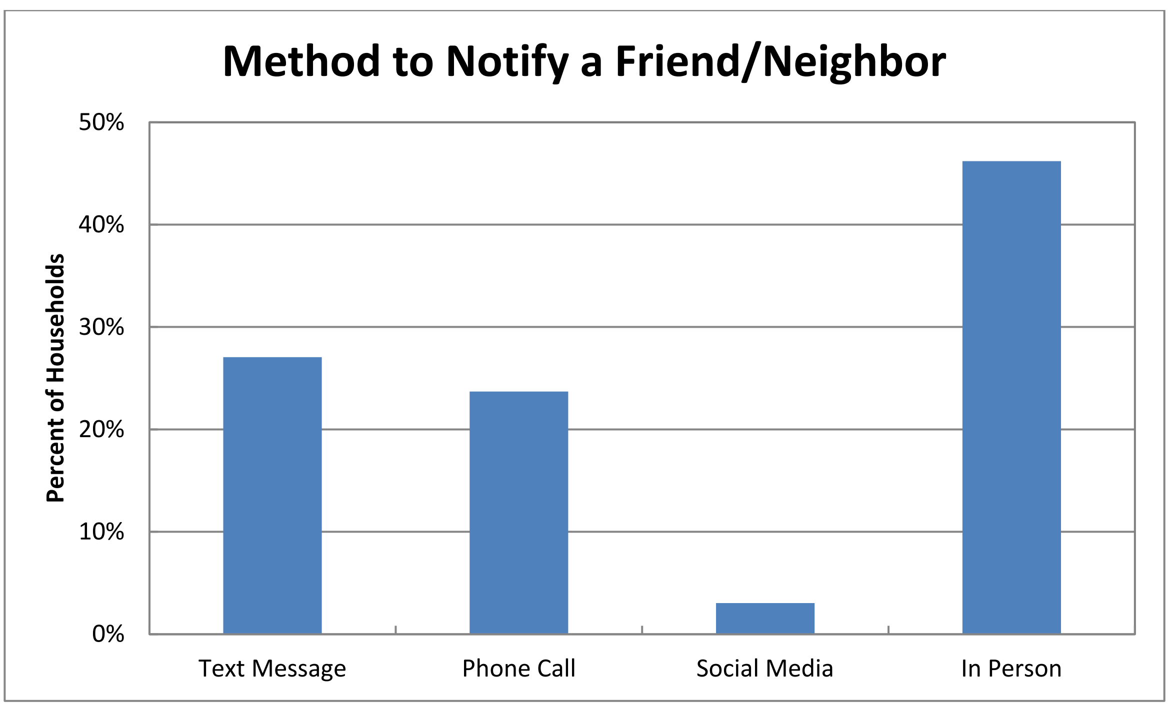


Figure F-12. Method to Notify a Friend/Neighbor

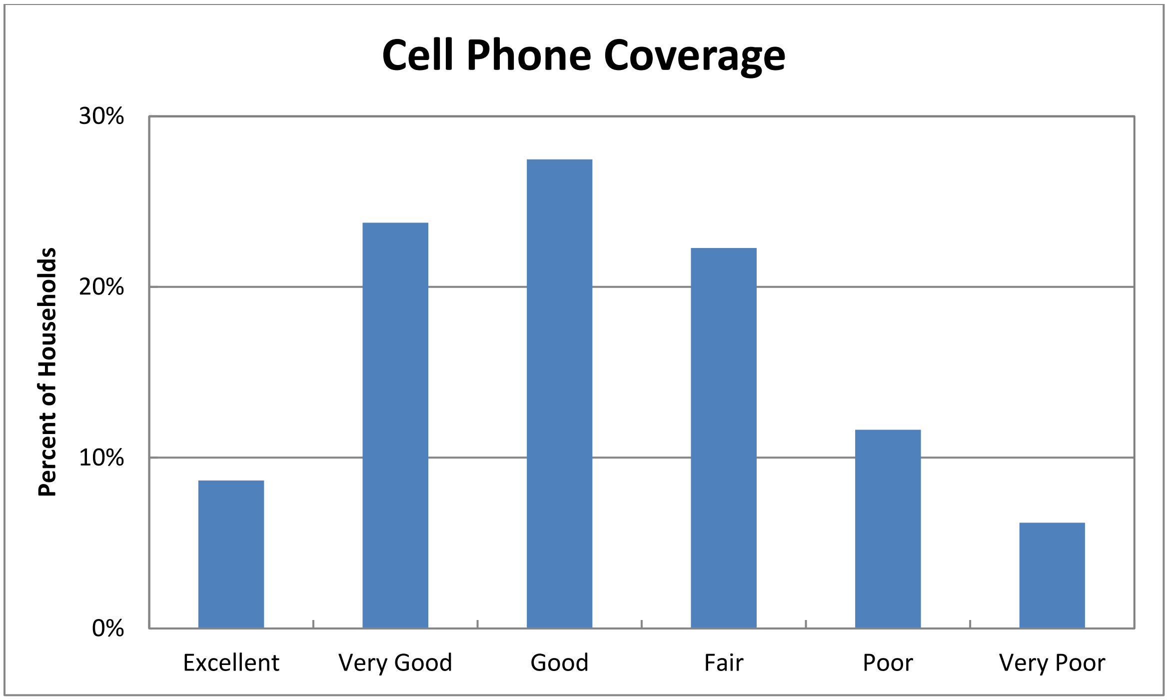


Figure F-13. Cell Phone Coverage

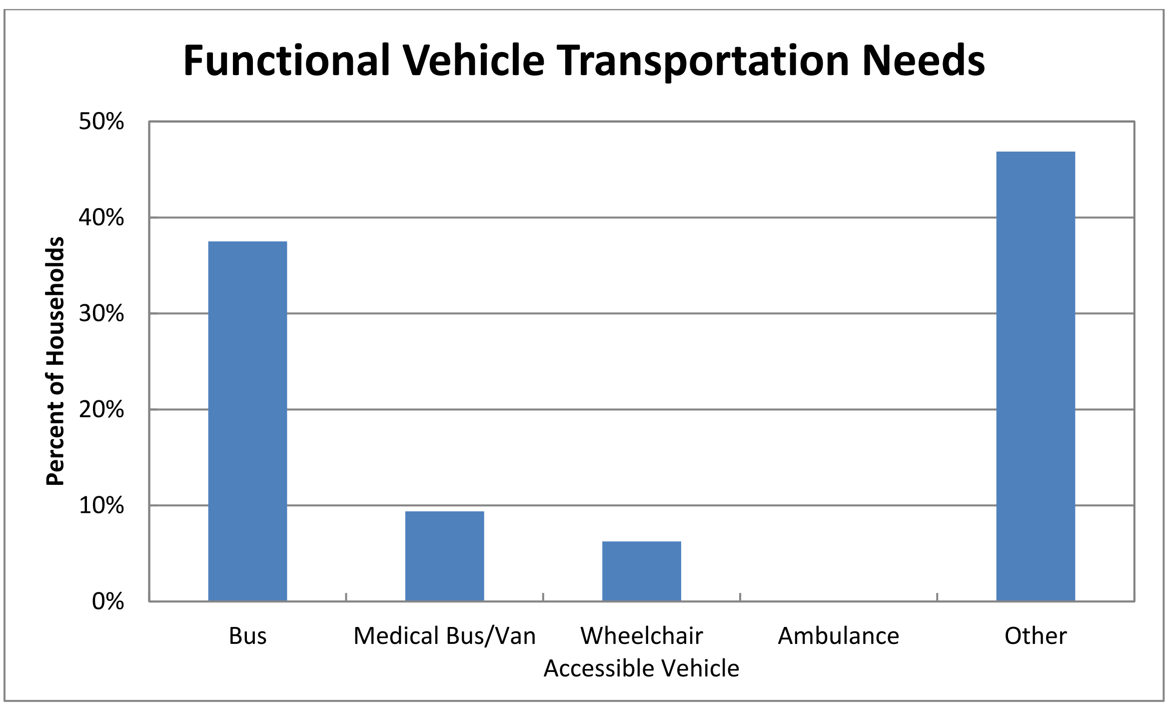


Figure F-14. Functional Vehicle Transportation Needs

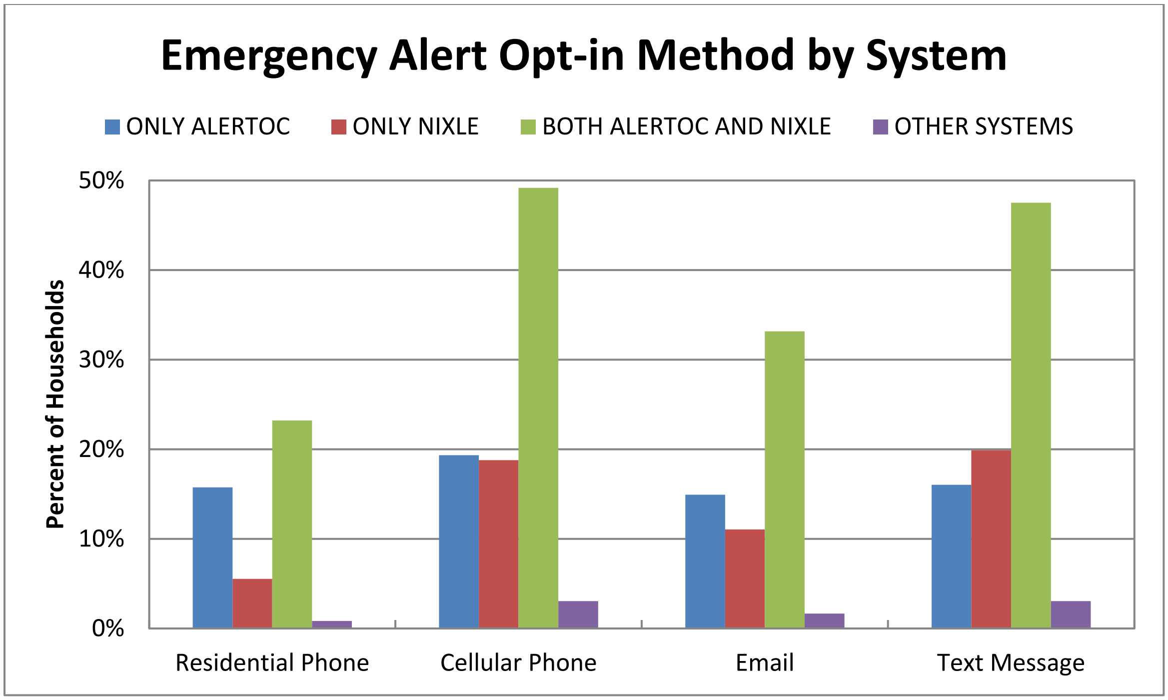


Figure F-15. Emergency Alert Opt-in Method by System

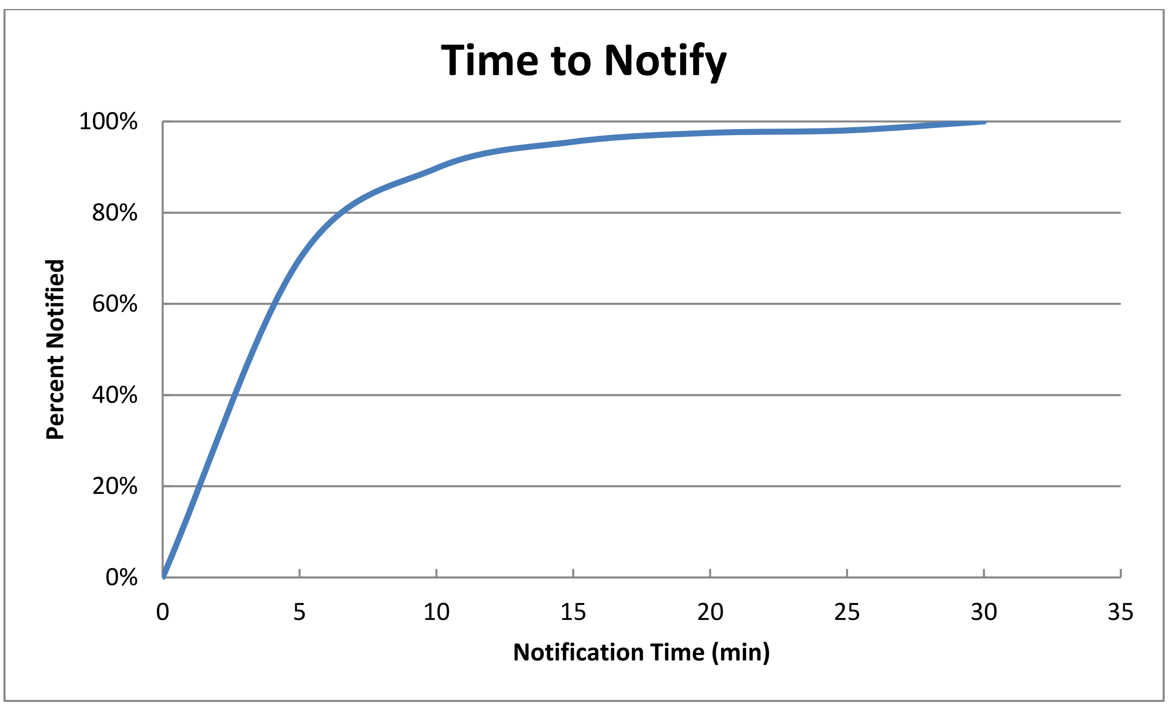


Figure F-16. Time to Notify

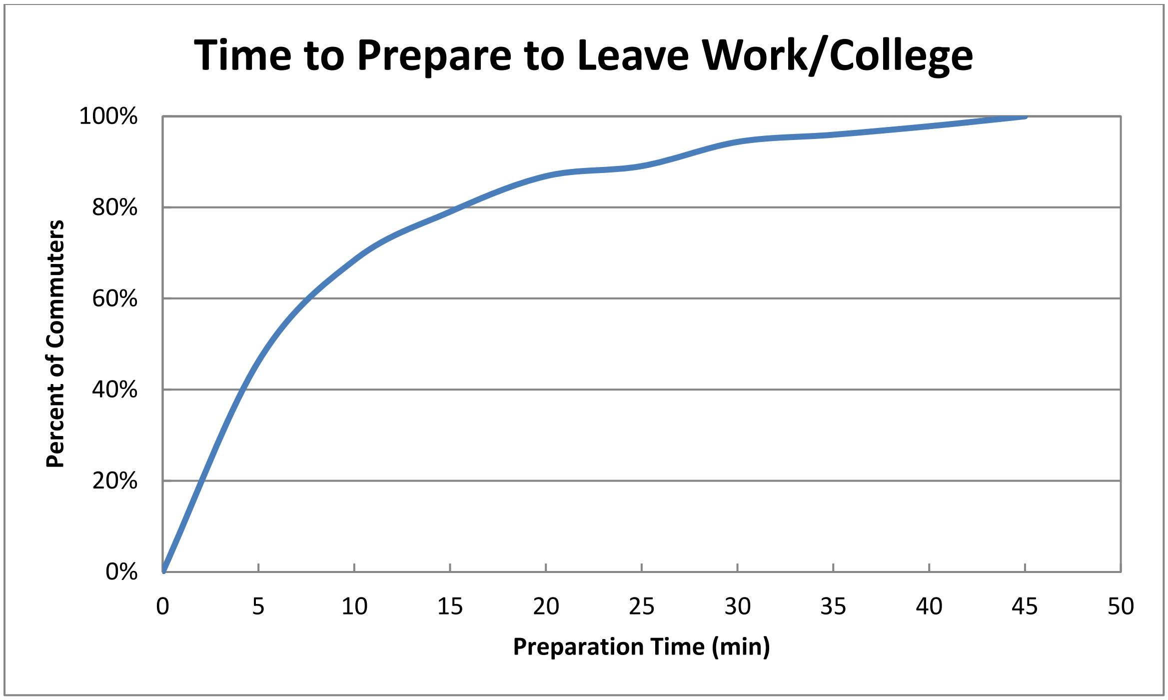


Figure F-17. Time Required to Prepare to Leave Work/College

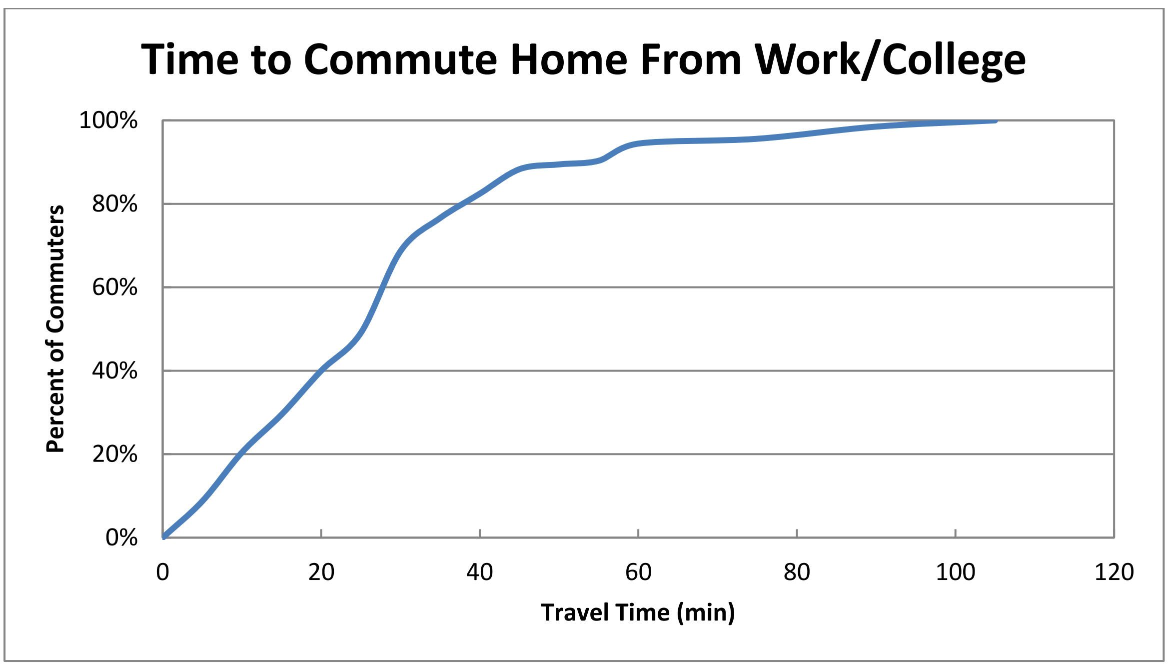


Figure F-18. Time to Travel Home from Work/College

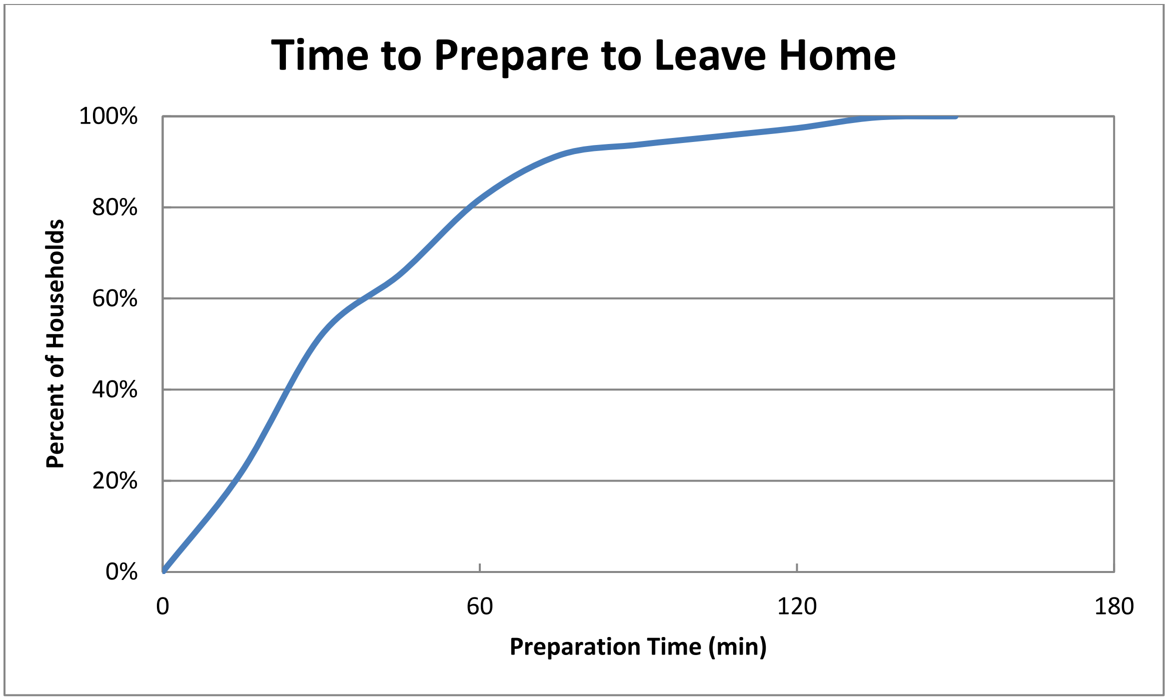


Figure F-19. Time to Prepare Home for Evacuation

ATTACHMENT A

Demographic Survey Instrument

City of Laguna Beach Wildfire Egress Study

* Required

Instructions

Please fill out the following multiple-choice questions. For questions 6 and 7-1 through 8-4, only mark your answers depending on how many commuters you have marked for Question 5. For example, if you answered 3 commuters for Question 5, ignore questions that ask about commuter #4. For this specific example, Questions 7-4 and 8-4 should be left blank.

Purpose

The purpose of this survey is to identify local behavior during emergency situations. The information gathered in this survey will be shared with the City of Laguna Beach to enhance emergency response plans in your area for wildfires. Your responses will greatly contribute to local emergency preparedness. Please do not provide your name or any personal information, and the survey will take less than 5 minutes to complete.

1. What is your gender?

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Decline to State
- ◯ Other: ____________________

2. What is your home zip code? *

Mark only one oval.

- ◯ 92603
- ◯ 92607
- ◯ 92651
- ◯ 92652
- ◯ 92654
- ◯ 92656
- ◯ Decline to State
- ◯ Other: ____________________

3A. In total, how many running cars, or other vehicles are usually available to the household?
Mark only one oval.

- ONE
- TWO
- THREE
- FOUR
- FIVE
- SIX
- SEVEN
- EIGHT
- NINE OR MORE
- ZERO (NONE)
- DECLINE TO STATE

3B. Of these running cars, or other vehicles, how many of them are powered by electric?
Mark only one oval.

- ONE
- TWO
- THREE
- FOUR
- FIVE
- SIX
- SEVEN
- EIGHT
- NINE OR MORE
- ZERO (NONE)
- DECLINE TO STATE

3C. In an emergency, could you get a ride out of the area with a neighbor or friend?
Mark only one oval.

- YES
- NO
- DECLINE TO STATE

4. How many people usually live in this household?

Mark only one oval.

- ONE
- TWO
- THREE
- FOUR
- FIVE
- SIX
- SEVEN
- EIGHT
- NINE
- TEN
- ELEVEN
- TWELVE
- THIRTEEN
- FOURTEEN
- FIFTEEN
- SIXTEEN
- SEVENTEEN
- EIGHTEEN
- NINETEEN OR MORE
- DECLINE TO STATE

5. How many people in the household commute to a job, or to college on a daily basis? *

Mark only one oval.

- ZERO
- ONE
- TWO
- THREE
- FOUR OR MORE
- DECLINE TO STATE

6. Thinking about each commuter, how does each person usually travel to work or college?

THE NUMBER OF COMMUTERS MARKED MUST MATCH QUESTION 5 ABOVE. FILL IN THE APPROPRIATE ROW FOR EACH NUMBERED COMMUTER

Mark only one oval per row.

	Bus	Walk/Bicycle	Drive Alone	Carpool 2 or more people	Don't Know
Commuter 1	⬭	⬭	⬭	⬭	⬭
Commuter 2	⬭	⬭	⬭	⬭	⬭
Commuter 3	⬭	⬭	⬭	⬭	⬭
Commuter 4	⬭	⬭	⬭	⬭	⬭

7-1. How much time on average, would it take Commuter #1 to travel home from work or college?

Mark only one oval.

⬭ 5 MINUTES OR LESS
⬭ 6-10 MNIUTES
⬭ 11-15 MINUTES
⬭ 16-20 MINUTES
⬭ 21-25 MINUTES
⬭ 26-30 MINUTES
⬭ 31-35 MINUTES
⬭ 36-40 MINUTES
⬭ 41-45 MINUTES
⬭ 46-50 MINUTES
⬭ 51-55 MINUTES
⬭ 56 – 1 HOUR
⬭ OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
⬭ BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
⬭ BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
⬭ BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
⬭ OVER 2 HOURS
⬭ DECLINE TO STATE

7-2. How much time on average, would it take Commuter #2 to travel home from work or college?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- OVER 2 HOURS
- DECLINE TO STATE

7-3. How much time on average, would it take Commuter #3 to travel home from work or college?

Mark only one oval.

- ◯ 5 MINUTES OR LESS
- ◯ 6-10 MNIUTES
- ◯ 11-15 MINUTES
- ◯ 16-20 MINUTES
- ◯ 21-25 MINUTES
- ◯ 26-30 MINUTES
- ◯ 31-35 MINUTES
- ◯ 36-40 MINUTES
- ◯ 41-45 MINUTES
- ◯ 46-50 MINUTES
- ◯ 51-55 MINUTES
- ◯ 56 – 1 HOUR
- ◯ OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- ◯ BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- ◯ BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- ◯ BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- ◯ OVER 2 HOURS
- ◯ DECLINE TO STATE

7-4. How much time on average, would it take Commuter #4 to travel home from work or college?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- OVER 2 HOURS
- DECLINE TO STATE

8-1. In a wildfire situation, approximately how much time would it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- OVER 2 HOURS
- DECLINE TO STATE

8-2. In a wildfire situation, approximately how much time would it take Commuter #2 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- OVER 2 HOURS
- DECLINE TO STATE

8-3. In a wildfire situation, approximately how much time would it take Commuter #3 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- OVER 2 HOURS
- DECLINE TO STATE

8-4. In a wildfire situation, approximately how much time would it take Commuter #4 to complete preparation for leaving work or college prior to starting the trip home?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
- BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
- BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
- BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
- OVER 2 HOURS
- DECLINE TO STATE

9. If you were advised by local authorities to evacuate due to a wildfire, how much time would it take the household to pack clothing, medications, secure the house, load the car, and complete preparations prior to evacuating the area?

Mark only one oval.

- LESS THAN 15 MINUTES
- 15-30 MINUTES
- 31-45 MINUTES
- 46 MINUTES - 1 HOUR
- 1 HOUR TO 1 HOUR 15 MINUTES
- 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
- 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
- 1 HOUR 46 MINUTES TO 2 HOURS
- 2 HOURS TO 2 HOURS 15 MINUTES
- 2 HOURS 16 MINUTES TO 2 HOURS 30 MIUNTES
- 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES
- 2 HOURS 46 MINUTES TO 3 HOURS
- 3 HOURS TO 3 HOURS AND 15 MINUTES
- 3 HOURS 16 MINUTES TO 3 HOURS 30 MINUTES
- 3 HOURS 31 MINUTES TO 3 HOURS 45 MINUTES
- 3 HOURS 46 MINUTES TO 4 HOURS
- 4 HOURS TO 4 HOURS 15 MINUTES
- 4 HOURS 16 MINUTES TO 4 HOURS 30 MINUTES
- 4 HOURS 31 MINUTES TO 4 HOURS 45 MINUTES
- 4 HOURS 46 MINUTES TO 5 HOURS
- 5 HOURS TO 5 HOURS 30 MINUTES
- 5 HOURS AND 31 MINUTES TO 6 HOURS
- OVER 6 HOURS
- WILL NOT EVACUATE
- DECLINE TO STATE

10. Please specify the number of people in your household who require Functional or Transportation needs in an evacuation:
Mark only one oval per row.

	0	1	2	3	4	More than 4
Bus	⬭	⬭	⬭	⬭	⬭	⬭
Medical Bus/Van	⬭	⬭	⬭	⬭	⬭	⬭
Wheelchair Accessible Vehicle	⬭	⬭	⬭	⬭	⬭	⬭
Ambulance	⬭	⬭	⬭	⬭	⬭	⬭
Other	⬭	⬭	⬭	⬭	⬭	⬭

11. Please choose one of the following:

If Don't Know, leave blank
Mark only one oval.

- ⬭ During a wildfire situation, I would await the return of household commuters to evacuate together.
- ⬭ During a wildfire situation, I would evacuate independently and meet other household members later.

12. How many vehicles would your household use during a wildfire evacuation?

Mark only one oval.

- ONE
- TWO
- THREE
- FOUR
- FIVE
- SIX
- SEVEN
- EIGHT
- NINE
- NINE OR MORE
- ZERO (NONE)
- I WOULD EVACUATE BY BICYCLE
- I WOULD EVACUATE BY BUS (Orange County Transit Authority)
- DECLINE TO STATE

13A. Emergency officials advise you to shelter-in-place in a wildfire emergency because you are not in the area of risk. Would you:

If Don't Know, leave blank

Mark only one oval.

- SHELTER-IN-PLACE
- EVACUATE

13B. Emergency officials advise you to shelter-in-place now in a wildfire emergency and possibly evacuate later while people in other areas are advised to evacuate now. Would you:

If Don't Know, leave blank

Mark only one oval.

- SHELTER-IN-PLACE
- EVACUATE

13C. Emergency officials advise you to evacuate due to a wildfire. Where would you evacuate to?
Mark only one oval.

- ◯ A RELATIVE'S OR FRIEND'S HOME
- ◯ A RECEPTION CENTER
- ◯ A HOTEL, MOTEL OR CAMPGROUND
- ◯ A SECOND/SEASONAL HOME
- ◯ WOULD NOT EVACUATE
- ◯ DON'T KNOW
- ◯ OTHER (Specify Below)
- ◯ DELINE TO STATE

Fill in OTHER answer

____

14A. Do you have any pet(s) and/or animal(s)? *

Mark only one oval.

- ◯ YES
- ◯ NO
- ◯ DECLINE TO STATE

14B. What type of animals do you have?
Check all that apply.

- ☐ DOG
- ☐ CAT
- ☐ BIRD
- ☐ REPTILE
- ☐ HORSE
- ☐ FISH
- ☐ CHICKEN
- ☐ GOAT
- ☐ PIG
- ☐ OTHER SMALL PETS/ANIMALS (Specify Below)
- ☐ OTHER LARGE PETS/ANIMALS (Specify Below)
- ☐ DECLINE TO STATE
- ☐ OTHER: ______________________________

14C. What would you do with your animal(s) if you had to evacuate?
Mark only one oval.

- ⬭ TAKE PET WITH ME TO A SHELTER
- ⬭ TAKE PET WITH ME SOMEWHERE ELSE
- ⬭ LEAVE PET AT HOME
- ⬭ DECLINE TO STATE

14D. If you have animal(s) and would evacuate with them, do you have sufficient room in your vehicle(s) to evacuate with your animal(s)?
Mark only one oval.

- ⬭ YES
- ⬭ NO
- ⬭ WILL USE A TRAILER
- ⬭ DECLINE TO STATE
- ⬭ OTHER: ______________________________

15. How would you rate the cell phone coverage in your area?
Mark only one oval.

- ⬭ EXCELLENT
- ⬭ VERY GOOD
- ⬭ GOOD
- ⬭ FAIR
- ⬭ POOR
- ⬭ VERY POOR
- ⬭ DON'T HAVE A CELL PHONE
- ⬭ DECLINE TO STATE

16. Have you opted into your local Emergency Alert and Warning Systems?
Mark only one oval per row.

	OPTED IN ALERTOC	OPTED IN NIXLE	BOTH ALERTOC AND NIXLE	OTHER SYSTEMS
With Residential Phone	⬭	⬭	⬭	⬭
With Cellular Phone	⬭	⬭	⬭	⬭
With Email	⬭	⬭	⬭	⬭
With Text Message	⬭	⬭	⬭	⬭

17A. If Emergency officials notified you to evacuate, would you notify a neighbor or friend to evacuate as well?
If Don't Know, leave blank
Mark only one oval.

⬭ YES
⬭ NO
⬭ DECLINE TO STATE

17B. How would you notify your neighbor or friend to evacuate?
Check all that apply.

☐ TEXT MESSAGE
☐ PHONE CALL
☐ SOCIAL MEDIA
☐ IN PERSON
☐ DECLINE TO STATE
☐ OTHER: ____________________

17C. If you were to notify a neighbor or friend to evacuate, how long would it take you to notify them?

Mark only one oval.

- 5 MINUTES OR LESS
- 6-10 MNIUTES
- 11-15 MINUTES
- 16-20 MINUTES
- 21-25 MINUTES
- 26-30 MINUTES
- 31-35 MINUTES
- 36-40 MINUTES
- 41-45 MINUTES
- 46-50 MINUTES
- 51-55 MINUTES
- 56 – 1 HOUR
- OVER 1 HOUR
- DECLINE TO STATE

APPENDIX G

Evacuation Regions

G EVACUATION REGIONS

This appendix presents the evacuation percentages for each Evacuation Region (Table G-1) and maps of all Evacuation Regions.

The evacuation regions were created based on the City of Laguna Beach Evacuation Plan dated April 2018. These regions are made up of Emergency Management Zones (EMZs). An ETE was computed for each of the twenty-two EMZs as well as for groupings of multiple EMZs. These groupings were created based on the geography of the study area and major evacuation routes that would be used during an evacuation. As shown on page 84, 93, and 99 of the City of Laguna Beach Evacuation Plan, the groupings of EMZs are defined as follows:

- Laguna Coast North (North Laguna) – Irvine Cove, Emerald Bay, Boat Canyon, North Coast, and Downtown
- Laguna Coast Central (Central Laguna) – Club Laguna, El Toro, Big Bend, Canyon Acres, Park Avenue, Downtown, Central Coast, Bluebird Canyon, Top of the World, and Old Top of the World
- Laguna Coast South (South Laguna) – Arch Beach Heights, Balboa/Nyes, Wesley, Ceanothus, Mar Vista, Sunset, and South Coast

ETEs were computed for each of these three groupings of EMZs, as well as for combinations of these groups based on possible wildfire locations.

The evacuation percentages presented in Table G-1 are based on the methodology discussed in assumption 5 of Section 2.2 and the results of the demographic survey. It should be noted that for Regions R26 through R28 it was assumed that 100 percent of residents within the shadow region closest to the ridge line would also voluntarily evacuate. This area is shown in blue hatching in Figure G-29. For Region R26, 100 percent of the northern portion only was considered, and for Region R27, 100 percent of the southern portion only was considered. For Region 28, 100 percent of the whole area was considered. Fourteen percent (14%) of the remainder of the shadow region (grey hatching) was assumed to voluntarily evacuate.

Table G-1. Percent of EMZ Population Evacuating for Each Region

Region	Emergency Management Zone (EMZ)																					
	Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9a**	**9b**	**9c**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
R01	Arch Beach Heights	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R02	Balboa/Nyes	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R03	Big Bend	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R04	Bluebird Canyon	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R05	Boat Canyon	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R06	Canyon Acres	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R07	Ceanothus	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R08	Club Laguna	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R09	North Coast	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R10	Central Coast	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R11	South Coast	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R12	Downtown	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%
R13	El Toro	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%	14%
R14	Emerald Bay	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%	14%
R15	Irvine Cove	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%	14%
R16	Mar Vista	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%	14%
R17	Old Top of the World	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%	14%
R18	Park Avenue	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%	14%
R19	Sunset	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%	14%
R20	Temple Hills	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%	14%
R21	Top of the World	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**	14%
R22	Wesley	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	14%	**100%**
R23	North Laguna	14%	14%	14%	14%	**100%**	14%	14%	14%	**100%**	14%	14%	**100%**	14%	**100%**	**100%**	14%	14%	14%	14%	14%	14%	14%
R24	Central Laguna	14%	14%	**100%**	**100%**	14%	**100%**	14%	**100%**	14%	**100%**	14%	**100%**	**100%**	14%	14%	14%	**100%**	**100%**	14%	**100%**	**100%**	14%
R25	South Laguna	**100%**	**100%**	14%	14%	14%	14%	**100%**	14%	14%	14%	**100%**	14%	14%	14%	14%	**100%**	14%	14%	**100%**	14%	14%	**100%**

Region	Emergency Management Zone (EMZ)																						
	Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9a**	**9b**	**9c**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
R26	North and Central Laguna	14%	14%	**100%**	**100%**	**100%**	**100%**	14%	**100%**	**100%**	**100%**	14%	**100%**	**100%**	**100%**	**100%**	14%	**100%**	**100%**	14%	**100%**	**100%**	14%
R27	South and Central Laguna	**100%**	**100%**	**100%**	**100%**	14%	**100%**	**100%**	**100%**	14%	**100%**	**100%**	**100%**	**100%**	14%	14%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
R28	All EMZs	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Zone(s) Shelter-in-Place												**Zone(s) Evacuate**											

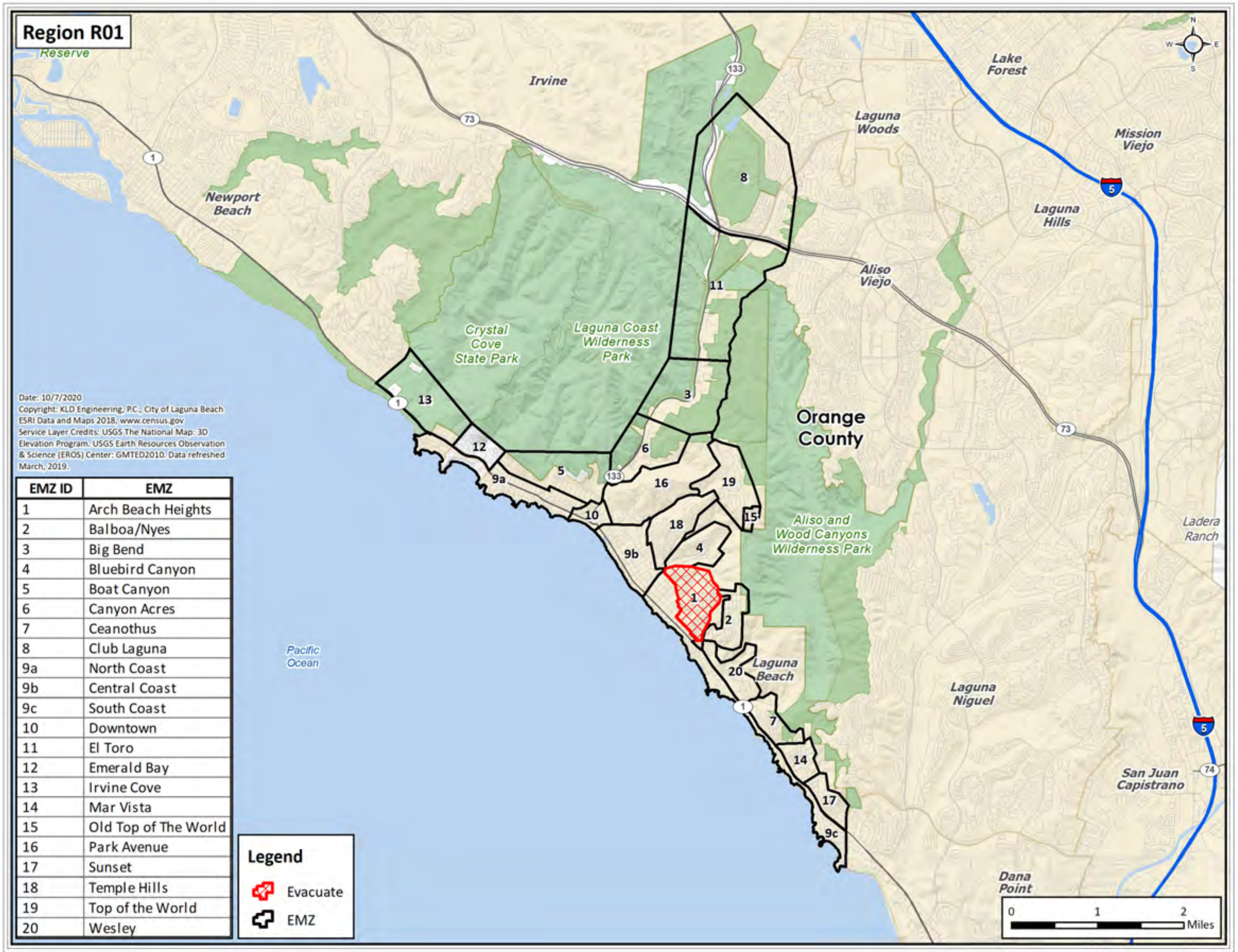


Figure G-1. Region R01

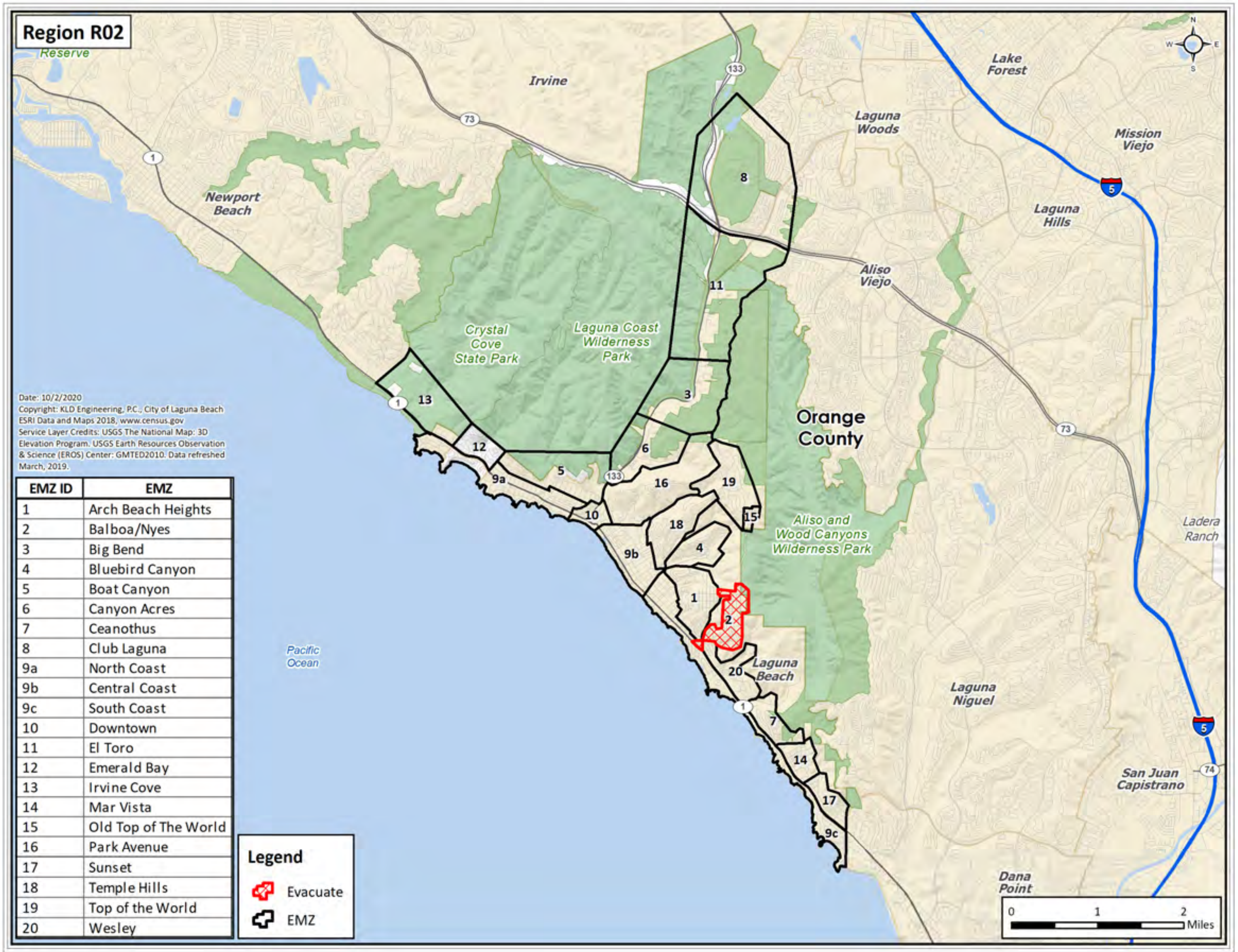


Figure G-2. Region R02

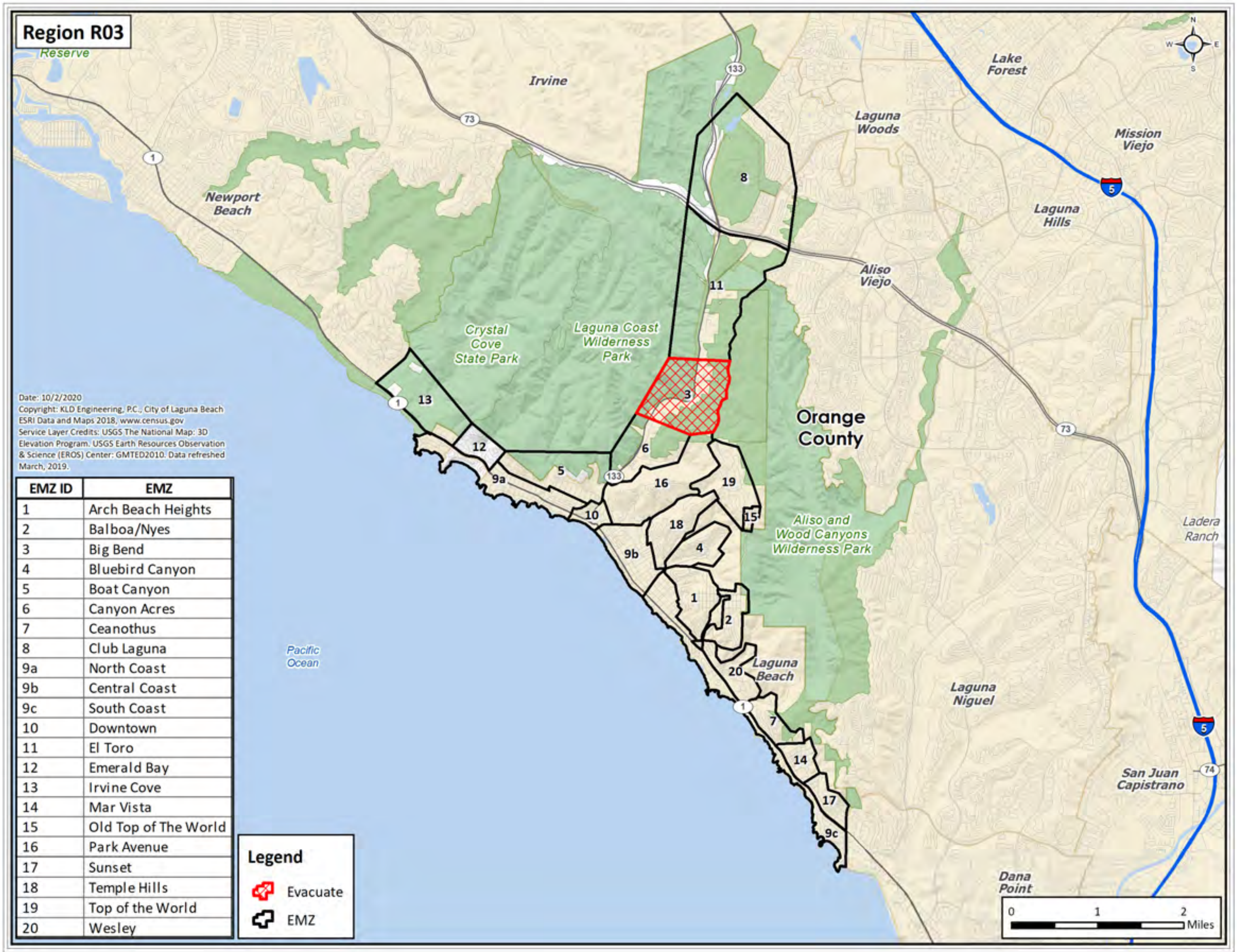


Figure G-3. Region R03

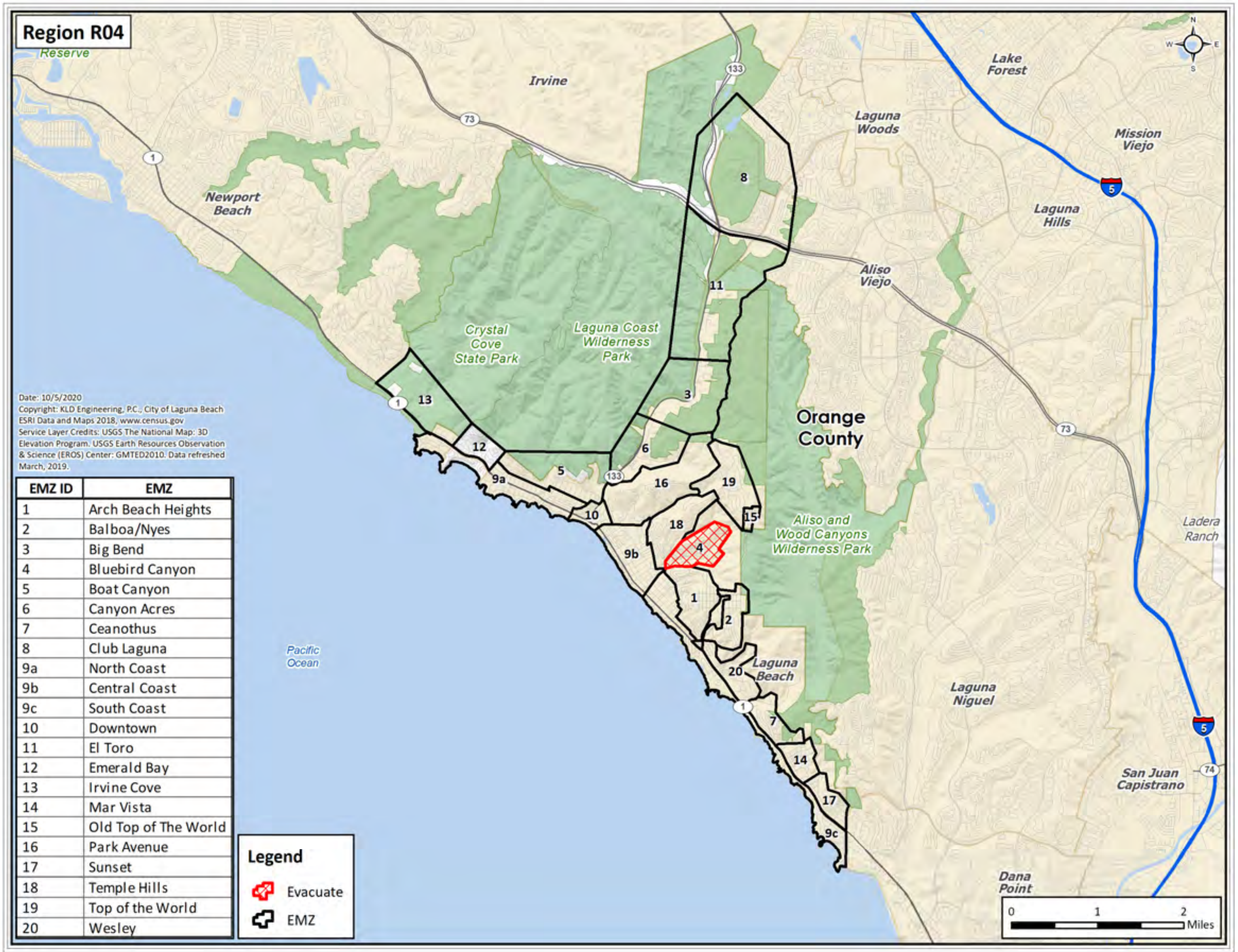


Figure G-4. Region R04

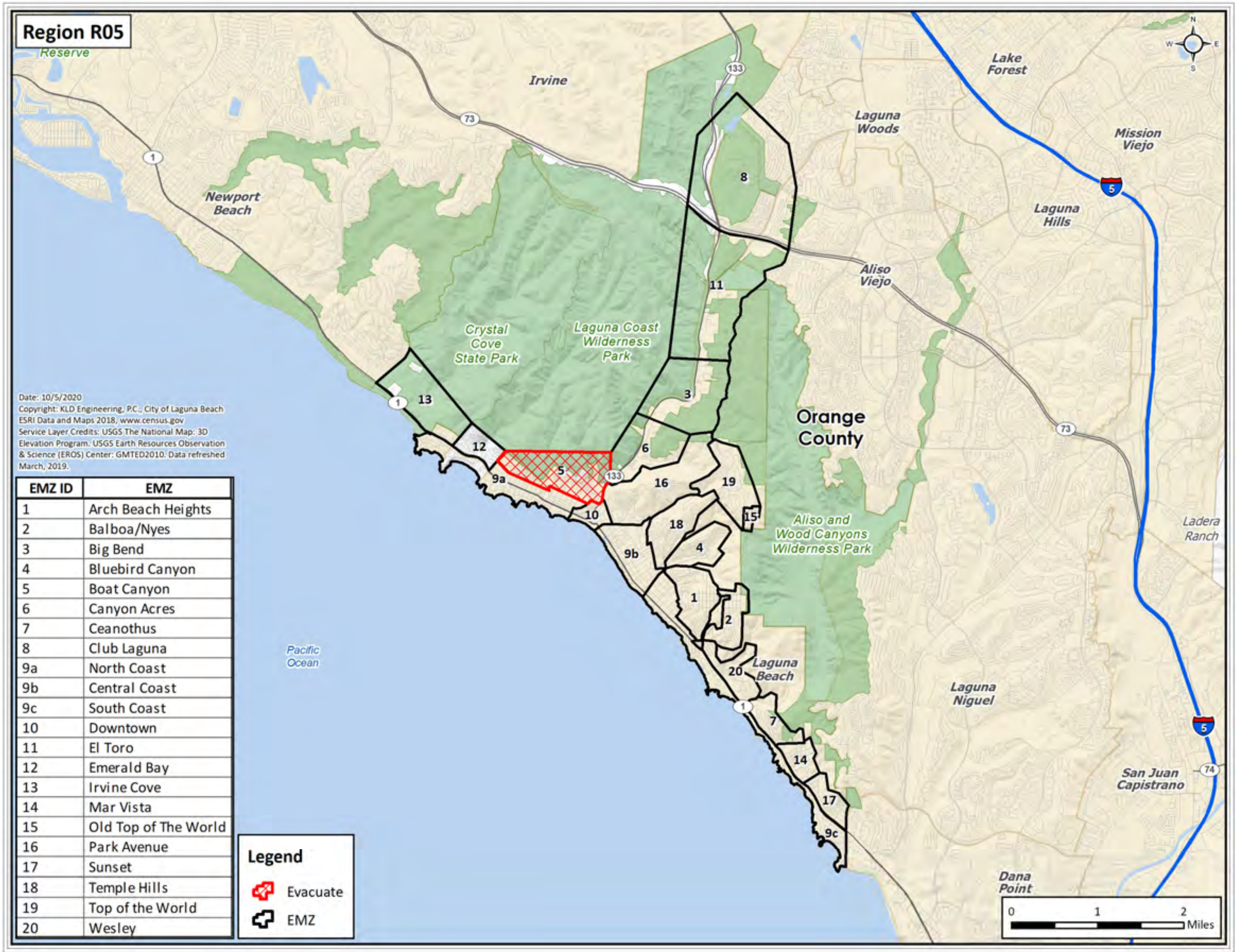


Figure G-5. Region R05

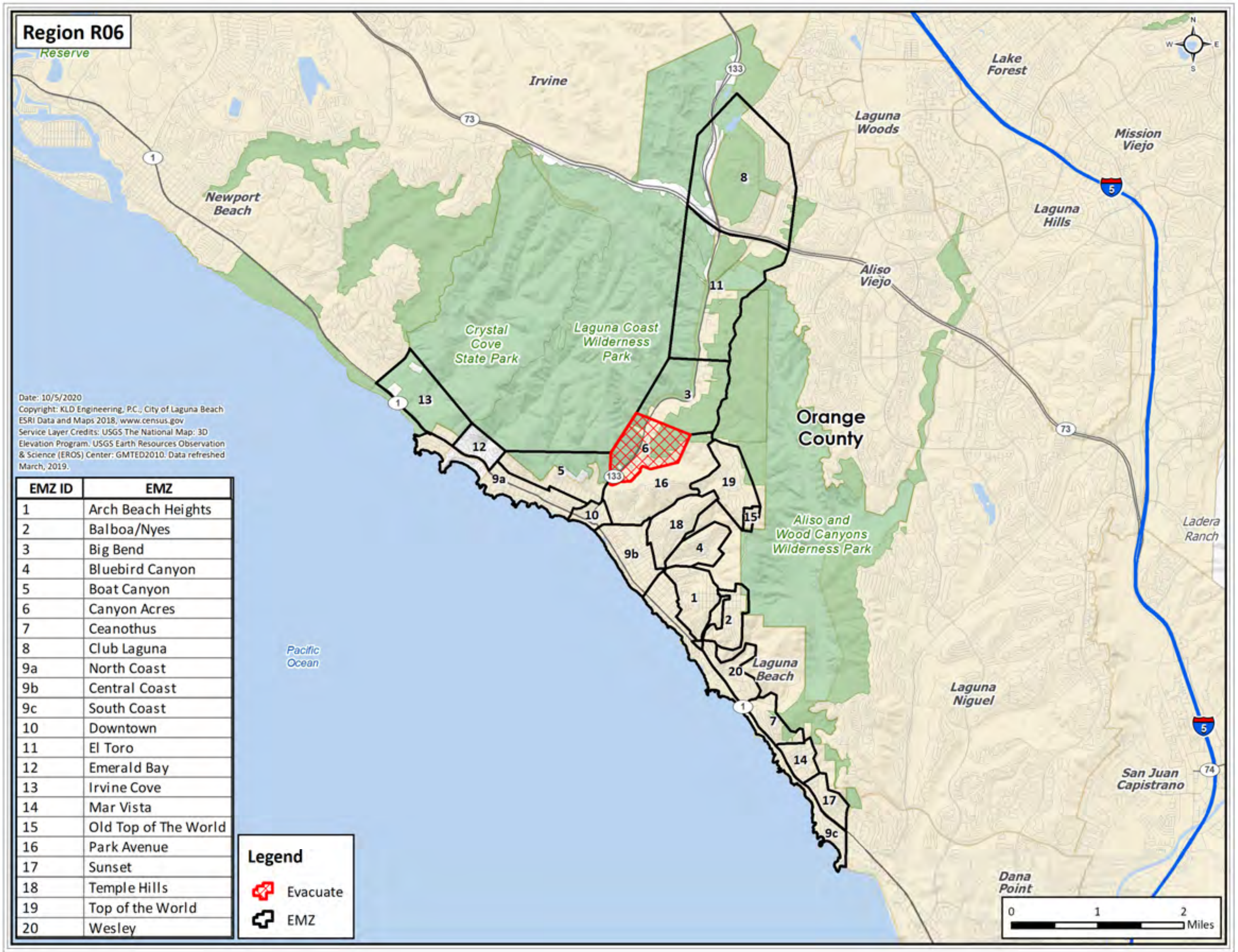


Figure G-6. Region R06

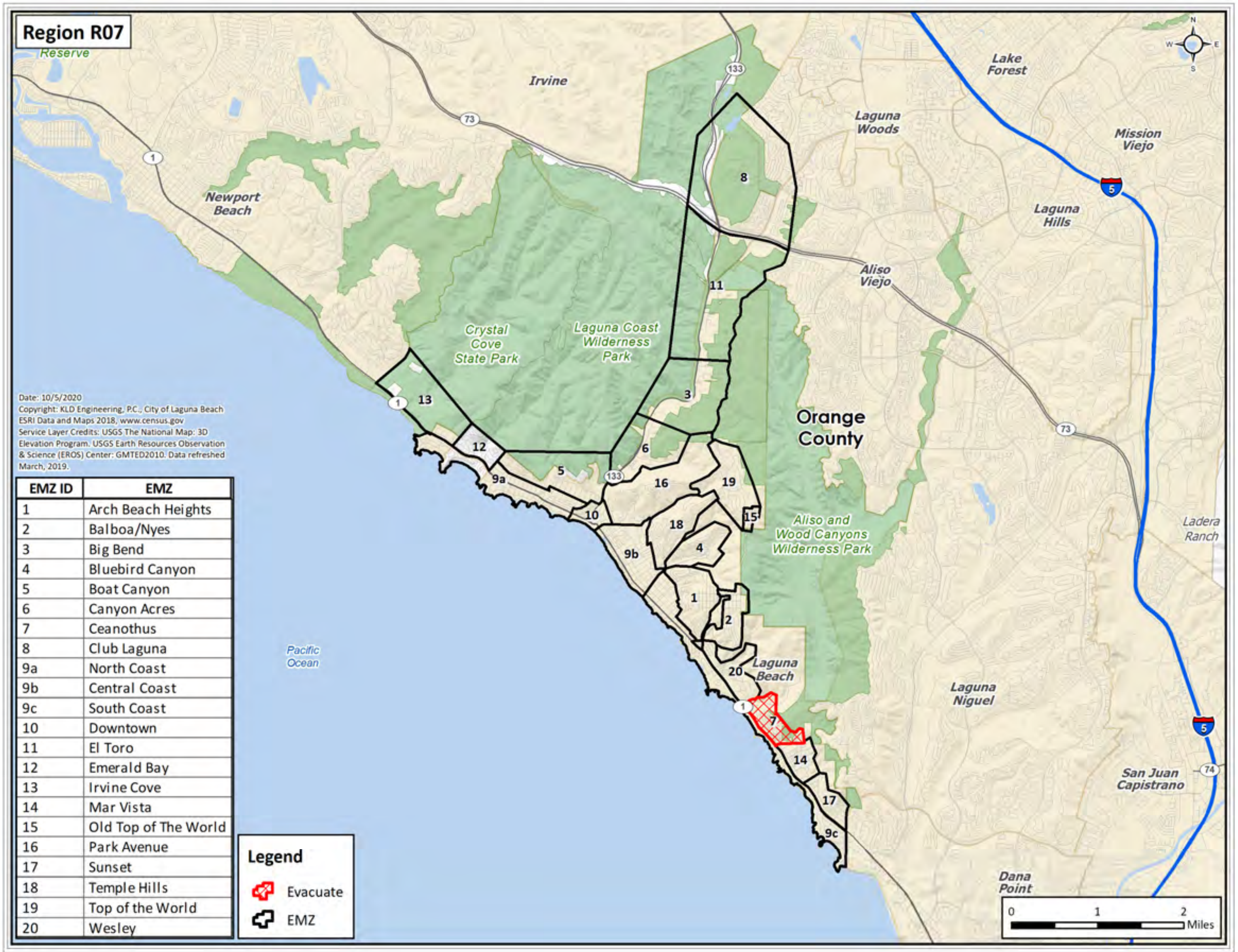


Figure G-7. Region R07

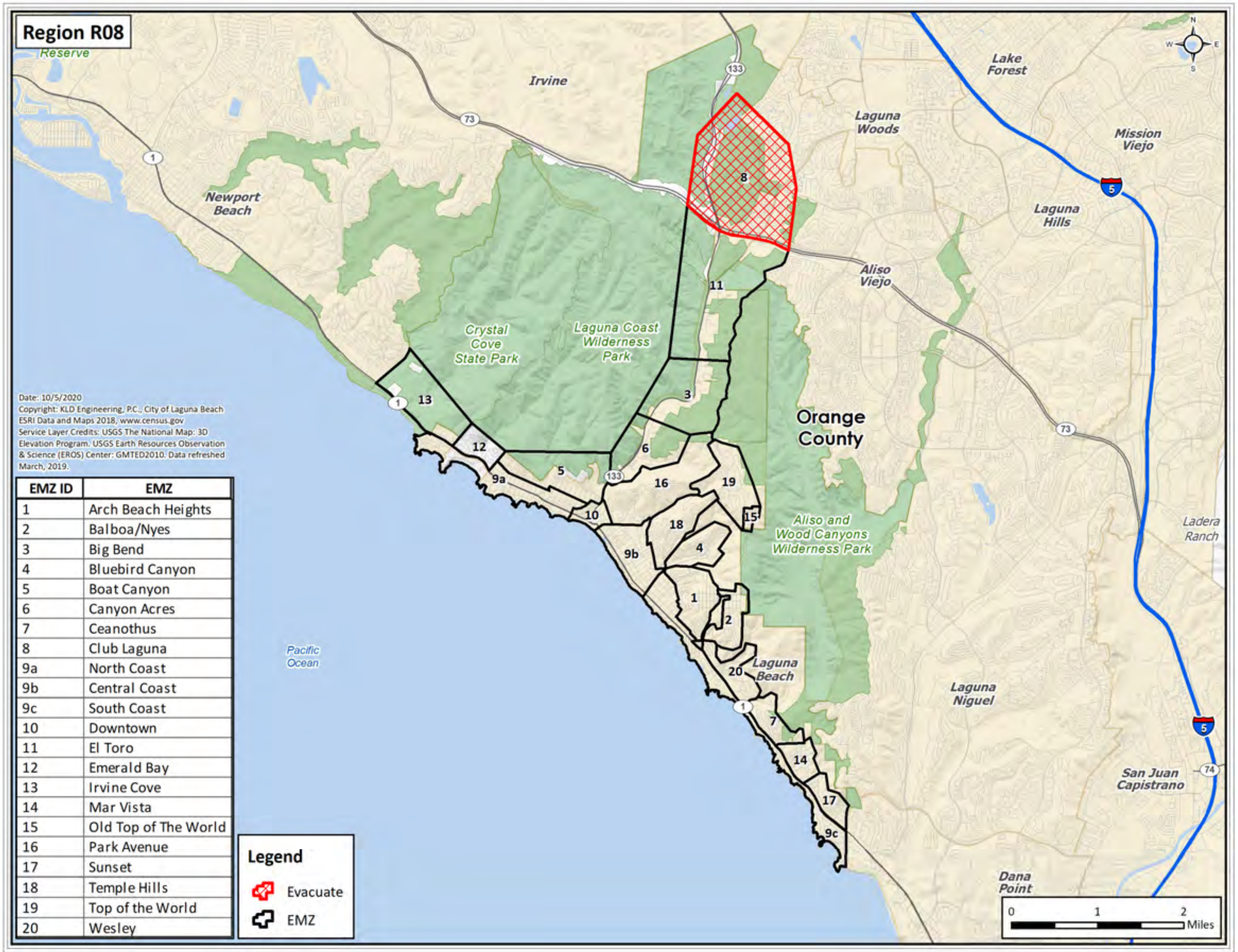
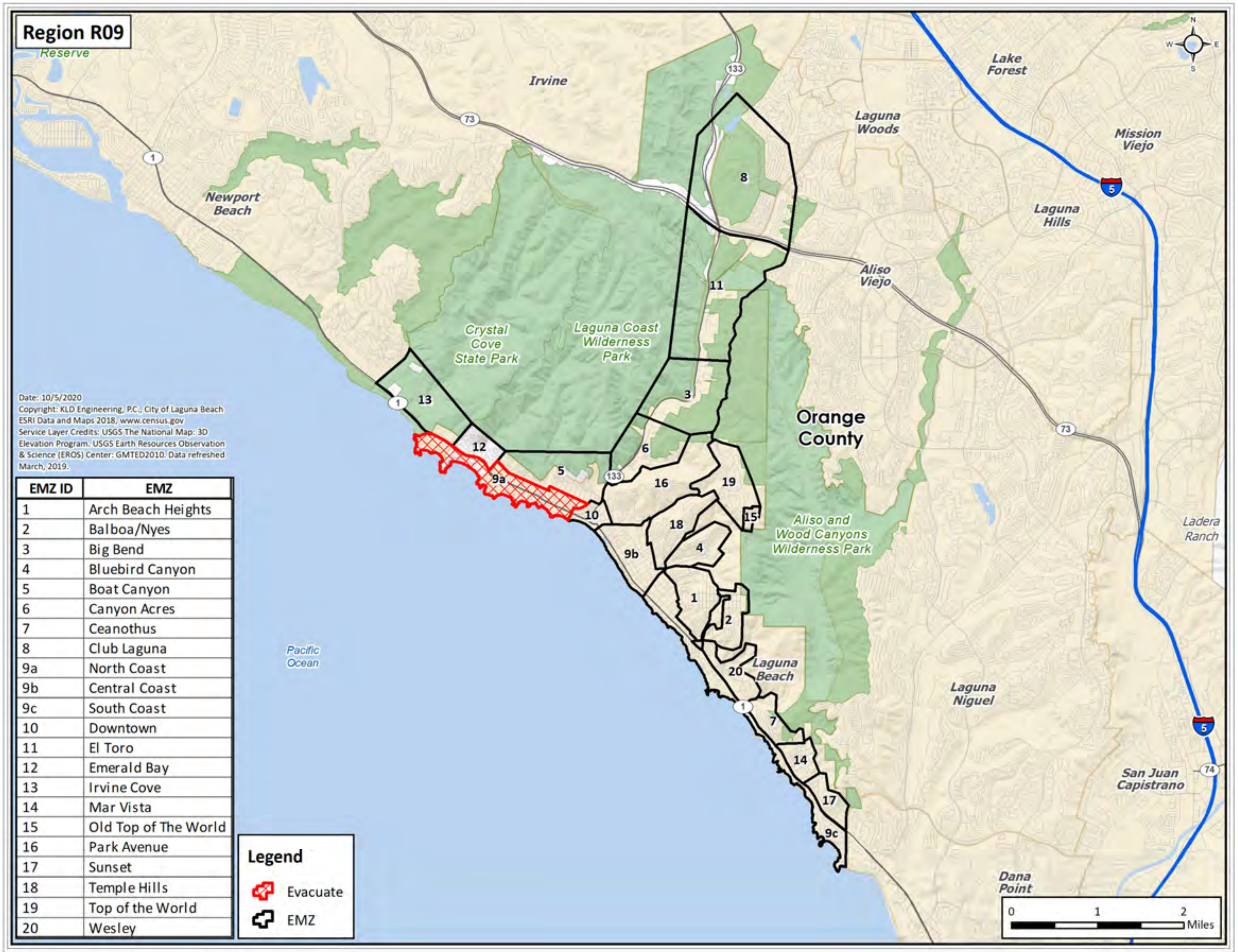


Figure G-8. Region R08



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure G-9. Region R09

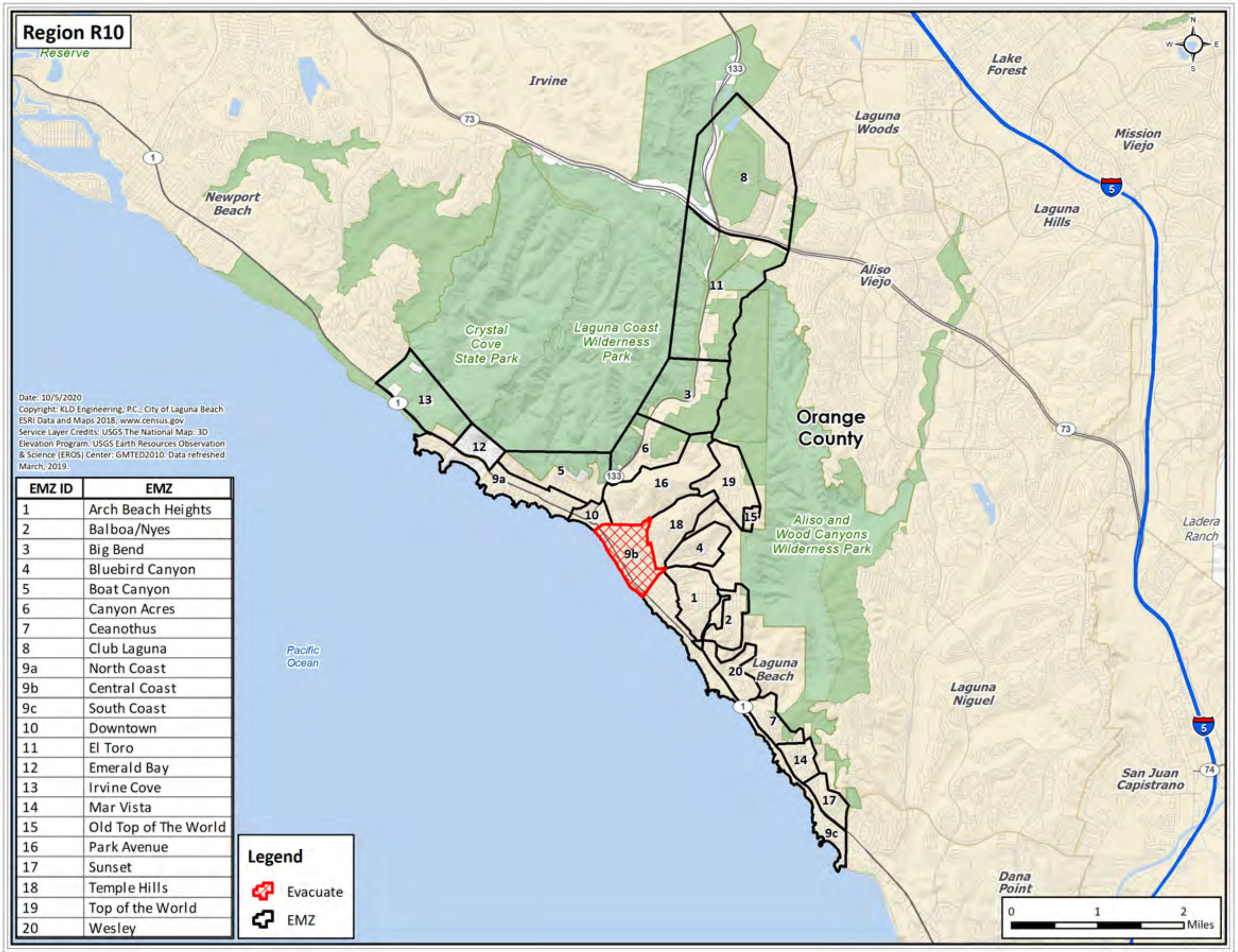


Figure G-10. Region R10

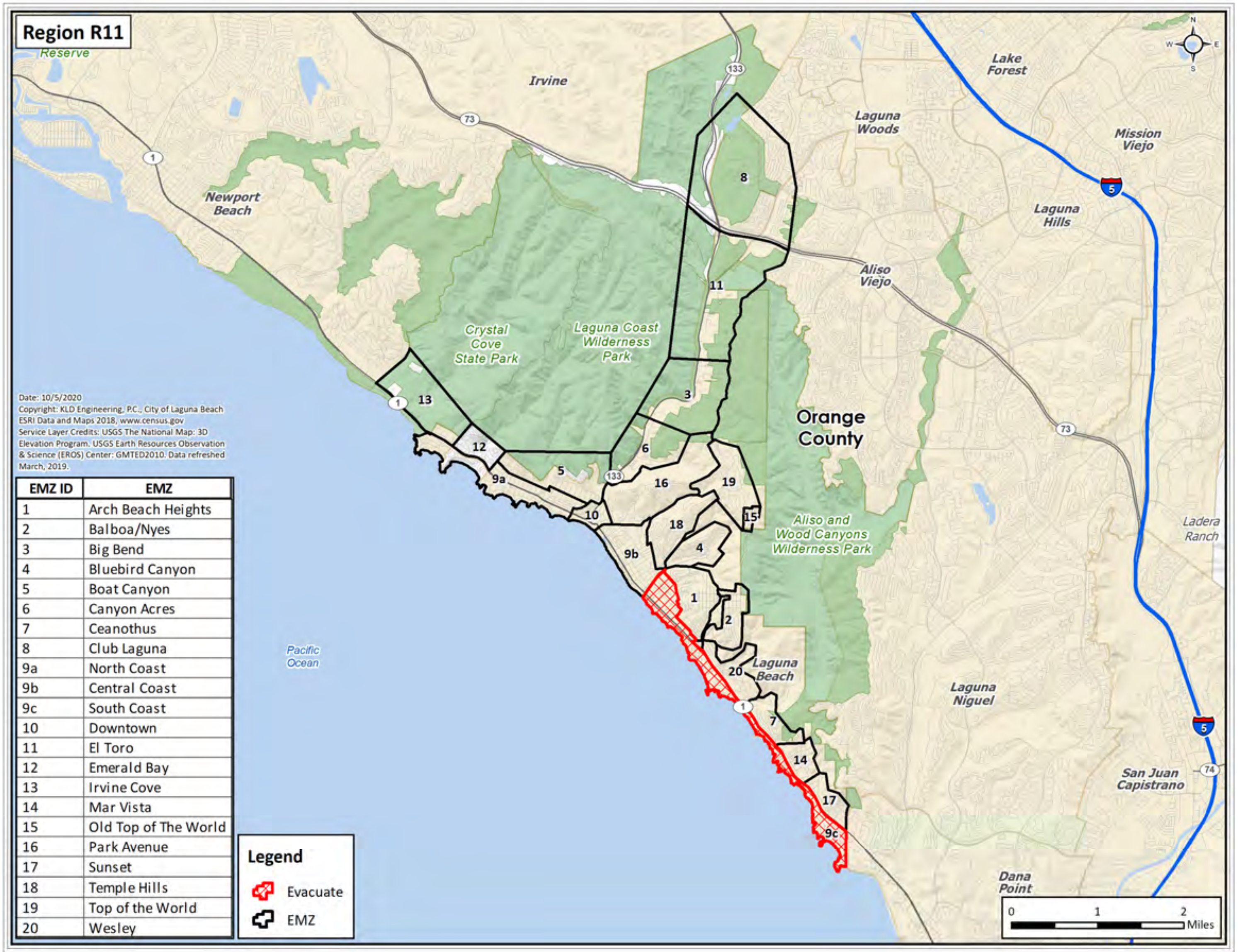
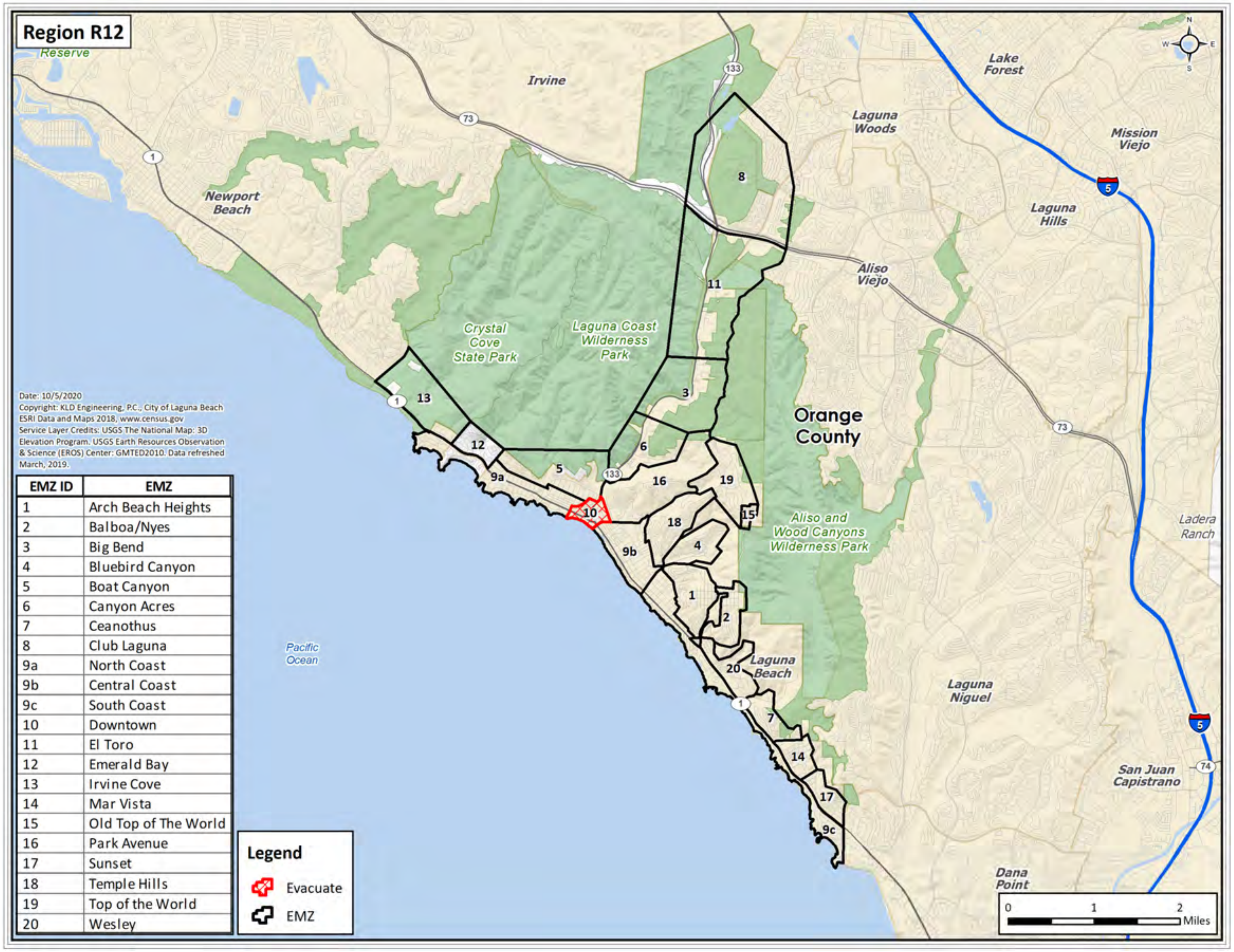
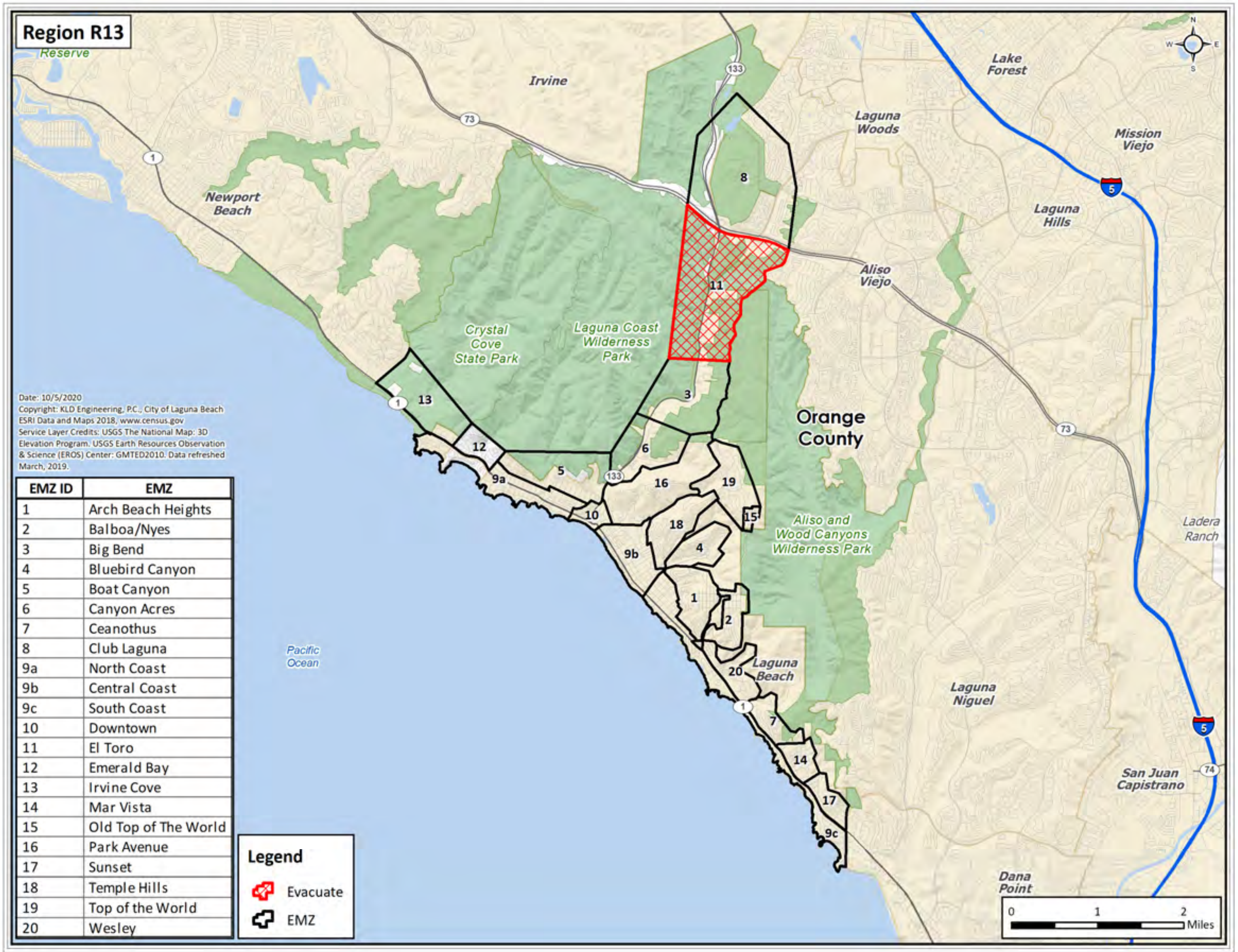


Figure G-11. Region R11



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure G-12. Region R12



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure G-13. Region R13

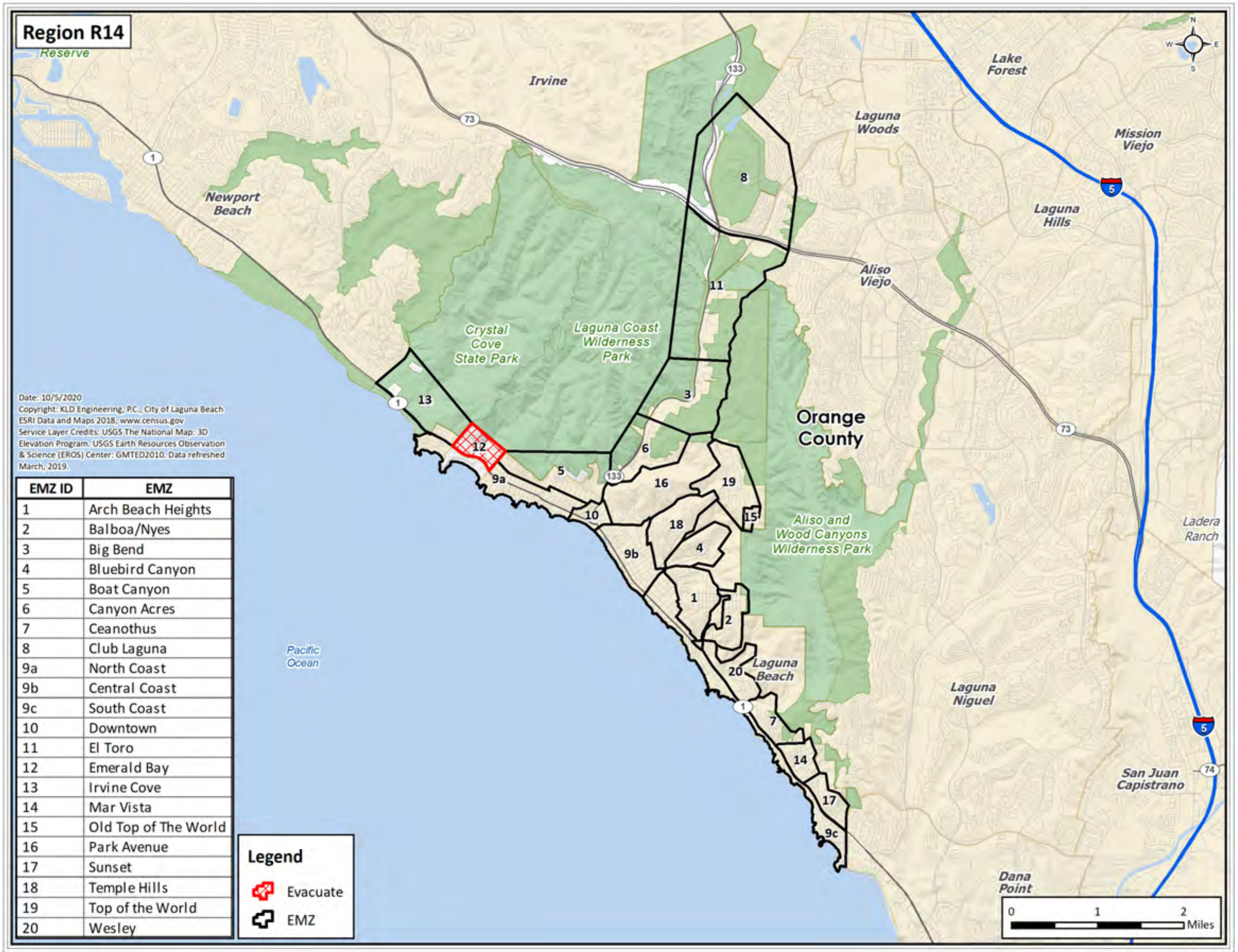


Figure G-14. Region R14

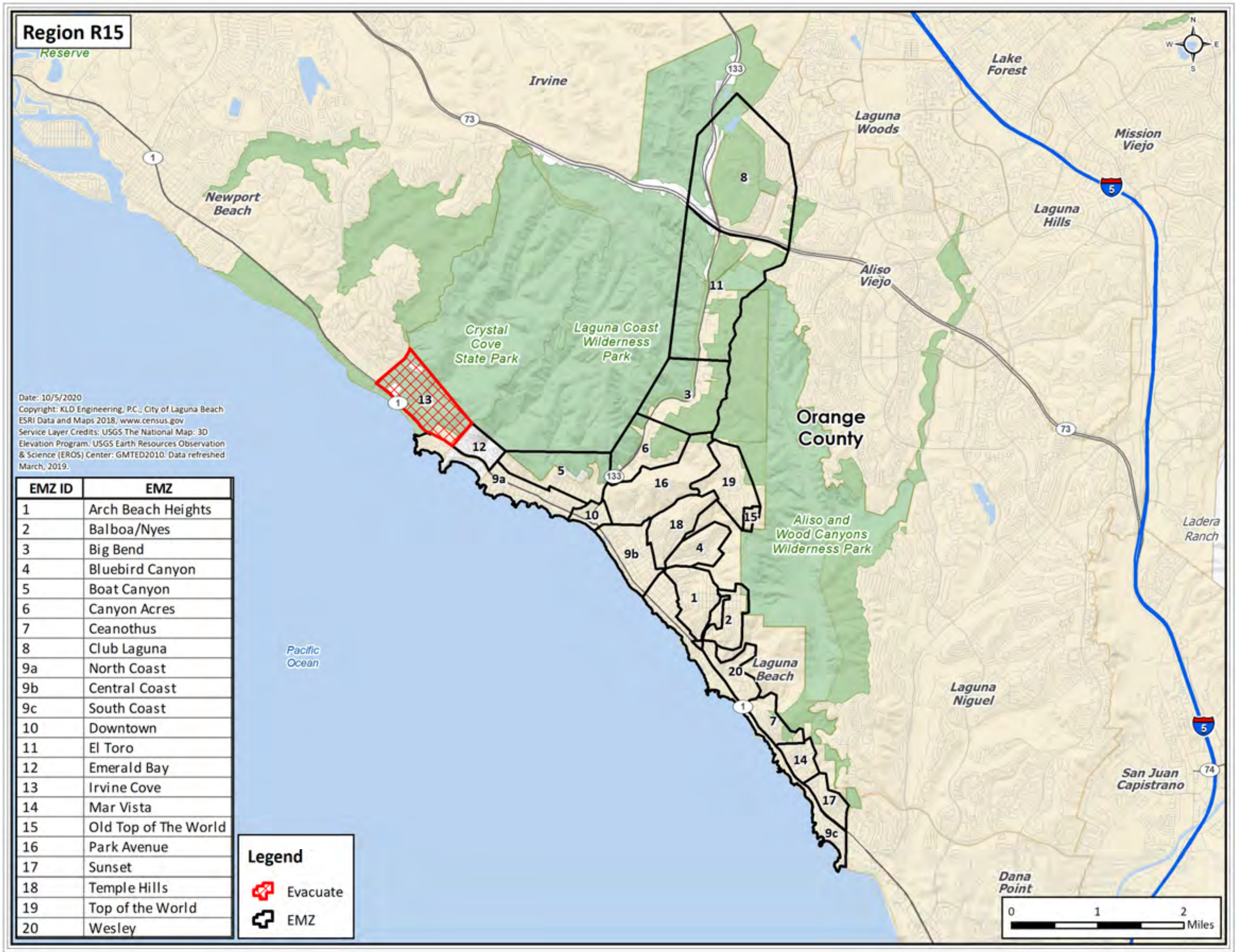


Figure G-15. Region R15

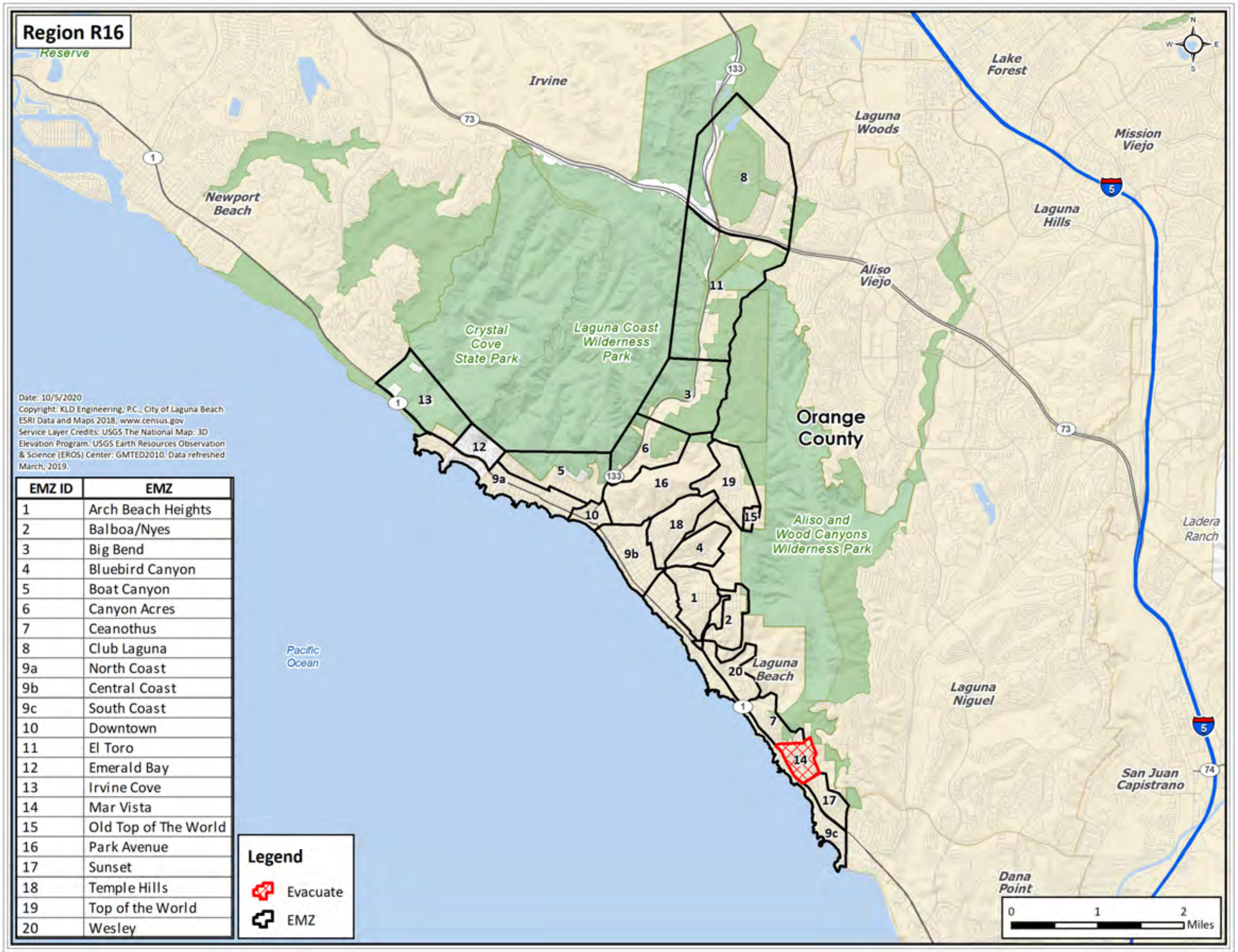


Figure G-16. Region R16

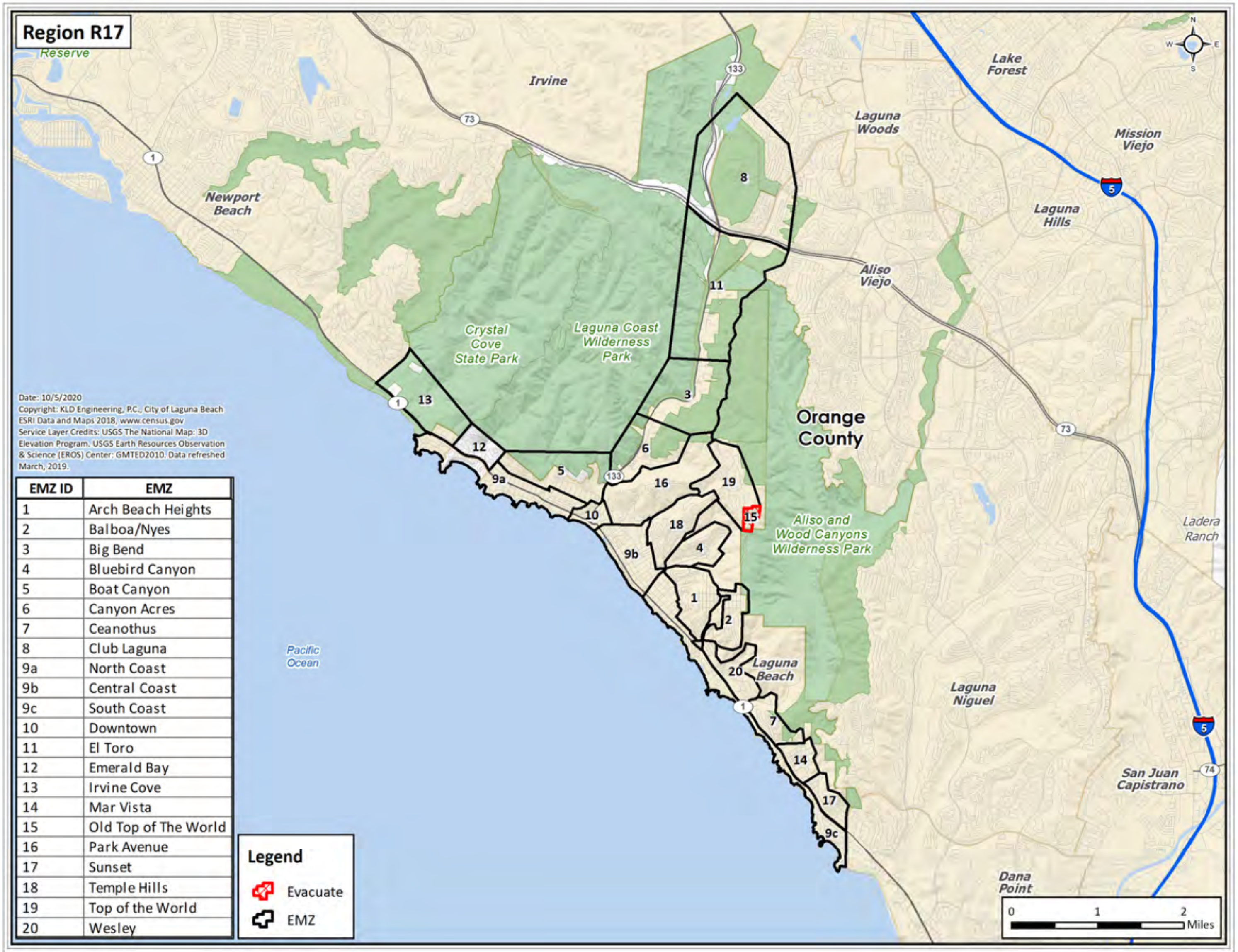


Figure G-17. Region R17

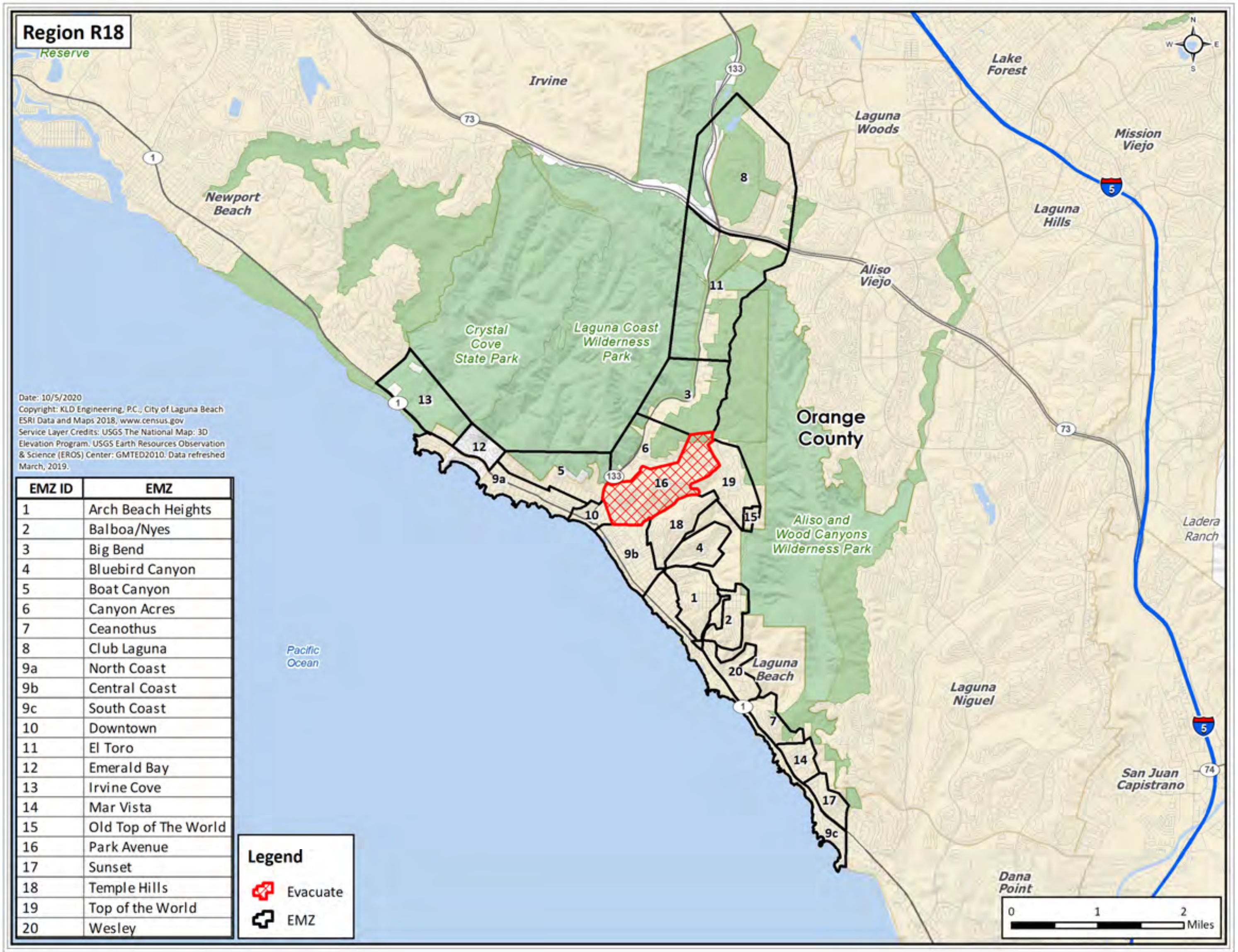


Figure G-18. Region R18

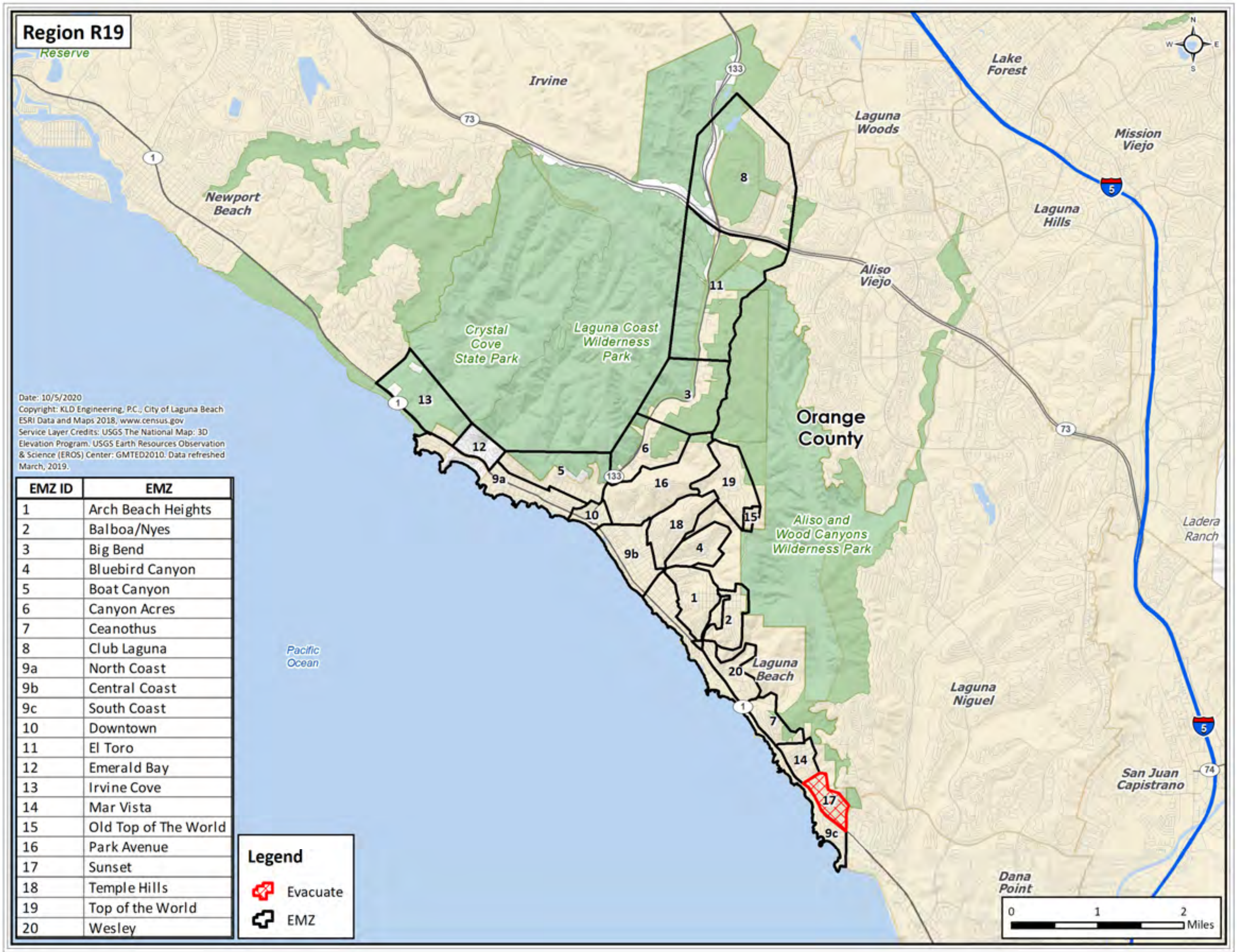
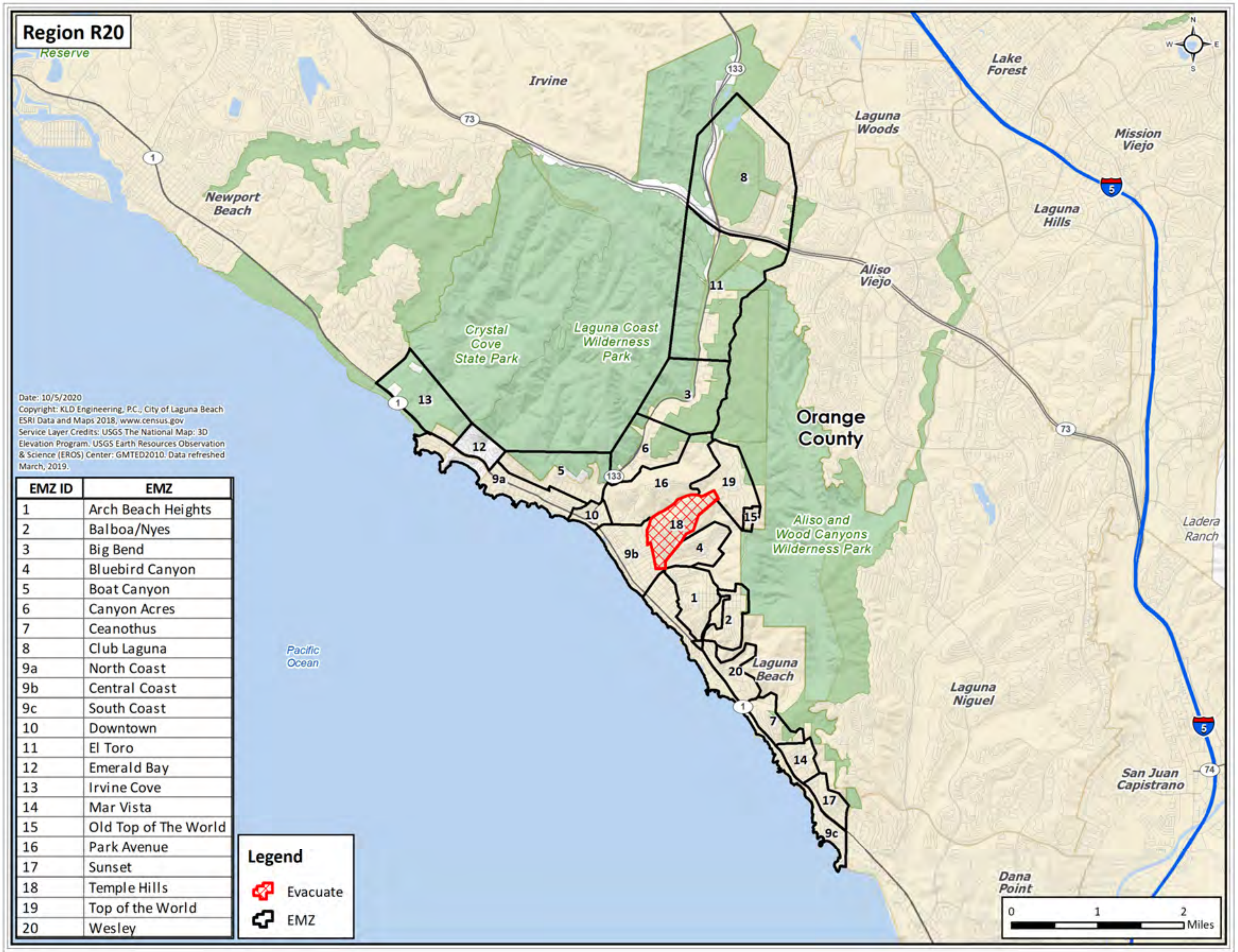


Figure G-19. Region R19



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure G-20. Region R20

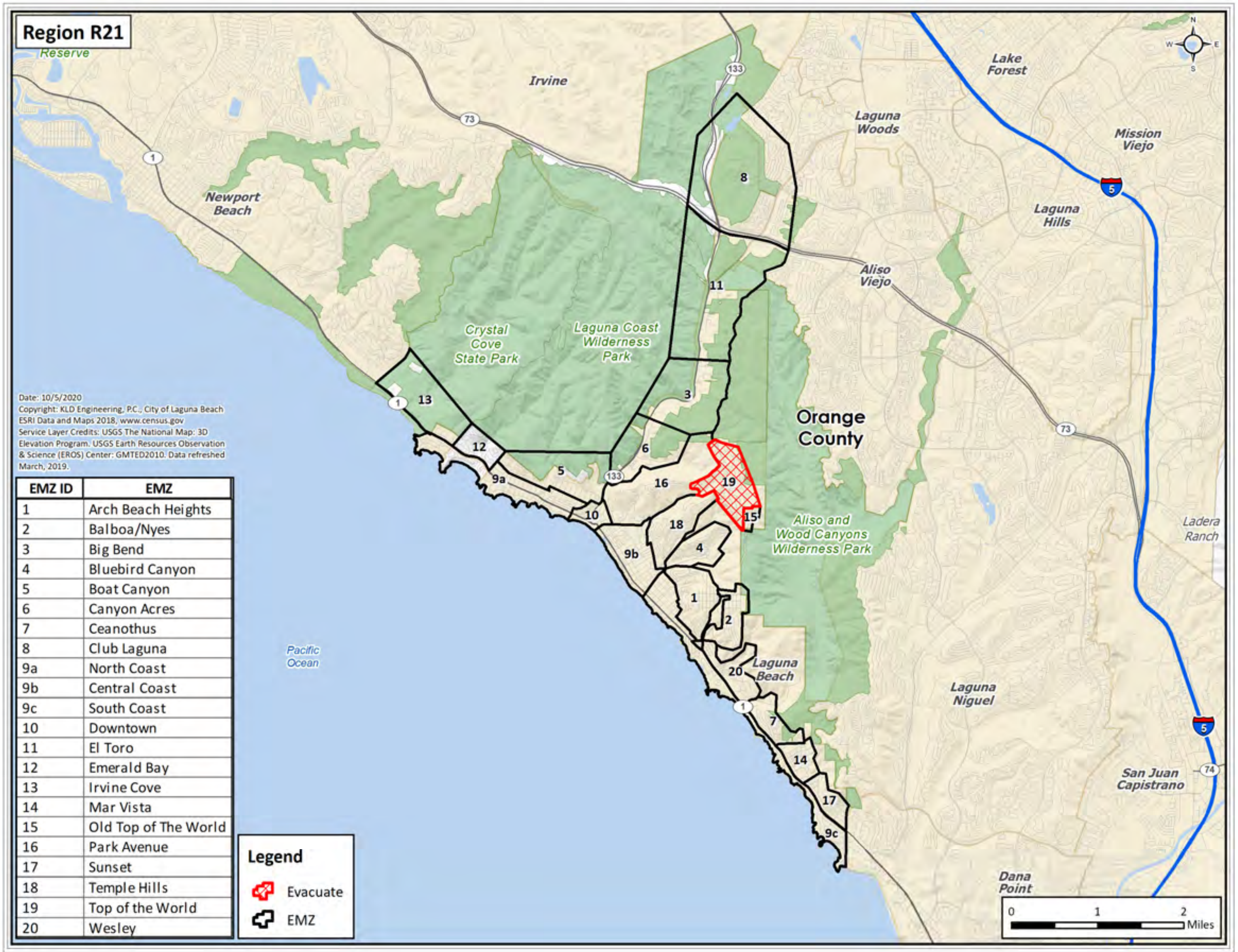
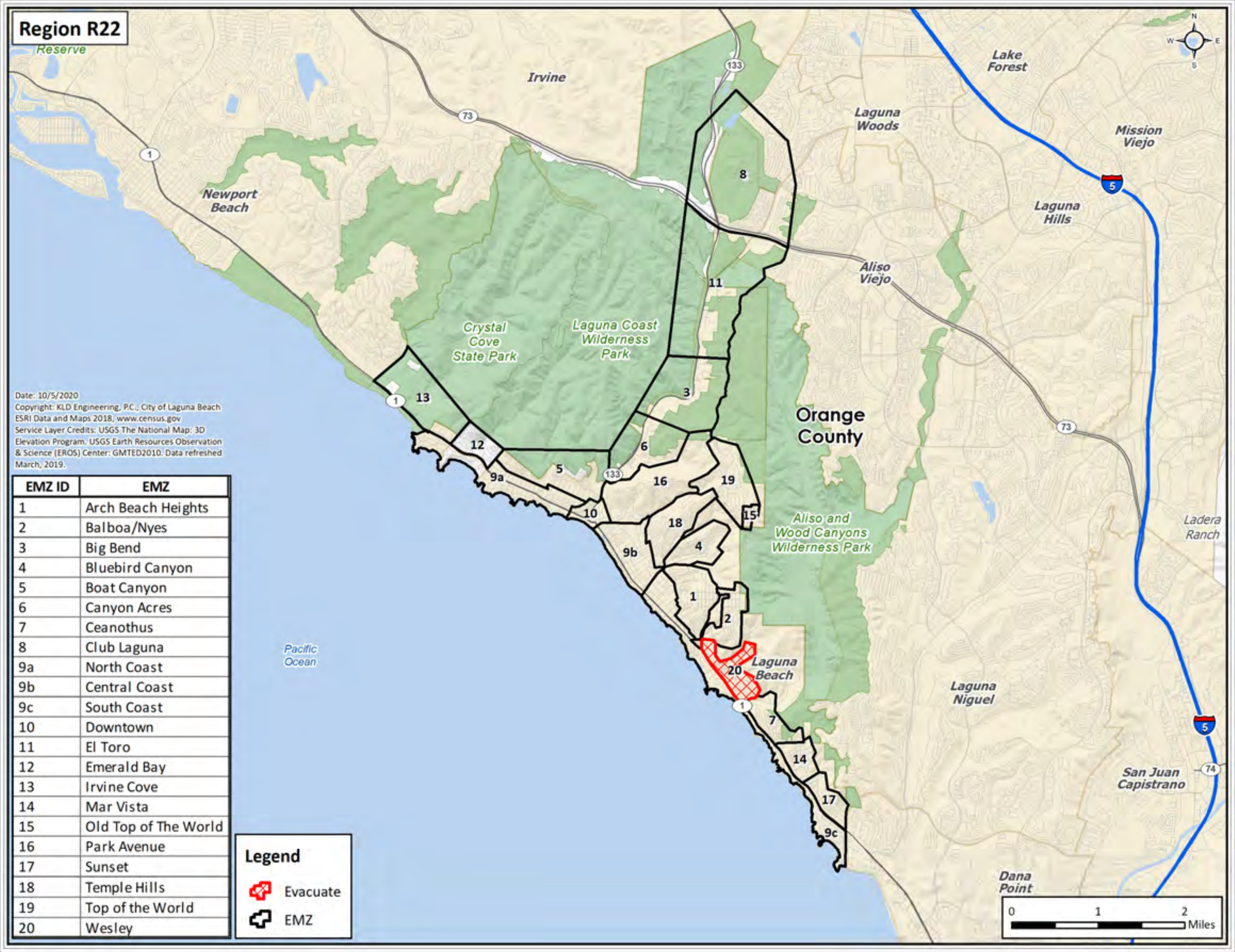


Figure G-21. Region R21



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure G-22. Region R22

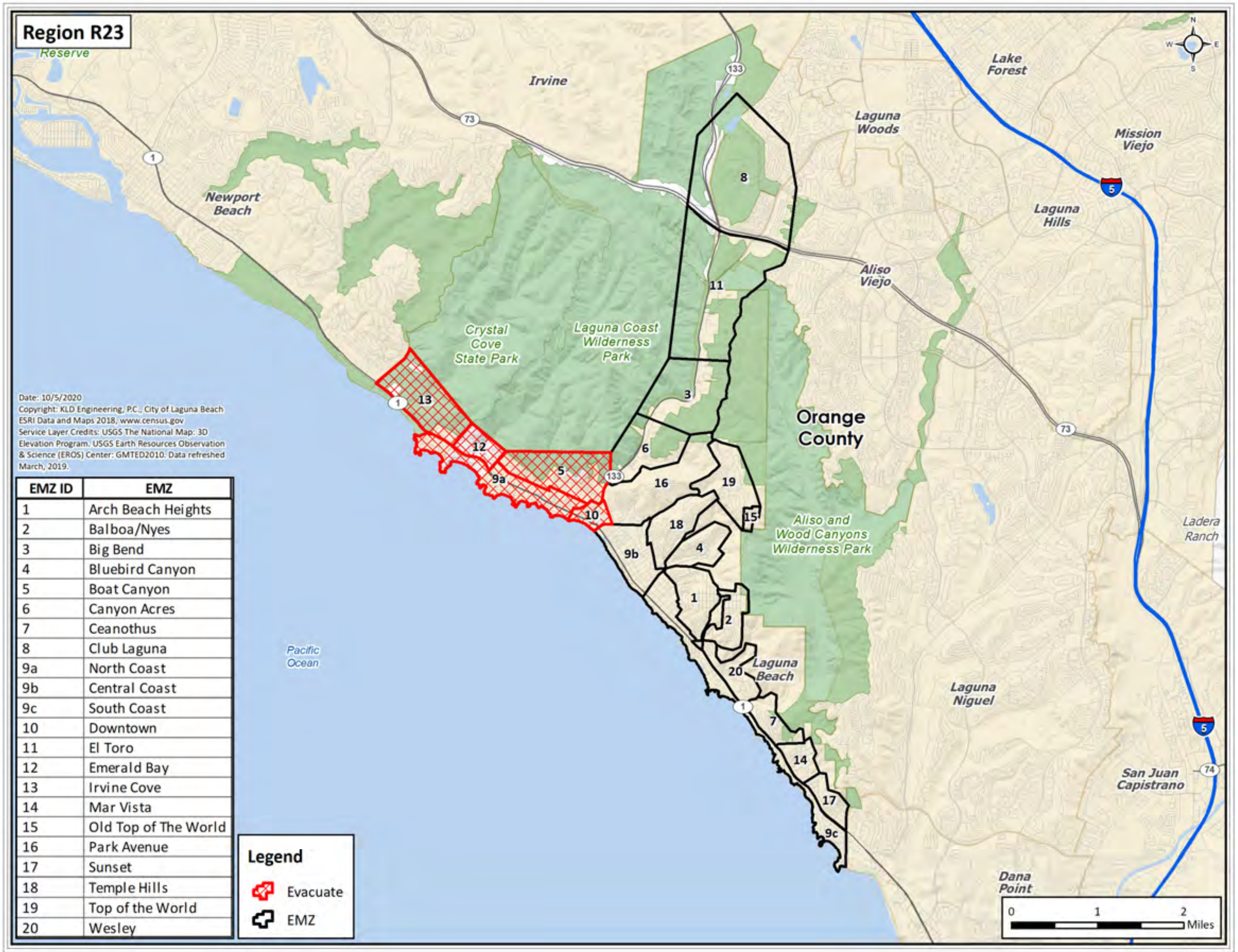


Figure G-23. Region R23

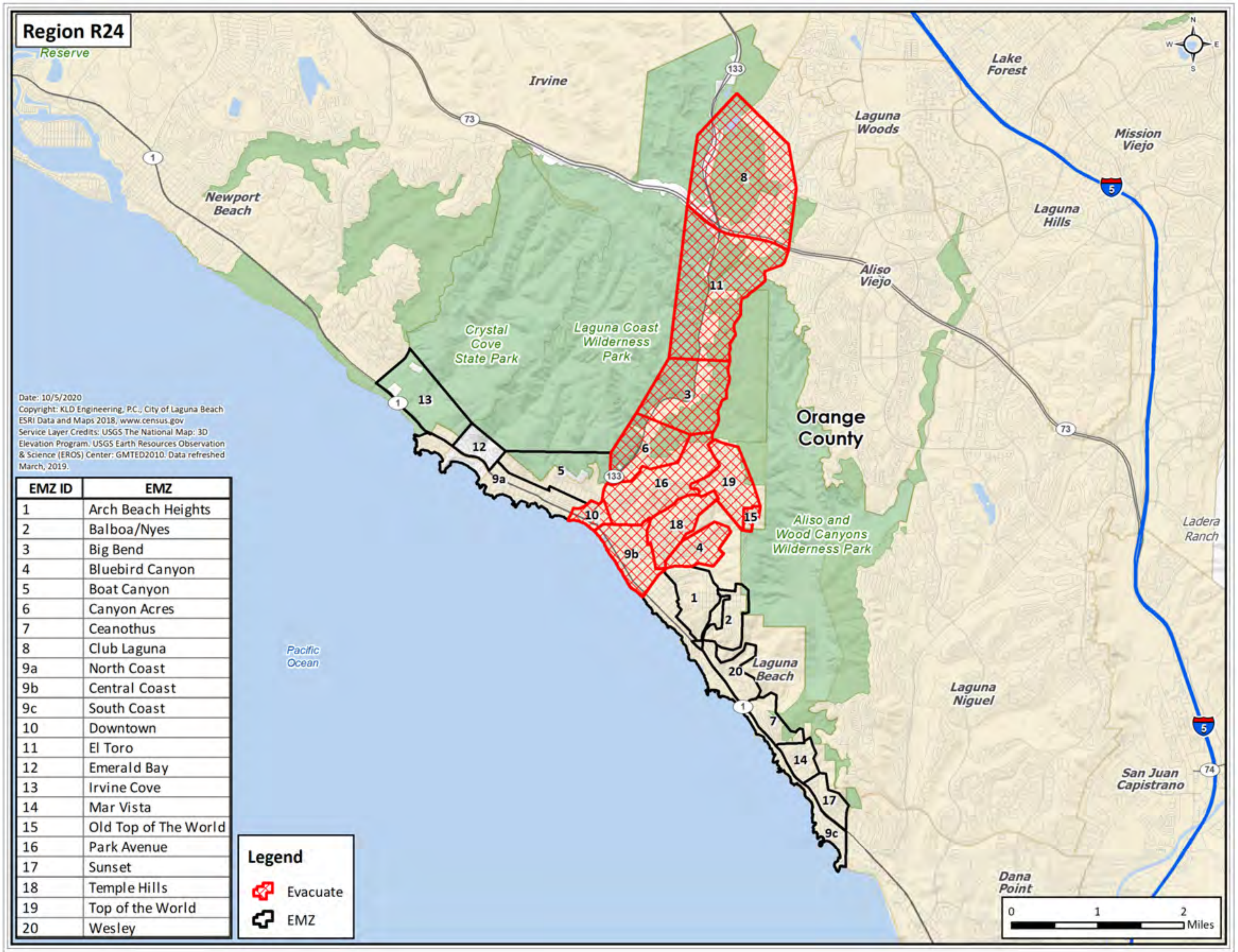


Figure G-24. Region R24

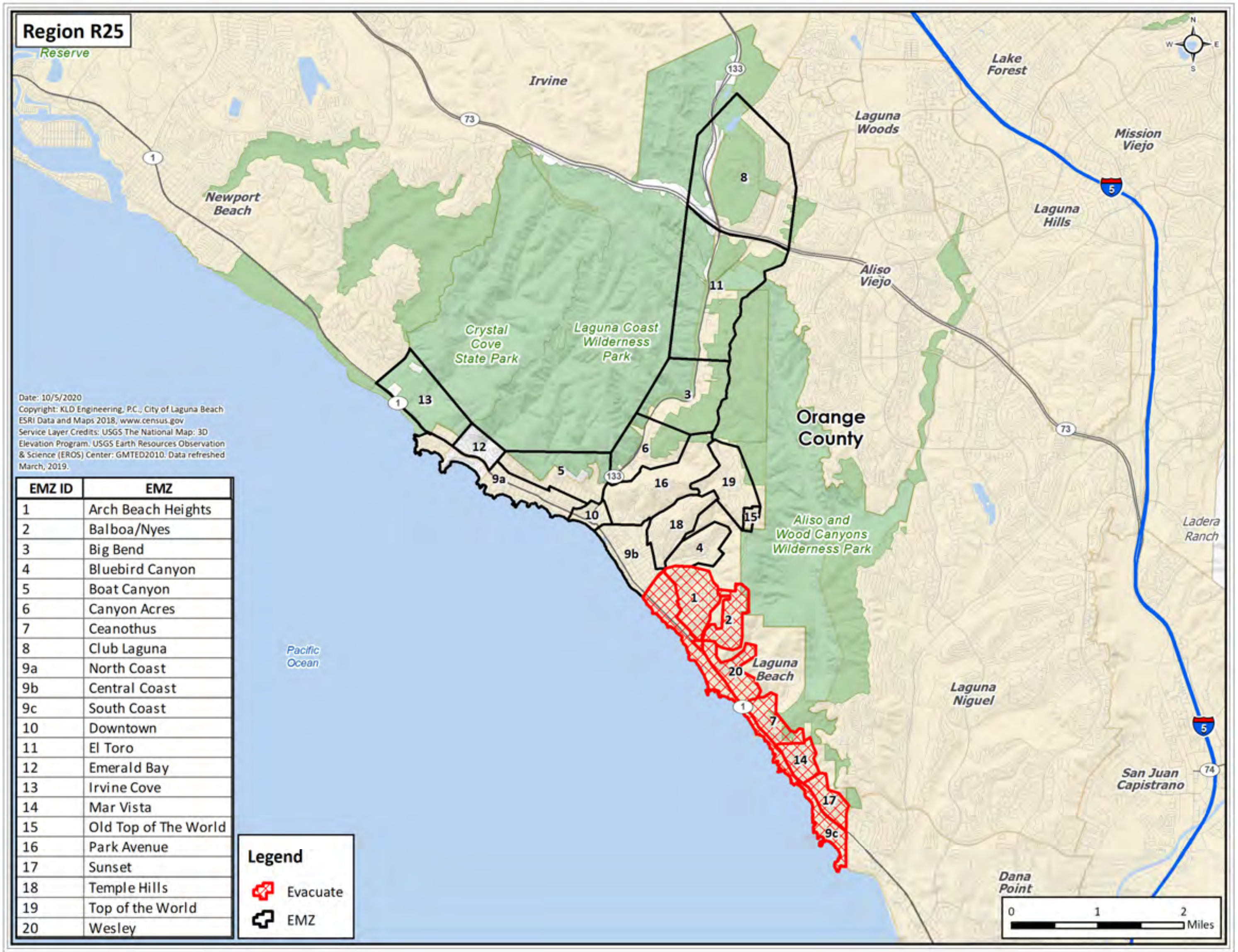


Figure G-25. Region R25

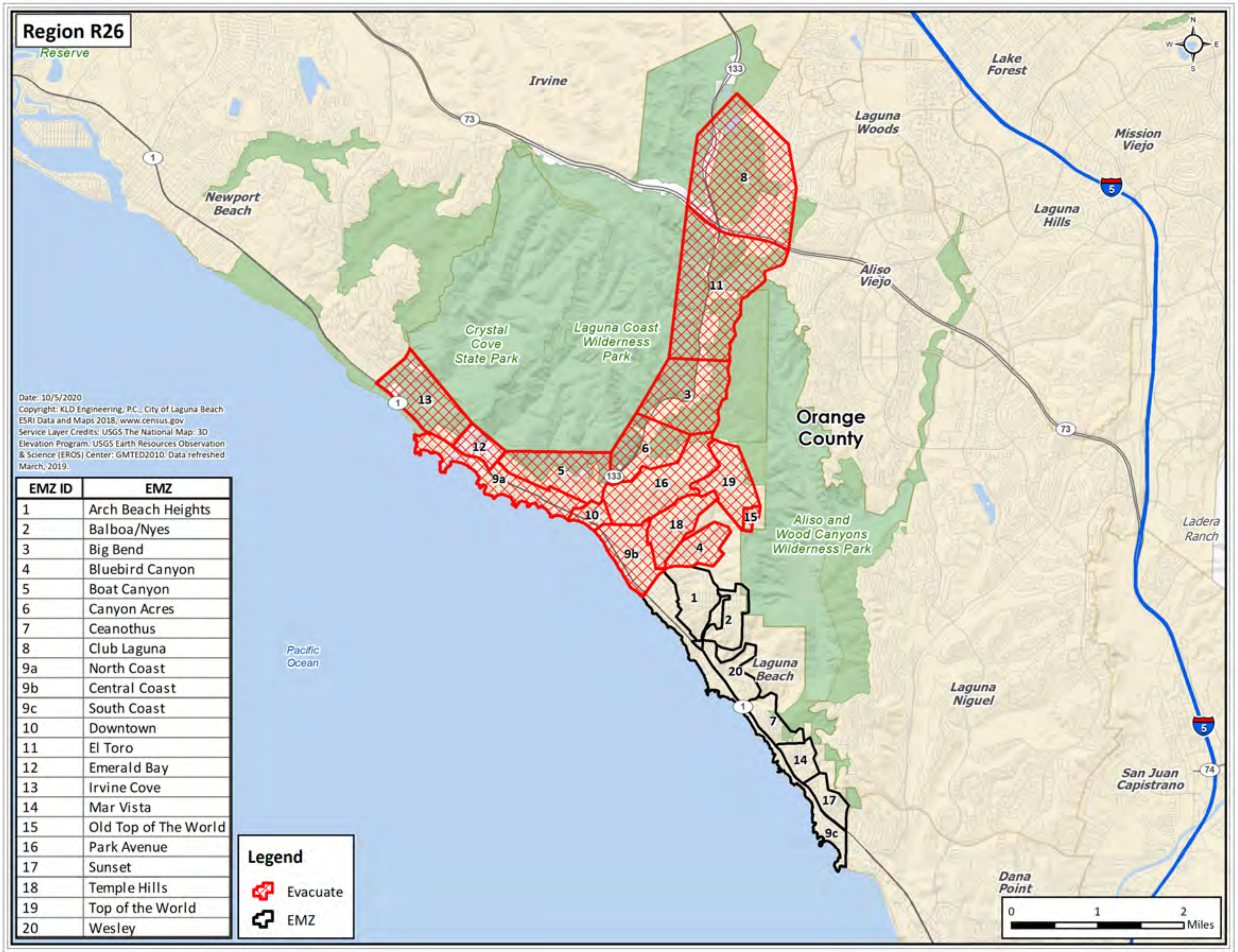


Figure G-26. Region R26

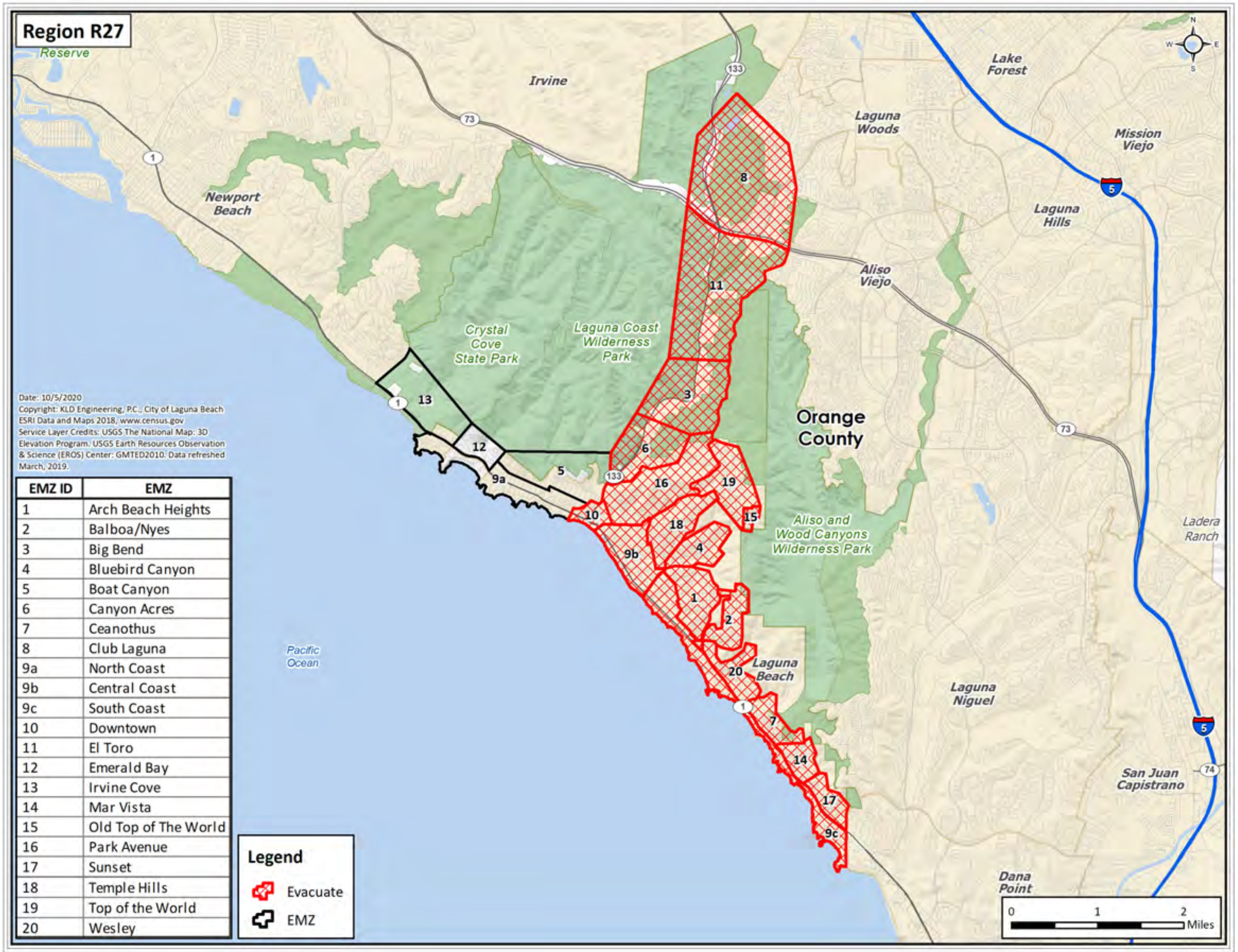


Figure G-27. Region R27

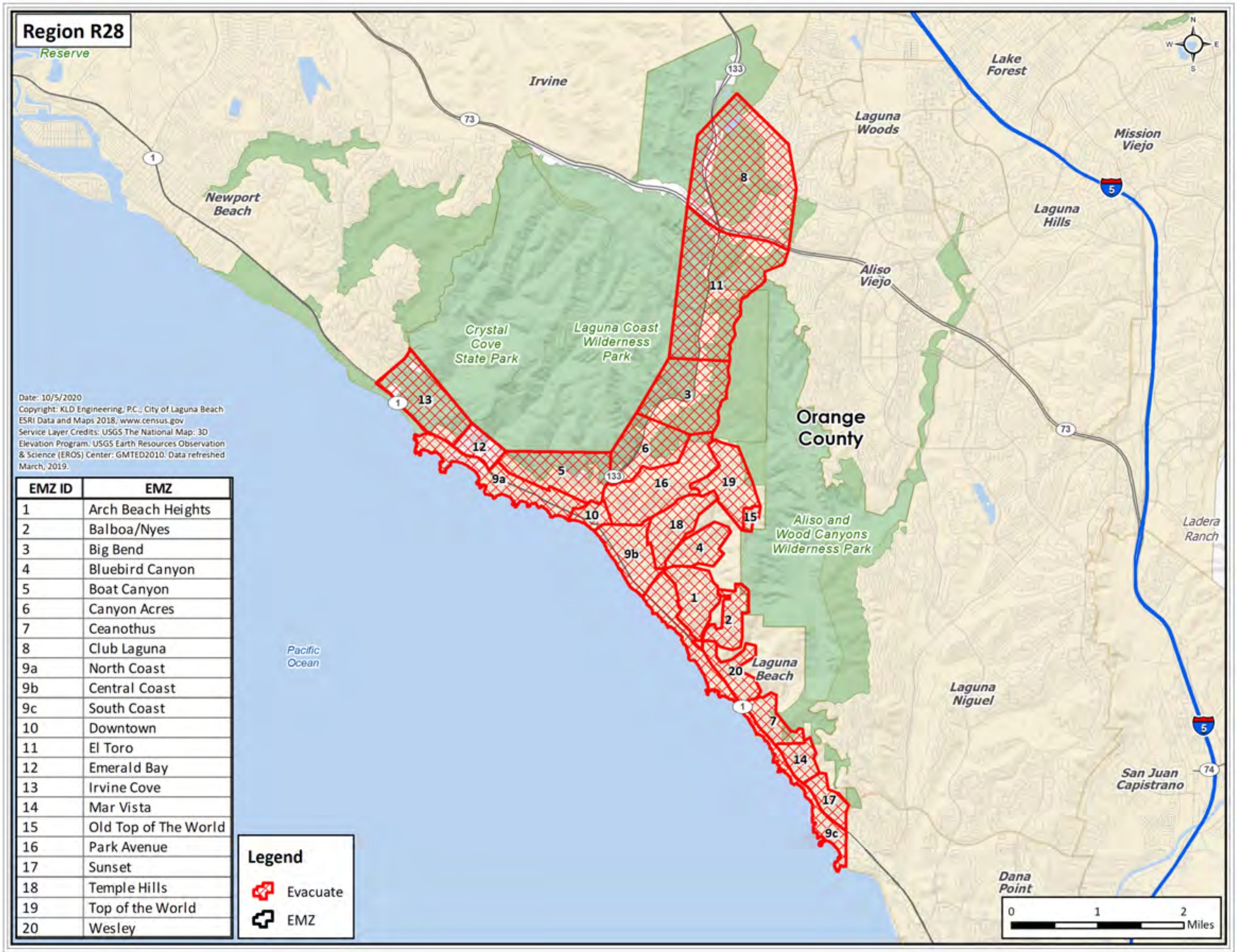
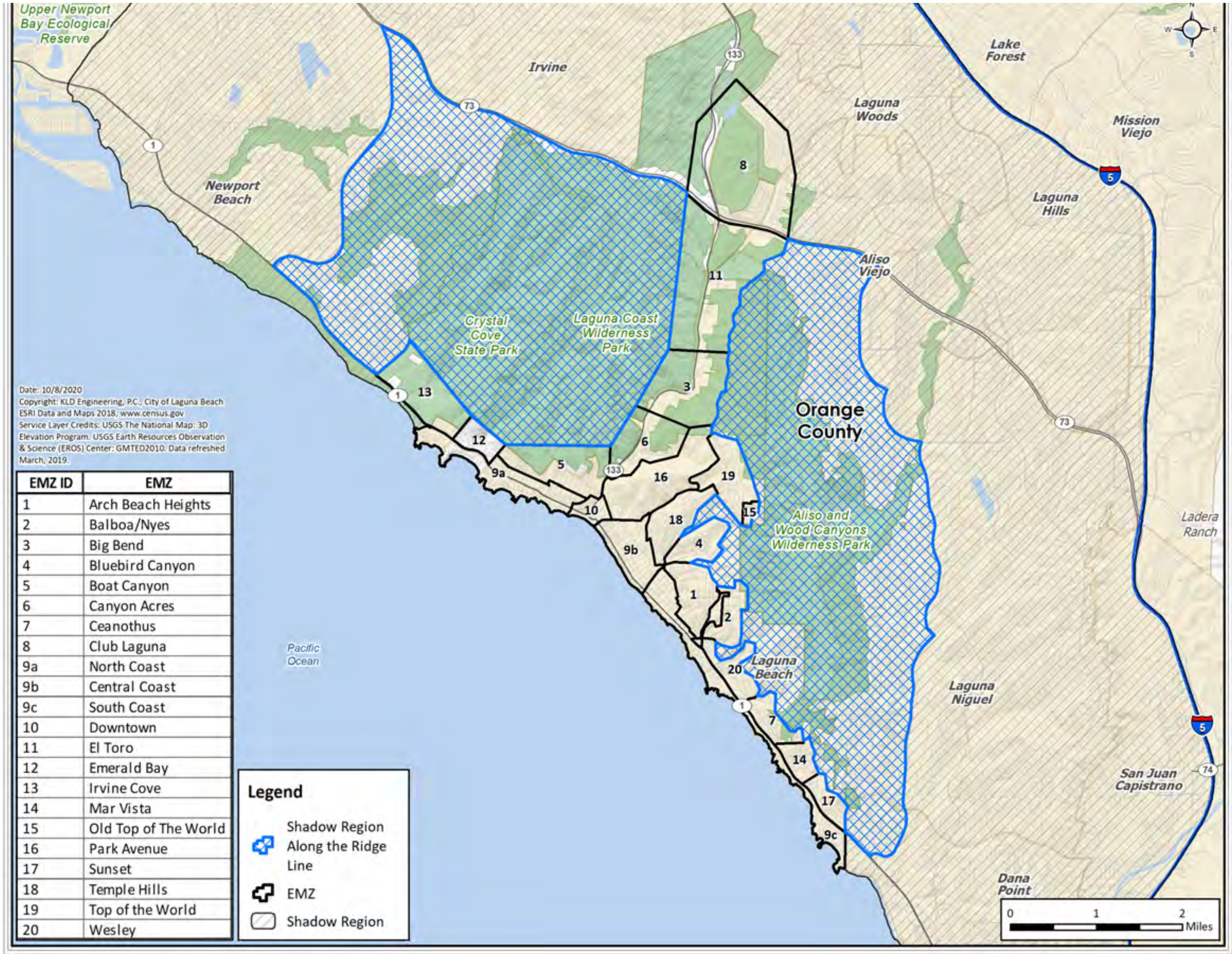


Figure G-28. Region R28



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure G-29. Shadow Region along the Ridge Line

APPENDIX H

Evacuation Roadway Network

H. EVACUATION ROADWAY NETWORK

This appendix presents the evacuation roadway network used in the study. As discussed in Section 1.3, a link-node analysis network was constructed to model the roadway network within the study area. Figure H-1 provides an overview of the link-node analysis network. The figure has been divided up into 58 more detailed figures (Figure H-2 through Figure H-59) which show each of the links and nodes in the network.

The analysis network was calibrated using the observations made during the field survey conducted in November 2019. Table H-1 lists the characteristics of each roadway section modeled in the study area. Each link is identified by its road name and the upstream and downstream node numbers. The geographic location of each link can be observed by referencing the grid map number provided in Table H-1. The roadway type identified in Table H-1 is generally based on the following criteria:

- Freeway: limited access highway, 2 or more lanes in each direction, high free flow speeds
- Freeway ramp: ramp on to or off of a limited access highway
- Major arterial: 3 or more lanes in each direction
- Minor arterial: 2 or more lanes in each direction
- Collector: single lane in each direction
- Local roadways: single lane in each direction, local roads with low free flow speeds

The term, "No. of Lanes" in Table H-1 identifies the number of lanes that extend throughout the length of the link. Many links have additional lanes on the immediate approach to an intersection (turn pockets); these have been recorded and entered into the input stream for the DYNEV II System.

As discussed in Section 1.3, lane width and shoulder width were not physically measured during the road survey. Rather, estimates of these measures were based on visual observations and recorded images.

Table H-2 identifies each node in the network that is controlled and the type of control (stop sign, yield sign, pre-timed signal, actuated signal, traffic control point) at that node. Uncontrolled nodes are not included in Table H-2. The location of each node can be observed by referencing the grid map number provided.

Table H-1. Evacuation Roadway Network Characteristics

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1	1	3	SR-1	Minor Arterial	954	2	12	4	1,750	40	56
2	1	88	Dana Point Harbor Dr	Minor Arterial	1,293	2	12	4	1,750	45	56
3	1	89	SR-1	Major Arterial	686	3	12	4	1,750	40	56
4	2	1178	MacArthur Blvd	Major Arterial	1,322	4	12	4	1,750	55	4
5	3	1	SR-1	Major Arterial	954	3	12	4	1,750	40	56
6	3	4	SR-1	Minor Arterial	1,059	2	12	4	1,750	40	56
7	4	3	SR-1	Major Arterial	1,059	3	12	4	1,750	40	56
8	4	5	SR-1	Minor Arterial	1,348	2	12	4	1,750	40	56
9	5	4	SR-1	Minor Arterial	1,347	2	12	4	1,750	40	56
10	5	6	SR-1	Minor Arterial	697	2	12	4	1,750	40	56
11	5	84	Golden Lantern	Minor Arterial	643	2	12	4	1,750	45	56
12	6	5	SR-1	Minor Arterial	697	2	12	4	1,750	40	56
13	6	7	SR-1	Minor Arterial	632	2	12	4	1,750	40	56
14	7	6	SR-1	Minor Arterial	632	2	12	4	1,750	40	56
15	7	10	SR-1	Minor Arterial	480	2	12	4	1,900	40	56
16	8	9	SR-1	Major Arterial	338	2	12	4	1,750	40	55
17	8	11	SR-1	Minor Arterial	264	2	12	4	1,750	40	55
18	9	8	SR-1	Minor Arterial	338	2	12	4	1,750	40	55
19	9	10	SR-1	Minor Arterial	277	2	12	4	1,900	40	55
20	10	7	SR-1	Minor Arterial	480	2	12	4	1,750	40	56
21	10	9	SR-1	Minor Arterial	277	2	12	4	1,750	40	55
22	11	8	SR-1	Minor Arterial	264	2	12	4	1,750	40	55
23	11	12	SR-1	Minor Arterial	680	2	12	4	1,750	45	55
24	12	11	SR-1	Minor Arterial	683	2	12	4	1,750	45	55
25	12	13	SR-1	Minor Arterial	789	2	12	4	1,900	50	55
26	13	12	SR-1	Minor Arterial	789	2	12	4	1,750	50	55
27	13	14	SR-1	Minor Arterial	1,532	2	12	4	1,750	50	55
28	14	13	SR-1	Minor Arterial	1,532	2	12	4	1,900	50	55
29	14	15	SR-1	Minor Arterial	2,141	2	12	4	1,750	50	55
30	15	14	SR-1	Minor Arterial	2,141	2	12	4	1,750	50	55

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
31	15	16	SR-1	Minor Arterial	2,006	2	12	4	1,900	50	52
32	15	71	Niguel Rd	Minor Arterial	597	2	12	4	1,750	40	55
33	16	15	SR-1	Minor Arterial	2,006	2	12	4	1,750	50	52
34	16	1495	SR-1	Minor Arterial	1,435	2	12	4	1,700	45	52
35	17	18	SR-1	Minor Arterial	877	2	12	4	1,750	45	52
36	17	1495	SR-1	Minor Arterial	858	2	12	4	1,750	45	52
37	18	17	SR-1	Minor Arterial	877	2	12	4	1,750	45	52
38	18	19	SR-1	Minor Arterial	3,211	2	12	4	1,750	45	51
39	18	66	Crown Valley Pkwy	Minor Arterial	453	2	12	8	1,900	35	52
40	19	18	SR-1	Minor Arterial	3,210	2	12	4	1,750	45	51
41	19	20	SR-1	Minor Arterial	1,166	2	12	4	1,900	40	51
42	20	19	SR-1	Minor Arterial	1,169	2	12	4	1,750	40	51
43	20	1422	SR-1	Minor Arterial	1,409	2	12	4	1,750	40	51
44	21	22	SR-1	Minor Arterial	1,152	2	12	4	1,750	40	51
45	21	1422	SR-1	Minor Arterial	724	2	12	4	1,750	40	51
46	22	21	SR-1	Minor Arterial	1,152	2	12	4	1,750	40	51
47	22	23	SR-1	Minor Arterial	1,362	2	12	4	1,750	40	46
48	23	22	SR-1	Minor Arterial	1,361	2	12	4	1,750	40	46
49	23	24	SR-1	Minor Arterial	1,551	2	12	4	1,900	40	46
50	24	23	SR-1	Minor Arterial	1,551	2	12	4	1,750	40	46
51	24	25	SR-1	Minor Arterial	635	2	12	4	1,900	40	46
52	25	24	SR-1	Minor Arterial	638	2	12	4	1,900	40	46
53	25	26	SR-1	Minor Arterial	758	2	12	4	1,900	40	46
54	26	25	SR-1	Minor Arterial	759	2	12	4	1,900	40	46
55	26	27	SR-1	Minor Arterial	1,160	2	12	4	1,750	40	46
56	27	26	SR-1	Minor Arterial	1,161	2	12	4	1,900	40	46
57	27	28	SR-1	Minor Arterial	1,190	2	12	4	1,750	40	46
58	28	27	SR-1	Minor Arterial	1,190	2	12	4	1,750	40	46
59	28	29	SR-1	Minor Arterial	2,077	2	12	4	1,750	40	45
60	29	28	SR-1	Minor Arterial	2,077	2	12	4	1,750	40	45
61	29	30	SR-1	Minor Arterial	227	2	12	4	1,900	40	45
62	30	29	SR-1	Minor Arterial	227	2	12	4	1,750	40	45

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
63	30	1425	SR-1	Minor Arterial	651	2	12	4	1,750	40	45
64	31	32	SR-1	Minor Arterial	1,280	2	12	4	1,750	40	40
65	31	52	SR-1	Minor Arterial	1,313	2	12	4	1,750	40	40
66	32	31	SR-1	Minor Arterial	1,280	2	12	4	1,750	40	40
67	32	46	SR-1	Minor Arterial	1,530	2	12	4	1,750	40	40
68	33	34	SR-1	Minor Arterial	942	2	12	4	1,750	40	40
69	33	46	SR-1	Minor Arterial	720	2	12	4	1,750	40	40
70	34	33	SR-1	Minor Arterial	942	2	12	4	1,750	40	40
71	34	35	SR-1	Minor Arterial	769	2	12	4	1,750	40	40
72	35	34	SR-1	Minor Arterial	769	2	12	4	1,750	40	40
73	35	36	SR-1	Minor Arterial	264	2	12	4	1,900	40	40
74	36	35	SR-1	Minor Arterial	263	2	12	4	1,750	40	40
75	36	37	SR-1	Minor Arterial	255	2	12	4	1,750	40	39
76	37	36	SR-1	Minor Arterial	254	2	12	4	1,900	40	39
77	37	38	SR-1	Minor Arterial	412	2	12	4	1,750	40	39
78	38	37	SR-1	Minor Arterial	412	2	12	4	1,750	40	39
79	38	39	SR-1	Minor Arterial	1,008	2	12	4	1,750	40	39
80	38	40	SR-133	Minor Arterial	723	2	12	4	1,750	30	39
81	39	38	SR-1	Minor Arterial	1,008	2	12	4	1,750	40	39
82	39	885	SR-1	Minor Arterial	1,290	2	12	4	1,750	40	39
83	40	38	SR-133	Minor Arterial	722	2	12	4	1,750	30	39
84	40	353	SR-133	Minor Arterial	227	2	12	4	1,750	30	39
85	41	37	Ocean Ave	Local Roadway	738	1	12	4	1,750	25	39
86	41	40	Beach St	Local Roadway	284	1	12	4	1,750	30	39
87	43	1334	Legion St	Local Roadway	1,087	1	12	4	1,125	25	40
88	43	1409	Park Ave	Local Roadway	157	1	12	2	1,575	35	40
89	44	33	Cleo St	Local Roadway	369	1	12	4	1,750	25	40
90	44	1334	Glenneyre St	Minor Arterial	955	2	12	4	1,900	30	40
91	45	33	Cleo St	Local Roadway	355	1	12	4	1,750	25	40
92	46	32	SR-1	Minor Arterial	1,530	2	12	4	1,750	40	40
93	46	33	SR-1	Minor Arterial	720	2	12	4	1,750	40	40
94	47	1633	Thalia St	Local Roadway	179	1	12	4	1,125	25	40

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
95	48	46	Thalia St	Local Roadway	308	1	12	4	1,750	25	40
96	49	1314	Cress St	Local Roadway	765	1	12	4	1,125	25	40
97	50	32	Cress St	Local Roadway	314	1	12	4	1,750	25	40
98	51	1332	Bluebird Canyon Dr	Local Roadway	1,035	1	12	4	1,125	25	40
99	52	31	SR-1	Minor Arterial	1,312	2	12	4	1,750	40	40
100	52	1427	SR-1	Minor Arterial	1,723	2	12	4	1,900	40	45
101	53	1375	Diamond St	Local Roadway	782	1	12	4	1,125	25	40
102	54	29	Nyes Pl	Local Roadway	518	1	12	4	1,750	25	45
103	55	28	South Terrace	Local Roadway	375	1	12	4	1,750	25	45
104	56	28	Montage Resert Dr	Local Roadway	370	1	12	4	1,750	25	45
105	57	27	Wesley Dr	Local Roadway	756	1	12	4	1,750	25	46
106	58	23	West St	Local Roadway	182	1	12	4	1,750	25	46
107	59	58	West St	Local Roadway	764	1	12	0	1,125	25	46
108	60	22	Seacliff Dr	Local Roadway	343	1	12	4	1,750	25	46
109	61	22	3rd Ave	Local Roadway	927	1	12	4	1,750	25	46
110	62	21	7th Ave	Local Roadway	661	1	12	4	1,750	25	51
111	63	21	Circle Dr	Local Roadway	360	1	12	4	1,750	25	51
112	64	19	Vista Del Sol	Local Roadway	1,064	1	12	4	1,750	25	51
113	65	19	Vista Del Sol	Local Roadway	566	1	12	4	1,750	25	51
114	66	18	Crown Valley Pkwy	Minor Arterial	466	1	12	8	1,750	35	52
115	66	67	Crown Valley Pkwy	Minor Arterial	996	2	12	8	1,900	35	52
116	67	66	Crown Valley Pkwy	Minor Arterial	988	2	12	8	1,900	35	52
117	67	142	Crown Valley Pkwy	Minor Arterial	668	2	12	8	1,750	45	52
118	68	18	Monarch Bay Dr	Collector	731	1	12	4	1,750	25	52
119	69	17	Monarch Bay Plaza	Collector	349	1	12	0	1,750	30	52
120	70	71	Niguel Rd	Minor Arterial	1,012	2	12	4	1,750	40	52
121	70	240	Stonehill Dr	Minor Arterial	937	2	12	4	1,900	40	52
122	71	15	Niguel Rd	Minor Arterial	597	1	12	4	1,750	40	55
123	71	70	Niguel Rd	Minor Arterial	1,018	1	12	4	1,750	40	52
124	72	15	Ritz Carlton Dr	Collector	939	2	12	4	1,750	30	55
125	73	14	Selva Rd	Collector	945	1	12	2	1,750	35	55
126	74	14	Selva Rd	Collector	698	1	12	2	1,750	35	55

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
127	75	12	Shoreline Dr	Collector	951	1	12	0	1,750	30	55
128	76	11	Street of the Blue Lantern	Collector	939	1	12	2	1,750	30	55
129	77	11	Street of the Blue Lantern	Collector	633	1	12	2	1,750	30	55
130	78	8	Pacific Coast Hwy	Minor Arterial	362	1	12	4	1,750	30	55
131	79	9	Street of the Ruby Lantern	Collector	400	1	12	2	1,750	30	55
132	80	7	Street of the Amber Lantern	Collector	673	1	12	4	1,750	30	56
133	81	6	Street of the Violet Lantern	Collector	816	1	12	2	1,750	30	56
134	81	84	La Cresta Dr	Collector	698	1	12	4	1,750	25	56
135	82	6	Street of the Violet Lantern	Collector	861	1	12	2	1,750	30	56
136	83	5	Golden Lantern	Minor Arterial	757	2	12	4	1,750	30	56
137	84	5	Golden Lantern	Minor Arterial	643	1	12	4	1,750	45	56
138	84	90	Golden Lantern	Minor Arterial	1,341	2	12	4	1,750	45	56
139	85	4	Copper Lantern St	Collector	618	1	12	4	1,750	30	56
140	86	3	Crystal Lantern	Collector	588	1	12	4	1,750	30	56
141	87	1	Dana Point Harbor Dr	Minor Arterial	910	2	12	4	1,750	40	56
142	88	1	Dana Point Harbor Dr	Minor Arterial	1,292	1	12	4	1,750	45	56
143	88	733	Dana Point Harbor Dr	Minor Arterial	1,047	2	12	4	1,900	45	56
144	89	1	SR-1	Major Arterial	686	2	12	4	1,750	40	56
145	89	735	SR-1	Major Arterial	1,387	3	12	4	1,900	45	56
146	90	84	Golden Lantern	Minor Arterial	1,341	2	12	4	1,750	45	56
147	90	91	Golden Lantern	Minor Arterial	822	2	12	4	1,900	45	56
148	91	90	Golden Lantern	Minor Arterial	822	2	12	4	1,750	45	56
149	91	92	Golden Lantern	Minor Arterial	513	2	12	4	1,750	45	56
150	92	91	Golden Lantern	Minor Arterial	513	2	12	4	1,900	45	56
151	92	93	Golden Lantern	Minor Arterial	979	2	12	4	1,750	45	53
152	92	117	Stonehill Dr	Minor Arterial	1,887	2	12	8	1,750	45	56
153	93	92	Golden Lantern	Minor Arterial	979	2	12	4	1,750	45	53
154	93	1621	Golden Lantern	Minor Arterial	626	2	12	4	1,900	45	53
155	94	1498	Golden Lantern	Minor Arterial	193	2	12	4	1,750	45	53
156	94	1621	Golden Lantern	Minor Arterial	1,671	2	12	4	1,750	45	53
157	95	96	Golden Lantern	Minor Arterial	599	2	12	4	1,750	45	53

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
158	95	1499	Golden Lantern	Minor Arterial	554	2	12	4	1,900	45	53
159	96	95	Golden Lantern	Minor Arterial	595	2	12	4	1,750	45	53
160	96	97	Golden Lantern	Major Arterial	819	3	12	4	1,750	50	53
161	96	123	Camino Del Avion	Minor Arterial	822	2	12	4	1,750	45	53
162	97	96	Golden Lantern	Minor Arterial	820	2	12	4	1,750	50	53
163	97	98	Golden Lantern	Major Arterial	857	3	12	4	1,900	50	53
164	98	97	Golden Lantern	Major Arterial	857	3	12	4	1,750	50	53
165	98	99	Golden Lantern	Major Arterial	1,355	3	12	4	1,900	50	53
166	99	98	Golden Lantern	Major Arterial	1,347	3	12	4	1,900	50	53
167	99	100	Golden Lantern	Major Arterial	727	3	12	4	1,750	50	53
168	100	99	Golden Lantern	Major Arterial	727	3	12	4	1,900	50	53
169	100	101	Golden Lantern	Major Arterial	1,488	3	12	4	1,750	50	48
170	101	100	Golden Lantern	Major Arterial	1,501	3	12	4	1,750	50	48
171	101	102	Golden Lantern	Major Arterial	1,382	3	12	4	1,900	50	48
172	102	101	Golden Lantern	Major Arterial	1,386	3	12	4	1,750	50	48
173	102	103	Golden Lantern	Major Arterial	1,224	3	12	4	1,750	50	48
174	103	102	Golden Lantern	Major Arterial	1,218	3	12	4	1,900	50	48
175	103	104	Golden Lantern	Minor Arterial	1,995	2	12	4	1,900	50	48
176	104	103	Golden Lantern	Minor Arterial	1,989	2	12	4	1,750	50	48
177	104	105	Golden Lantern	Minor Arterial	1,089	2	12	4	1,750	50	48
178	105	104	Golden Lantern	Minor Arterial	1,085	2	12	4	1,900	50	48
179	105	106	Golden Lantern	Minor Arterial	1,012	2	12	4	1,750	50	48
180	106	105	Golden Lantern	Minor Arterial	1,011	2	12	4	1,750	50	48
181	106	136	Golden Lantern	Minor Arterial	933	2	12	4	1,900	50	48
182	107	108	Golden Lantern	Major Arterial	878	3	12	4	1,750	50	48
183	107	136	Golden Lantern	Major Arterial	626	3	12	4	1,900	50	48
184	108	107	Golden Lantern	Major Arterial	878	3	12	4	1,750	50	48
185	108	109	Golden Lantern	Major Arterial	1,777	3	12	4	1,750	50	43
186	109	108	Golden Lantern	Major Arterial	1,777	3	12	4	1,750	50	43
187	109	110	Golden Lantern	Major Arterial	2,126	3	12	4	1,900	50	43
188	110	109	Golden Lantern	Major Arterial	2,126	3	12	4	1,750	50	43
189	110	111	Golden Lantern	Major Arterial	925	3	12	4	1,750	50	43

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
190	111	110	Golden Lantern	Major Arterial	921	3	12	4	1,900	50	43
191	111	112	Golden Lantern	Major Arterial	626	3	12	4	1,750	50	43
192	111	139	Paseo de Colinas	Minor Arterial	1,260	2	12	4	1,750	45	43
193	112	111	Golden Lantern	Major Arterial	626	1	12	4	1,750	50	43
194	112	113	Golden Lantern	Major Arterial	2,075	2	12	4	1,750	50	43
195	113	112	Golden Lantern	Major Arterial	2,075	3	12	4	1,750	50	43
196	113	159	Crown Valley Pkwy	Major Arterial	1,430	3	12	4	1,750	45	43
197	113	517	Crown Valley Pkwy	Major Arterial	1,188	3	12	4	1,900	45	43
198	114	90	Selva Rd	Collector	1,170	1	12	2	1,750	35	56
199	115	90	Selva Rd	Collector	724	1	12	2	1,750	35	56
200	116	84	La Cresta Dr	Collector	519	1	12	4	1,750	25	56
201	117	721	Stonehill Dr	Minor Arterial	380	2	12	8	1,750	45	56
202	118	92	Stonehill Dr	Minor Arterial	1,307	2	12	4	1,750	40	56
203	119	93	Acapulco Dr	Collector	391	1	12	4	1,750	25	53
204	120	93	Acapulco Dr	Collector	1,089	1	12	4	1,750	25	53
205	121	95	Terra Vista	Collector	397	1	12	4	1,750	30	53
206	121	124	Ocean Ranch	Collector	627	1	12	4	1,750	30	53
207	122	95	Terra Vista	Collector	1,020	1	12	4	1,750	30	53
208	123	669	Camino Del Avion	Minor Arterial	2,330	2	12	4	1,900	45	53
209	124	96	Camino Del Avion	Minor Arterial	570	2	12	4	1,750	45	53
210	125	97	Via Ladera	Collector	430	1	12	4	1,750	30	53
211	126	97	Via Ladera	Collector	349	1	12	4	1,750	30	53
212	127	100	Old Ranch Rd	Collector	879	1	12	4	1,750	35	53
213	128	100	Old Ranch Rd	Collector	993	1	12	4	1,750	35	53
214	129	101	Beacon Hill Way	Collector	1,041	1	12	4	1,750	30	48
215	130	103	St Christopher	Collector	691	1	12	4	1,750	30	48
216	131	103	St Christopher	Collector	765	1	12	4	1,750	30	48
217	132	105	St Christopher	Collector	966	1	12	4	1,750	30	48
218	133	106	Chapparosa Park Rd	Collector	1,591	1	12	4	1,750	25	48
219	134	107	Sweet Meadow Ln	Collector	646	1	12	4	1,750	30	48
220	135	107	Sweet Meadow Ln	Collector	857	1	12	4	1,750	30	48
221	136	106	Golden Lantern	Minor Arterial	935	2	12	4	1,750	50	48

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
222	136	107	Golden Lantern	Major Arterial	633	3	12	4	1,750	50	48
223	137	108	Marina Hills Dr	Minor Arterial	714	2	12	4	1,750	45	48
224	138	109	Hidden Hills Rd	Collector	817	1	12	4	1,750	35	43
225	138	137	Tessier St	Collector	1,474	1	12	4	1,750	30	48
226	139	532	Paseo de Colinas	Minor Arterial	1,444	2	12	4	1,900	45	43
227	140	111	Paseo de Colinas	Minor Arterial	319	2	12	4	1,750	45	43
228	141	112	Paseo Escuela	Minor Arterial	638	2	12	4	1,750	30	43
229	142	67	Crown Valley Pkwy	Minor Arterial	668	2	12	8	1,900	45	52
230	142	143	Crown Valley Pkwy	Minor Arterial	1,407	2	12	8	1,900	45	52
231	143	142	Crown Valley Pkwy	Minor Arterial	1,405	2	12	8	1,750	45	52
232	143	144	Crown Valley Pkwy	Major Arterial	895	3	12	8	1,750	45	52
233	144	143	Crown Valley Pkwy	Minor Arterial	892	2	12	8	1,900	45	52
234	144	145	Crown Valley Pkwy	Major Arterial	1,681	3	12	6	1,900	55	52
235	144	162	Camino Del Avion	Minor Arterial	1,005	2	12	0	1,750	45	52
236	145	144	Crown Valley Pkwy	Major Arterial	1,683	2	12	6	1,750	55	52
237	145	1505	Crown Valley Pkwy	Major Arterial	1,213	3	12	6	1,900	55	52
238	146	147	Crown Valley Pkwy	Major Arterial	947	3	12	6	1,900	55	47
239	146	1505	Crown Valley Pkwy	Major Arterial	1,069	3	12	6	1,900	55	47
240	147	146	Crown Valley Pkwy	Major Arterial	946	3	12	6	1,900	55	47
241	147	148	Crown Valley Pkwy	Major Arterial	1,488	3	12	6	1,750	55	47
242	148	147	Crown Valley Pkwy	Major Arterial	1,487	3	12	6	1,900	55	47
243	148	149	Crown Valley Pkwy	Major Arterial	2,055	3	12	6	1,900	55	47
244	149	148	Crown Valley Pkwy	Major Arterial	2,053	3	12	6	1,750	55	47
245	149	150	Crown Valley Pkwy	Major Arterial	1,114	3	12	6	1,900	55	47
246	150	149	Crown Valley Pkwy	Major Arterial	1,114	3	12	6	1,900	55	47
247	150	151	Crown Valley Pkwy	Major Arterial	893	3	12	6	1,750	55	47
248	151	150	Crown Valley Pkwy	Major Arterial	893	3	12	6	1,900	55	47
249	151	152	Crown Valley Pkwy	Major Arterial	490	3	12	6	1,750	55	47
250	152	151	Crown Valley Pkwy	Major Arterial	490	3	12	6	1,750	55	47
251	152	153	Crown Valley Pkwy	Major Arterial	1,458	3	12	4	1,750	45	47
252	153	152	Crown Valley Pkwy	Major Arterial	1,457	3	12	4	1,750	45	47
253	153	155	Crown Valley Pkwy	Major Arterial	1,417	3	12	4	1,750	45	42

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
254	153	168	Niguel Rd	Minor Arterial	929	2	12	4	1,750	40	47
255	154	155	Crown Valley Pkwy	Major Arterial	1,042	3	12	4	1,750	45	42
256	154	156	Crown Valley Pkwy	Major Arterial	1,701	3	12	4	1,750	45	43
257	155	153	Crown Valley Pkwy	Major Arterial	1,416	3	12	4	1,750	45	42
258	155	154	Crown Valley Pkwy	Major Arterial	1,038	3	12	4	1,750	45	42
259	156	154	Crown Valley Pkwy	Major Arterial	1,698	3	12	4	1,750	45	43
260	156	157	Crown Valley Pkwy	Major Arterial	1,212	3	12	4	1,750	45	43
261	157	156	Crown Valley Pkwy	Major Arterial	1,212	3	12	4	1,750	45	43
262	157	158	Crown Valley Pkwy	Major Arterial	633	3	12	4	1,750	45	43
263	158	157	Crown Valley Pkwy	Major Arterial	633	3	12	4	1,750	45	43
264	158	159	Crown Valley Pkwy	Major Arterial	1,133	3	12	4	1,750	45	43
265	159	113	Crown Valley Pkwy	Major Arterial	1,429	3	12	4	1,750	45	43
266	159	158	Crown Valley Pkwy	Major Arterial	1,133	3	12	4	1,750	45	43
267	160	142	Sea Island Dr	Collector	806	1	12	4	1,750	30	52
268	161	144	Pacific Island Dr	Minor Arterial	1,104	2	12	6	1,750	45	52
269	162	144	Camino Del Avion	Minor Arterial	1,013	2	12	0	1,750	45	52
270	162	245	Camino Del Avion	Minor Arterial	943	2	12	0	1,900	45	52
271	163	148	Club House Dr	Collector	800	1	12	4	1,750	30	47
272	164	148	Club House Dr	Collector	913	1	12	4	1,750	30	47
273	165	151	Hillhurst Dr	Collector	935	1	12	4	1,750	30	47
274	166	152	Alicia Pkwy	Minor Arterial	1,027	2	12	4	1,750	40	47
275	167	153	Niguel Rd	Minor Arterial	1,042	2	12	4	1,750	40	42
276	168	153	Niguel Rd	Minor Arterial	938	2	12	4	1,750	40	47
277	168	269	Niguel Rd	Minor Arterial	982	2	12	4	1,750	40	47
278	169	154	Parkside Dr E	Collector	451	1	12	4	1,750	30	42
279	170	154	Central Park Dr	Collector	558	1	12	4	1,750	30	42
280	171	155	Community Park	Collector	632	1	12	4	1,750	30	42
281	172	156	La Plata Dr	Collector	816	1	12	4	1,750	25	43
282	173	156	La Plata Dr	Collector	888	1	12	4	1,750	25	43
283	174	157	La Paz Rd	Minor Arterial	1,588	2	12	4	1,750	45	43
284	175	158	Adelanto Dr	Collector	926	1	12	4	1,750	30	43
285	176	159	Nueva Vista Dr	Collector	840	1	12	4	1,750	30	43

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
286	177	159	Nueva Vista Dr	Collector	630	1	12	4	1,750	30	43
287	178	179	I-5	Freeway	4,744	6	12	8	2,250	70	57
288	179	178	I-5	Freeway	4,761	6	12	8	2,250	70	57
289	179	180	I-5	Freeway	1,329	5	12	8	2,250	70	57
290	179	1270	SR-1 On Ramp	Freeway Ramp	847	1	12	4	1,700	45	57
291	180	179	I-5	Freeway	1,329	6	12	8	2,250	70	57
292	180	181	I-5	Freeway	769	5	12	8	2,250	70	57
293	181	180	I-5	Freeway	769	6	12	8	2,250	70	57
294	181	182	I-5	Freeway	1,305	5	12	8	2,250	70	57
295	182	181	I-5	Freeway	1,305	5	12	8	2,250	70	57
296	182	183	I-5	Freeway	1,079	5	12	8	2,250	70	57
297	183	182	I-5	Freeway	1,076	5	12	8	2,250	70	57
298	183	185	I-5	Freeway	744	5	12	8	2,250	70	57
299	184	185	I-5	Freeway	1,228	5	12	8	2,250	70	57
300	184	186	I-5	Freeway	2,608	6	12	8	2,250	70	54
301	185	183	I-5	Freeway	744	5	12	8	2,250	70	57
302	185	184	I-5	Freeway	1,231	5	12	8	2,250	70	57
303	186	184	I-5	Freeway	2,608	5	12	8	2,250	70	54
304	186	187	I-5	Freeway	2,228	5	12	8	2,250	70	54
305	187	186	I-5	Freeway	2,228	5	12	8	2,250	70	54
306	187	188	I-5	Freeway	1,723	5	12	8	2,250	70	54
307	188	187	I-5	Freeway	1,723	5	12	8	2,250	70	54
308	188	189	I-5	Freeway	3,115	5	12	8	2,250	70	54
309	189	188	I-5	Freeway	3,118	5	12	8	2,250	70	54
310	189	190	I-5	Freeway	1,069	5	12	8	2,250	70	54
311	190	189	I-5	Freeway	1,069	5	12	8	2,250	70	54
312	190	191	I-5	Freeway	758	5	12	8	2,250	70	49
313	191	190	I-5	Freeway	758	5	12	8	2,250	70	49
314	191	192	I-5	Freeway	4,712	6	12	8	2,250	70	49
315	192	191	I-5	Freeway	4,712	6	12	8	2,250	70	49
316	192	193	I-5	Freeway	2,518	6	12	8	2,250	70	49
317	193	192	I-5	Freeway	2,518	6	12	8	2,250	70	49

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
318	193	194	I-5	Freeway	1,700	6	12	8	2,250	70	49
319	194	193	I-5	Freeway	1,706	6	12	8	2,250	70	49
320	194	195	I-5	Freeway	1,426	6	12	8	2,250	70	44
321	195	194	I-5	Freeway	1,426	6	12	8	2,250	70	44
322	195	196	I-5	Freeway	1,641	6	12	8	2,250	70	44
323	196	195	I-5	Freeway	1,641	6	12	8	2,250	70	44
324	196	197	I-5	Freeway	3,100	5	12	8	2,250	70	44
325	196	781	SR-73 On Ramp	Freeway Ramp	2,373	2	12	4	1,900	45	44
326	197	196	I-5	Freeway	3,100	5	12	8	2,250	70	44
327	197	198	I-5	Freeway	909	5	12	8	2,250	70	44
328	198	197	I-5	Freeway	909	5	12	8	2,250	70	44
329	198	199	I-5	Freeway	1,879	5	12	8	2,250	70	44
330	199	198	I-5	Freeway	1,879	5	12	8	2,250	70	44
331	199	200	I-5	Freeway	2,065	5	12	8	2,250	70	38
332	200	199	I-5	Freeway	2,065	5	12	8	2,250	70	38
333	200	201	I-5	Freeway	1,178	5	12	8	2,250	70	38
334	201	200	I-5	Freeway	1,178	5	12	8	2,250	70	38
335	201	202	I-5	Freeway	1,028	5	12	8	2,250	70	38
336	202	201	I-5	Freeway	1,028	5	12	8	2,250	70	38
337	202	203	I-5	Freeway	1,321	5	12	8	2,250	70	38
338	203	202	I-5	Freeway	1,321	5	12	8	2,250	70	38
339	203	204	I-5	Freeway	2,274	5	12	8	2,250	70	38
340	204	203	I-5	Freeway	2,274	5	12	8	2,250	70	38
341	204	205	I-5	Freeway	1,826	5	12	8	2,250	70	38
342	205	204	I-5	Freeway	1,826	5	12	8	2,250	70	38
343	205	207	I-5	Freeway	1,218	5	12	8	2,250	70	30
344	206	207	I-5	Freeway	1,401	5	12	8	2,250	70	30
345	206	208	I-5	Freeway	2,326	5	12	8	2,250	70	30
346	207	205	I-5	Freeway	1,218	5	12	8	2,250	70	30
347	207	206	I-5	Freeway	1,401	5	12	8	2,250	70	30
348	208	206	I-5	Freeway	2,326	5	12	8	2,250	70	30
349	208	209	I-5	Freeway	2,252	5	12	8	2,250	70	30

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
350	209	208	I-5	Freeway	2,249	5	12	8	2,250	70	30
351	209	210	I-5	Freeway	1,232	5	12	8	2,250	70	30
352	210	209	I-5	Freeway	1,230	5	12	8	2,250	70	30
353	210	211	I-5	Freeway	988	5	12	4	2,250	70	30
354	211	210	I-5	Freeway	988	5	12	4	2,250	70	30
355	211	212	I-5	Freeway	2,293	5	12	4	2,250	70	22
356	212	211	I-5	Freeway	2,293	5	12	4	2,250	70	22
357	212	213	I-5	Freeway	1,481	6	12	8	2,250	70	22
358	213	212	I-5	Freeway	1,482	5	12	8	2,250	70	22
359	213	214	I-5	Freeway	2,840	6	12	8	2,250	70	22
360	214	213	I-5	Freeway	2,838	5	12	8	2,250	70	22
361	214	215	I-5	Freeway	2,525	6	12	8	2,250	70	22
362	215	214	I-5	Freeway	2,522	5	12	8	2,250	70	22
363	215	216	I-5	Freeway	982	6	12	8	2,250	70	21
364	216	218	I-5	Freeway	293	6	12	8	2,250	70	21
365	216	1626	I-5	Freeway	546	6	12	8	2,250	70	21
366	217	218	I-5	Freeway	543	6	12	8	2,250	70	21
367	217	1651	I-5	Freeway	1,749	6	12	4	2,250	70	21
368	218	216	I-5	Freeway	293	6	12	8	2,250	70	21
369	218	217	I-5	Freeway	543	6	12	8	2,250	70	21
370	218	1644	I-5	Freeway	183	2	12	4	2,250	70	21
371	219	220	I-5	Freeway	1,556	6	12	4	2,250	70	19
372	219	1650	I-5	Freeway	950	6	12	4	2,250	70	21
373	220	219	I-5	Freeway	1,556	6	12	4	2,250	70	19
374	220	221	I-5	Freeway	1,355	6	12	4	2,250	70	19
375	221	220	I-5	Freeway	1,355	6	12	4	2,250	70	19
376	221	222	I-5	Freeway	3,209	6	12	4	2,250	70	19
377	221	1647	I-5	Freeway	1,328	2	12	4	2,250	70	19
378	222	221	I-5	Freeway	3,211	6	12	4	2,250	70	19
379	222	223	I-5	Freeway	726	3	12	4	2,250	70	19
380	222	864	I-5	Freeway	1,591	3	12	4	2,250	70	19
381	223	222	I-5	Freeway	726	6	12	4	2,250	70	19

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
382	223	224	I-5	Freeway	3,203	4	12	4	2,250	70	18
383	223	1397	I-405 On Ramp HOV	Freeway Ramp	1,340	1	12	4	1,700	40	18
384	224	223	I-5	Freeway	3,203	4	12	4	2,250	70	18
385	224	225	I-5	Freeway	3,394	5	12	4	2,250	70	11
386	225	224	I-5	Freeway	3,394	5	12	4	2,250	70	11
387	225	226	I-5	Freeway	3,409	5	12	4	2,250	70	11
388	226	225	I-5	Freeway	3,409	5	12	4	2,250	70	11
389	226	227	I-5	Freeway	1,193	5	12	4	2,250	70	11
390	227	226	I-5	Freeway	1,193	5	12	4	2,250	70	11
391	227	228	I-5	Freeway	2,353	5	12	4	2,250	70	11
392	228	227	I-5	Freeway	2,359	6	12	4	2,250	70	11
393	228	229	I-5	Freeway	1,727	6	12	4	2,250	70	11
394	229	228	I-5	Freeway	1,723	6	12	4	2,250	70	11
395	229	230	I-5	Freeway	2,406	6	12	8	2,250	70	11
396	230	229	I-5	Freeway	2,401	6	12	8	2,250	70	11
397	232	114	Selva Rd	Collector	1,142	1	12	2	1,575	35	56
398	232	235	Selva Rd	Collector	249	1	12	2	1,575	35	55
399	233	232	Street of the Blue Lantern	Collector	772	1	12	2	1,350	30	55
400	234	118	Street of the Blue Lantern	Collector	1,054	1	12	2	1,750	30	56
401	234	232	Street of the Blue Lantern	Collector	656	1	12	2	1,350	30	55
402	235	74	Selva Rd	Minor Arterial	1,571	2	12	2	1,900	35	55
403	236	70	Niguel Rd	Minor Arterial	1,075	2	12	4	1,750	40	52
404	237	238	Niguel Rd	Minor Arterial	943	3	12	4	1,750	40	52
405	237	1493	Niguel Rd	Minor Arterial	792	2	12	4	1,750	40	52
406	238	237	Niguel Rd	Minor Arterial	943	2	12	4	1,750	40	52
407	238	243	Camino Del Avion	Minor Arterial	2,731	2	12	4	1,750	45	52
408	238	250	Niguel Rd	Minor Arterial	1,190	2	12	4	1,750	50	52
409	239	71	Mariner Dr	Collector	658	1	12	4	1,750	30	55
410	240	70	Stonehill Dr	Collector	936	1	12	4	1,750	40	52
411	240	1691	Stonehill Dr	Minor Arterial	562	2	12	4	1,900	40	52
412	241	236	Tennis Club	Collector	578	1	12	4	1,750	30	52
413	242	237	Monarch Beach Dr	Minor Arterial	1,020	2	12	4	1,750	30	52

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
414	243	124	Camino Del Avion	Minor Arterial	1,076	2	12	4	1,750	45	53
415	244	238	Camino Del Avion	Minor Arterial	938	2	12	0	1,750	45	52
416	245	244	Camino Del Avion	Minor Arterial	773	2	12	0	1,750	45	52
417	246	162	South Peak	Collector	1,041	1	12	4	1,750	30	52
418	247	244	Camino Del Avion	Collector	920	1	12	4	1,750	30	52
419	248	244	Camino Del Avion	Collector	1,115	1	12	4	1,750	30	52
420	249	243	Bear Brand Rd	Collector	1,174	1	12	4	1,750	30	53
421	250	238	Niguel Rd	Major Arterial	1,190	3	12	4	1,750	50	52
422	250	251	Niguel Rd	Minor Arterial	1,402	2	12	4	1,750	50	52
423	251	250	Niguel Rd	Minor Arterial	1,392	2	12	4	1,750	50	52
424	251	252	Niguel Rd	Minor Arterial	1,369	2	12	4	1,900	50	52
425	252	251	Niguel Rd	Minor Arterial	1,373	2	12	4	1,750	50	52
426	252	253	Niguel Rd	Minor Arterial	1,911	2	12	4	1,750	50	52
427	253	252	Niguel Rd	Minor Arterial	1,908	2	12	4	1,900	50	52
428	253	254	Niguel Rd	Minor Arterial	1,690	2	12	4	1,750	50	47
429	254	253	Niguel Rd	Minor Arterial	1,687	2	12	4	1,750	50	47
430	254	255	Niguel Rd	Minor Arterial	2,866	2	12	4	1,750	50	47
431	255	254	Niguel Rd	Minor Arterial	2,893	2	12	4	1,750	50	47
432	255	256	Niguel Rd	Minor Arterial	1,202	2	12	4	1,750	50	47
433	256	255	Niguel Rd	Minor Arterial	1,191	2	12	4	1,750	50	47
434	256	269	Niguel Rd	Minor Arterial	1,505	2	12	4	1,750	40	47
435	256	1577	Marina Hills Dr	Minor Arterial	840	2	12	4	1,900	45	48
436	257	250	Charles Rd	Collector	1,051	1	12	4	1,750	30	52
437	258	251	Ridgeway Ave	Collector	944	1	12	4	1,750	30	52
438	259	253	Beacon Hill Way	Collector	1,094	1	12	4	1,750	30	47
439	260	254	Club House Dr	Collector	1,366	1	12	4	1,750	30	47
440	261	255	Augusta Dr	Minor Arterial	812	2	12	4	1,750	30	47
441	262	264	Marina Hills Dr	Minor Arterial	1,679	2	12	4	1,750	45	48
442	262	1577	Marina Hills Dr	Minor Arterial	496	2	12	4	1,900	45	48
443	263	137	Marina Hills Dr	Minor Arterial	1,395	2	12	4	1,750	45	48
444	263	264	Marina Hills Dr	Minor Arterial	1,368	2	12	4	1,900	45	48
445	264	262	Marina Hills Dr	Minor Arterial	1,677	2	12	4	1,750	45	48

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
446	264	263	Marina Hills Dr	Minor Arterial	1,368	2	12	4	1,750	45	48
447	265	262	Parc Vista	Collector	937	1	12	4	1,750	30	48
448	266	262	Valle Vista Dr	Collector	969	1	12	4	1,750	30	48
449	267	263	Parc Vista	Collector	855	1	12	4	1,750	30	48
450	268	263	Tropea	Collector	704	1	12	4	1,750	30	48
451	269	168	Niguel Rd	Minor Arterial	981	2	12	4	1,750	40	47
452	269	256	Niguel Rd	Minor Arterial	1,505	2	12	4	1,750	30	47
453	270	269	La Hermosa Ave	Collector	1,708	1	12	4	1,750	30	47
454	271	269	La Hermosa Ave	Collector	1,314	1	12	4	1,750	30	47
455	272	273	Pacific Island Dr	Minor Arterial	874	2	12	6	1,900	45	47
456	272	279	Pacific Island Dr	Minor Arterial	797	2	12	6	1,900	45	47
457	273	274	Pacific Island Dr	Minor Arterial	609	2	12	6	1,900	45	47
458	274	275	Pacific Island Dr	Minor Arterial	863	2	12	6	1,900	45	47
459	275	1507	Pacific Island Dr	Minor Arterial	863	2	12	6	1,900	45	47
460	276	277	Pacific Island Dr	Minor Arterial	1,469	2	12	6	1,900	45	47
461	277	278	Pacific Island Dr	Minor Arterial	1,477	2	12	6	1,900	45	52
462	278	161	Pacific Island Dr	Minor Arterial	1,556	2	12	6	1,900	45	52
463	279	280	Pacific Island Dr	Minor Arterial	1,012	2	12	6	1,900	45	47
464	280	281	Pacific Island Dr	Minor Arterial	2,208	2	12	6	1,750	45	47
465	281	166	Pacific Island Dr	Minor Arterial	1,050	1	12	6	1,750	45	47
466	282	272	La Brise	Collector	1,445	1	12	4	1,350	30	47
467	283	281	Highlands Ave	Collector	1,553	1	12	4	1,750	30	42
468	284	166	Alicia Pkwy	Major Arterial	1,214	3	12	4	1,750	50	42
469	284	167	Niguel Rd	Minor Arterial	584	2	12	4	1,750	40	42
470	285	284	Alicia Pkwy	Major Arterial	1,039	3	12	4	1,750	50	42
471	286	285	Alicia Pkwy	Major Arterial	1,480	3	12	4	1,900	50	42
472	287	286	Alicia Pkwy	Major Arterial	1,229	3	12	4	1,750	50	42
473	288	287	Alicia Pkwy	Major Arterial	1,055	3	12	4	1,900	50	42
474	288	289	Alicia Pkwy	Major Arterial	1,844	3	12	4	1,750	50	42
475	289	288	Alicia Pkwy	Major Arterial	1,844	3	12	4	1,750	50	42
476	289	290	Alicia Pkwy	Major Arterial	1,593	3	12	4	1,900	50	42
477	290	289	Alicia Pkwy	Major Arterial	1,591	3	12	4	1,750	50	42

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
478	290	291	Alicia Pkwy	Major Arterial	1,812	3	12	4	1,750	50	36
479	291	290	Alicia Pkwy	Major Arterial	1,815	3	12	4	1,900	50	36
480	291	326	Alicia Pkwy	Major Arterial	1,997	3	12	4	1,750	50	36
481	291	349	Aliso Creek Rd	Major Arterial	1,596	3	12	4	1,750	50	36
482	292	167	Ivy Glenn Dr	Collector	1,075	1	12	4	1,750	30	42
483	293	284	Niguel Rd	Minor Arterial	967	2	12	4	1,750	40	42
484	294	286	Kite Hill Dr S	Collector	1,283	1	12	4	1,750	30	42
485	295	288	Highlands Ave	Minor Arterial	1,745	2	12	4	1,750	30	42
486	296	289	Kite Hill Dr N	Collector	894	1	12	4	1,750	30	42
487	297	174	La Paz Rd	Minor Arterial	1,443	2	12	4	1,750	50	43
488	298	297	La Paz Rd	Minor Arterial	1,498	2	12	4	1,900	50	43
489	298	299	La Paz Rd	Minor Arterial	1,232	2	12	4	1,900	50	43
490	299	298	La Paz Rd	Minor Arterial	1,232	2	12	4	1,900	50	43
491	299	300	La Paz Rd	Minor Arterial	1,393	2	12	4	1,900	50	36
492	300	299	La Paz Rd	Minor Arterial	1,386	2	12	4	1,900	50	36
493	300	301	La Paz Rd	Major Arterial	1,257	3	12	4	1,750	45	36
494	301	300	La Paz Rd	Minor Arterial	1,258	2	12	4	1,900	45	36
495	301	316	La Paz Rd	Major Arterial	1,173	3	12	4	1,900	45	36
496	301	350	Aliso Creek Rd	Major Arterial	532	3	12	4	1,900	50	36
497	302	174	Kings Rd	Collector	1,635	1	12	4	1,750	30	43
498	303	298	Rancho Niguel Rd	Collector	1,134	1	12	4	1,350	30	43
499	304	113	Moulton Pkwy	Major Arterial	1,741	3	12	4	1,750	50	43
500	305	304	Moulton Pkwy	Major Arterial	1,514	3	12	4	1,750	50	43
501	305	1618	Moulton Pkwy	Major Arterial	1,006	3	12	4	1,750	50	37
502	306	309	Moulton Pkwy	Major Arterial	2,378	3	12	4	1,750	50	37
503	306	1618	Moulton Pkwy	Major Arterial	1,535	3	12	4	1,750	50	37
504	307	304	Nueva Vista	Collector	451	1	12	4	1,750	30	43
505	308	305	Rancho Niguel Rd	Collector	1,633	1	12	4	1,750	40	43
506	308	523	Rancho Niguel Rd	Minor Arterial	2,208	2	12	4	1,750	40	37
507	309	310	Moulton Pkwy	Major Arterial	1,106	3	12	4	1,750	50	37
508	310	311	Moulton Pkwy	Major Arterial	1,118	3	12	4	1,750	50	37
509	311	312	Moulton Pkwy	Major Arterial	848	3	12	4	1,750	50	37

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
510	312	505	Moulton Pkwy	Major Arterial	937	3	12	4	1,750	50	37
511	313	309	Avila Rd	Collector	737	1	12	4	1,750	30	37
512	314	310	Aliso Niguel	Collector	736	1	12	4	1,750	30	37
513	315	311	SR-73 Off-Ramp	Freeway Ramp	680	1	12	4	1,750	45	37
514	316	317	La Paz Rd	Major Arterial	1,757	3	12	4	1,750	45	36
515	317	318	La Paz Rd	Major Arterial	1,325	3	12	4	1,750	45	36
516	318	319	La Paz Rd	Major Arterial	830	3	12	4	1,750	45	36
517	319	320	La Paz Rd	Major Arterial	1,139	3	12	4	1,750	45	36
518	319	511	Pacific Park Dr	Major Arterial	632	3	12	4	1,750	50	36
519	320	321	La Paz Rd	Major Arterial	1,216	3	12	4	1,750	45	36
520	320	324	SR-73 On-Ramp	Freeway Ramp	505	2	12	4	1,900	30	36
521	321	320	La Paz Rd	Major Arterial	1,203	1	12	4	1,750	45	36
522	321	503	La Paz Rd	Major Arterial	896	3	12	4	1,750	45	37
523	321	504	SR-73 On-Ramp	Freeway Ramp	547	2	12	4	1,900	30	37
524	322	317	Avila Rd	Collector	1,095	1	12	4	1,750	30	36
525	322	327	Avila Rd	Collector	1,309	1	12	4	1,750	30	36
526	323	318	Avenida Breve	Collector	443	1	12	4	1,750	30	36
527	324	320	SR-73 Off-Ramp	Freeway Ramp	509	2	12	4	1,750	45	36
528	324	760	SR-73 On-Ramp	Freeway Ramp	721	1	12	4	1,350	30	36
529	326	327	Alicia Pkwy	Major Arterial	685	3	12	4	1,750	50	36
530	327	328	Alicia Pkwy	Major Arterial	948	3	12	4	1,750	50	36
531	328	329	Alicia Pkwy	Major Arterial	621	3	12	4	1,750	50	36
532	329	330	Alicia Pkwy	Major Arterial	1,572	3	12	4	1,750	50	36
533	330	331	Alicia Pkwy	Major Arterial	1,139	3	12	4	1,750	50	36
534	330	509	Pacific Park Dr	Major Arterial	1,020	3	12	4	1,750	50	36
535	331	336	Alicia Pkwy	Major Arterial	1,367	3	12	4	1,750	50	36
536	332	326	Federal Loading Dock	Collector	689	1	12	4	1,750	30	36
537	333	328	Marketplace Dr S	Collector	648	1	12	4	1,750	30	36
538	334	329	Marketplace Dr N	Minor Arterial	625	2	12	4	1,750	30	36
539	335	331	Morning Ridge	Collector	653	1	12	4	1,750	30	36
540	336	488	Alicia Pkwy	Major Arterial	1,381	3	12	4	1,750	50	28
541	337	291	Aliso Creek Rd	Major Arterial	964	3	12	4	1,750	50	36

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
542	338	337	Aliso Creek Rd	Major Arterial	972	3	12	4	1,750	50	36
543	339	338	Aliso Creek Rd	Major Arterial	923	3	12	4	1,750	50	36
544	340	339	Aliso Creek Rd	Major Arterial	1,742	3	12	4	1,750	50	36
545	340	341	Aliso Creek Rd	Major Arterial	1,130	3	12	4	1,750	50	36
546	341	340	Aliso Creek Rd	Major Arterial	1,130	3	12	4	1,750	50	36
547	341	342	Aliso Creek Rd	Major Arterial	1,390	3	12	4	1,750	50	36
548	342	419	Aliso Creek Rd	Major Arterial	1,068	3	12	4	1,750	45	36
549	342	424	Pacific Park Dr	Major Arterial	892	3	12	4	1,750	50	36
550	343	337	Wood Canyon Dr	Collector	1,976	1	12	4	1,750	30	36
551	344	338	Pursuit	Collector	852	1	12	4	1,750	30	36
552	345	339	Liberty	Collector	1,381	1	12	4	1,750	30	36
553	346	340	Aliso Viejo Pkwy	Minor Arterial	1,230	2	12	4	1,750	40	36
554	346	417	Aliso Viejo Pkwy	Minor Arterial	937	2	12	4	1,900	40	36
555	347	341	Journey	Collector	1,115	1	12	4	1,750	30	36
556	347	423	Journey	Collector	703	1	12	4	1,750	30	36
557	348	349	Dorine Rd	Collector	448	1	12	4	1,750	30	36
558	349	301	Aliso Creek Rd	Major Arterial	835	3	12	4	1,750	50	36
559	350	351	Aliso Creek Rd	Minor Arterial	1,023	2	12	4	1,750	50	36
560	351	306	Aliso Creek Rd	Minor Arterial	1,587	1	12	4	1,750	50	37
561	352	351	Niguel Heights Blvd	Collector	1,057	1	12	4	1,750	30	37
562	353	40	SR-133	Minor Arterial	226	2	12	4	1,750	30	39
563	353	354	SR-133	Minor Arterial	689	2	12	4	1,750	35	40
564	354	353	SR-133	Minor Arterial	682	2	12	4	1,750	35	40
565	354	1391	SR-133	Minor Arterial	229	2	12	4	1,750	35	40
566	355	356	SR-133	Minor Arterial	2,409	2	12	10	1,750	45	34
567	355	1391	SR-133	Minor Arterial	751	2	12	4	1,750	35	40
568	356	355	SR-133	Minor Arterial	2,409	2	12	10	1,750	45	34
569	356	357	SR-133	Collector	1,965	1	12	4	1,700	45	34
570	357	356	SR-133	Minor Arterial	1,954	2	12	4	1,750	45	34
571	357	1420	SR-133	Collector	1,231	1	12	4	1,700	45	34
572	358	353	N Beach St	Local Roadway	178	1	12	4	1,750	30	39
573	359	1336	3rd St	Local Roadway	915	1	12	4	1,750	30	40

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
574	360	355	Festival of Arts	Local Roadway	427	1	12	4	1,750	30	40
575	361	1624	Canyon Acres Dr	Local Roadway	1,165	1	12	4	1,750	30	34
576	362	1420	SR-133	Collector	452	1	12	4	1,700	45	34
577	362	1628	SR-133	Collector	596	1	12	4	1,700	45	34
578	363	1628	SR-133	Collector	539	1	12	4	1,700	45	34
579	363	1630	SR-133	Collector	687	1	12	4	1,700	45	34
580	364	365	SR-133	Collector	702	1	12	4	1,700	45	34
581	364	1630	SR-133	Collector	715	1	12	4	1,700	45	34
582	365	364	SR-133	Collector	702	1	12	4	1,700	45	34
583	365	366	SR-133	Collector	2,238	1	12	4	1,700	45	34
584	366	367	SR-133	Collector	1,065	1	12	4	1,700	45	34
585	367	368	SR-133	Collector	2,240	1	12	4	1,700	45	26
586	368	369	SR-133	Minor Arterial	651	2	12	4	1,750	45	26
587	369	371	El Toro Rd	Collector	556	1	12	4	1,700	45	26
588	369	372	SR-133	Minor Arterial	552	2	12	4	1,900	45	26
589	370	365	Castle Rock Rd	Collector	720	1	12	4	1,350	30	34
590	371	369	El Toro Rd	Collector	548	1	12	4	1,750	45	26
591	371	381	El Toro Rd	Collector	2,372	1	12	4	1,700	45	27
592	372	375	SR-133	Collector	458	1	12	4	1,700	45	26
593	373	374	SR-133	Minor Arterial	879	2	12	10	1,750	45	26
594	374	379	SR-73 On Ramp	Freeway Ramp	387	1	12	4	1,700	45	26
595	374	380	SR-133	Minor Arterial	675	2	12	10	1,900	55	26
596	375	373	SR-133	Minor Arterial	2,052	2	12	4	1,750	55	26
597	376	373	SR-73 Off Ramp	Freeway Ramp	744	1	12	4	1,750	45	26
598	377	769	SR-73 On Ramp	Freeway Ramp	914	1	12	8	1,700	45	26
599	378	377	SR-73 On Ramp	Freeway Ramp	671	1	12	8	1,700	45	26
600	379	374	SR-73 Off Ramp	Freeway Ramp	387	2	12	8	1,750	45	26
601	379	378	SR-73 On Ramp	Freeway Ramp	463	1	12	4	1,350	30	26
602	380	784	SR-133	Minor Arterial	1,817	2	12	10	1,900	65	26
603	381	371	El Toro Rd	Collector	2,373	1	12	4	1,700	45	27
604	381	382	El Toro Rd	Minor Arterial	917	2	12	4	1,750	45	27
605	382	381	El Toro Rd	Minor Arterial	935	2	12	4	1,900	45	27

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
606	382	383	SR-73 On Ramp	Freeway Ramp	1,002	2	12	4	1,900	45	27
607	382	387	El Toro Rd	Minor Arterial	604	2	12	4	1,750	45	27
608	383	774	SR-73 On Ramp	Freeway Ramp	2,096	2	12	4	1,900	45	27
609	384	382	SR-73 Off Ramp	Freeway Ramp	1,002	2	12	4	1,750	45	27
610	385	387	SR-73 Off Ramp	Freeway Ramp	842	2	12	4	1,750	45	27
611	386	768	SR-73 On Ramp	Freeway Ramp	850	1	12	4	1,700	45	27
612	387	382	El Toro Rd	Minor Arterial	604	2	12	4	1,750	45	27
613	387	386	SR-73 On Ramp	Freeway Ramp	1,127	2	12	4	1,900	45	27
614	387	388	El Toro Rd	Major Arterial	941	3	12	4	1,750	45	27
615	388	387	El Toro Rd	Major Arterial	941	2	12	4	1,750	45	27
616	388	1433	El Toro Rd	Major Arterial	782	3	12	4	1,750	45	27
617	389	390	El Toro Rd	Major Arterial	1,317	3	12	4	1,750	45	20
618	389	1433	El Toro Rd	Major Arterial	1,343	3	12	4	1,750	45	27
619	390	389	El Toro Rd	Major Arterial	1,317	3	12	4	1,750	45	20
620	390	391	El Toro Rd	Major Arterial	2,048	3	12	4	1,900	45	20
621	391	390	El Toro Rd	Major Arterial	2,042	3	12	4	1,750	45	20
622	391	392	El Toro Rd	Major Arterial	1,217	3	12	4	1,750	45	20
623	392	391	El Toro Rd	Major Arterial	1,219	3	12	4	1,900	45	20
624	392	393	El Toro Rd	Major Arterial	1,541	3	12	4	1,750	45	20
625	393	392	El Toro Rd	Major Arterial	1,550	3	12	4	1,750	45	20
626	393	394	El Toro Rd	Major Arterial	804	3	12	4	1,750	45	21
627	394	395	El Toro Rd	Major Arterial	1,482	3	12	4	1,750	45	21
628	395	396	El Toro Rd	Major Arterial	1,509	3	12	0	1,750	45	21
629	395	408	Moulton Pkwy	Major Arterial	805	3	12	4	1,750	50	21
630	395	409	Moulton Pkwy	Major Arterial	859	3	12	4	1,900	50	21
631	396	397	El Toro Rd	Major Arterial	820	3	12	0	1,750	45	21
632	397	398	El Toro Rd	Major Arterial	1,636	3	12	0	1,750	45	21
633	398	399	El Toro Rd	Major Arterial	783	3	12	4	1,750	45	21
634	398	413	Paseo De Valencia	Minor Arterial	777	2	12	4	1,900	45	21
635	399	400	El Toro Rd	Major Arterial	644	3	12	4	1,750	45	21
636	400	602	Avenida De La Carlota	Minor Arterial	609	1	12	4	1,750	45	21
637	400	607	El Toro Rd	Major Arterial	191	3	12	4	1,900	45	21

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
638	401	388	Bells Vireo Ln	Collector	669	1	12	4	1,750	30	27
639	402	1432	Aliso Creek Rd	Minor Arterial	658	2	12	4	1,750	45	27
640	403	390	Calle Corta	Collector	1,088	1	12	4	1,750	30	20
641	404	392	Canyon Wren Ln	Collector	960	1	12	4	1,750	30	20
642	405	393	Calle Sonora	Minor Arterial	1,452	2	12	4	1,750	40	20
643	406	393	Calle Sonora	Minor Arterial	1,586	2	12	4	1,750	40	21
644	407	394	Home Depot	Collector	762	1	12	4	1,750	30	21
645	408	395	Moulton Pkwy	Major Arterial	805	3	12	4	1,750	50	21
646	408	492	Moulton Pkwy	Major Arterial	2,170	3	12	4	1,750	50	21
647	409	395	Moulton Pkwy	Major Arterial	853	3	12	4	1,750	50	21
648	409	802	Moulton Pkwy	Major Arterial	1,388	3	12	4	1,900	50	21
649	410	396	Driveway	Local Roadway	424	1	12	4	1,750	30	21
650	411	397	Avenida Sevilla	Collector	1,013	1	12	4	1,750	30	21
651	412	397	Avenida Sevilla	Collector	1,100	1	12	4	1,750	30	21
652	413	602	Paseo De Valencia	Minor Arterial	535	1	12	4	1,750	45	21
653	414	398	Paseo De Valencia	Minor Arterial	1,000	2	12	4	1,750	45	21
654	415	399	Regional Center	Collector	1,065	1	12	4	1,750	30	21
655	416	346	Liberty	Minor Arterial	897	2	12	4	1,750	30	36
656	417	346	Aliso Viejo Pkwy	Minor Arterial	940	2	12	4	1,750	40	36
657	417	418	Aliso Viejo Pkwy	Major Arterial	902	3	12	4	1,750	40	36
658	418	423	Pacific Park Dr	Major Arterial	1,265	3	12	4	1,750	45	36
659	418	449	Aliso Viejo Pkwy	Major Arterial	1,150	3	12	4	1,750	50	36
660	418	454	Pacific Park Dr	Major Arterial	1,378	3	12	4	1,750	50	35
661	419	420	Aliso Creek Rd	Major Arterial	993	3	12	4	1,750	45	36
662	420	421	Aliso Creek Rd	Major Arterial	1,139	3	12	4	1,750	45	28
663	421	427	SR-73 On Ramp	Freeway Ramp	310	1	12	4	1,700	45	28
664	421	431	Aliso Creek Rd	Major Arterial	519	4	12	4	1,900	45	28
665	422	428	SR-73 On Ramp	Freeway Ramp	412	1	12	4	1,350	30	28
666	422	429	Aliso Creek Rd	Major Arterial	1,010	3	12	4	1,750	45	28
667	422	431	Aliso Creek Rd	Collector	540	1	12	4	1,700	45	28
668	423	342	Pacific Park Dr	Major Arterial	918	3	12	4	1,750	45	36
669	424	330	Pacific Park Dr	Major Arterial	2,032	3	12	4	1,750	50	36

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
670	425	419	Autumnglen	Collector	868	1	12	4	1,750	30	36
671	426	420	Summerfield	Collector	1,020	1	12	4	1,750	30	28
672	427	421	SR-73 Off Ramp	Freeway Ramp	310	1	12	4	1,750	45	28
673	427	772	SR-73 On Ramp	Freeway Ramp	587	2	12	4	1,900	30	28
674	428	422	SR-73 Off Ramp	Freeway Ramp	423	2	12	4	1,750	45	28
675	428	771	SR-73 On Ramp	Freeway Ramp	589	2	12	4	1,900	30	28
676	429	422	Aliso Creek Rd	Major Arterial	1,014	3	12	4	1,750	45	28
677	429	430	Aliso Creek Rd	Minor Arterial	1,042	2	12	4	1,750	45	28
678	430	429	Aliso Creek Rd	Minor Arterial	1,037	2	12	4	1,750	45	28
679	430	435	Aliso Viejo Pkwy	Major Arterial	688	3	12	4	1,750	50	28
680	430	436	Aliso Creek Rd	Minor Arterial	1,952	2	12	4	1,750	45	28
681	431	422	Aliso Creek Rd	Major Arterial	540	3	12	4	1,750	45	28
682	431	427	SR-73 On Ramp	Freeway Ramp	711	1	12	4	1,700	45	28
683	431	428	SR-73 On Ramp	Freeway Ramp	817	1	12	4	1,350	30	28
684	432	429	Windsong	Collector	624	1	12	4	1,750	30	28
685	433	429	Windsong	Collector	478	1	12	4	1,750	30	28
686	434	430	Aliso Viejo Pkwy	Major Arterial	1,587	3	12	4	1,750	50	28
687	435	430	Aliso Viejo Pkwy	Major Arterial	688	2	12	4	1,750	50	28
688	435	484	Aliso Viejo Pkwy	Major Arterial	1,501	3	12	4	1,900	50	28
689	436	437	Aliso Creek Rd	Minor Arterial	1,808	2	12	4	1,750	45	28
690	437	438	Aliso Creek Rd	Minor Arterial	1,046	2	12	4	1,750	45	28
691	437	443	Glenwood Dr	Minor Arterial	797	2	12	4	1,900	45	28
692	437	444	Glenwood Dr	Minor Arterial	1,040	2	12	4	1,750	45	28
693	438	437	Aliso Creek Rd	Minor Arterial	1,042	2	12	4	1,750	45	28
694	438	440	Aliso Creek Rd	Minor Arterial	1,091	2	12	4	1,900	45	27
695	439	402	Aliso Creek Rd	Minor Arterial	1,629	2	12	4	1,900	45	27
696	440	439	Aliso Creek Rd	Minor Arterial	1,088	2	12	4	1,750	45	27
697	441	436	Argonaut	Collector	775	1	12	4	1,750	30	28
698	442	434	Argonaut	Collector	860	1	12	4	1,750	30	28
699	442	436	Argonaut	Collector	681	1	12	4	1,750	30	28
700	443	437	Glenwood Dr	Minor Arterial	790	2	12	4	1,750	45	28
701	443	469	Pacific Park Dr	Minor Arterial	811	2	12	4	1,750	45	28

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
702	444	437	Glenwood Dr	Minor Arterial	1,040	2	12	4	1,750	45	28
703	444	478	Glenwood Dr	Minor Arterial	991	2	12	4	1,750	45	28
704	445	438	Eastwing	Collector	1,050	1	12	4	1,750	30	27
705	446	438	Eastwing	Collector	598	1	12	4	1,750	30	28
706	447	439	Westwing	Collector	911	1	12	4	1,750	30	27
707	448	439	Westwing	Collector	1,263	1	12	4	1,750	30	27
708	449	450	Aliso Viejo Pkwy	Major Arterial	1,138	3	12	4	1,750	50	36
709	450	451	Aliso Viejo Pkwy	Major Arterial	1,024	3	12	4	1,750	50	28
710	451	452	Aliso Viejo Pkwy	Major Arterial	706	3	12	4	1,750	50	28
711	452	453	Aliso Viejo Pkwy	Major Arterial	512	3	12	4	1,750	50	28
712	453	434	Aliso Viejo Pkwy	Major Arterial	1,707	3	12	4	1,750	50	28
713	454	418	Pacific Park Dr	Major Arterial	1,398	3	12	4	1,750	50	35
714	454	463	Pacific Park Dr	Minor Arterial	1,215	2	12	4	1,900	50	35
715	455	449	Driveway	Local Roadway	569	1	12	4	1,750	30	36
716	456	450	Grand	Collector	907	1	12	4	1,750	30	27
717	457	450	Grand	Collector	882	1	12	4	1,750	30	28
718	458	451	Vantis Dr	Collector	379	1	12	4	1,750	30	28
719	459	452	Parker Pl	Collector	593	1	12	4	1,750	30	28
720	460	453	Enterprise	Collector	1,082	1	12	4	1,750	30	28
721	461	453	Enterprise	Collector	872	1	12	4	1,750	30	28
722	462	463	Pacific Park Dr	Minor Arterial	1,689	2	12	4	1,900	50	27
723	462	464	Pacific Park Dr	Minor Arterial	1,363	2	12	4	1,750	45	27
724	463	454	Pacific Park Dr	Minor Arterial	1,218	2	12	4	1,750	50	35
725	463	462	Pacific Park Dr	Minor Arterial	1,685	2	12	4	1,750	50	27
726	464	465	Pacific Park Dr	Minor Arterial	841	2	12	4	1,900	45	27
727	465	466	Pacific Park Dr	Minor Arterial	1,190	2	12	4	1,750	45	27
728	466	467	Pacific Park Dr	Minor Arterial	849	2	12	4	1,900	45	27
729	467	468	Pacific Park Dr	Minor Arterial	435	2	12	4	1,750	45	27
730	467	476	SR-73 On Ramp	Freeway Ramp	617	1	12	4	1,350	30	27
731	468	469	Pacific Park Dr	Minor Arterial	728	2	12	4	1,750	45	27
732	468	476	SR-73 On Ramp	Freeway Ramp	373	1	12	4	1,350	30	27
733	469	443	Pacific Park Dr	Minor Arterial	811	2	12	4	1,900	45	28

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
734	469	468	Pacific Park Dr	Minor Arterial	728	1	12	12	1,750	45	27
735	470	454	Wood Canyon Dr	Minor Arterial	1,018	2	12	4	1,750	30	35
736	471	454	Wood Canyon Dr	Collector	1,401	1	12	4	1,750	30	35
737	472	462	Peppertree	Collector	736	1	12	4	1,750	30	27
738	473	462	Peppertree	Collector	619	1	12	4	1,750	30	27
739	474	464	Canyon Vistas	Collector	838	1	12	4	1,750	30	27
740	475	466	SR-73 Off Ramp	Freeway Ramp	967	1	12	4	1,750	45	27
741	476	468	SR-73 Off Ramp	Freeway Ramp	373	1	12	4	1,750	45	27
742	476	773	SR-73 On Ramp	Freeway Ramp	591	2	12	4	1,900	30	28
743	477	469	Brookline	Minor Arterial	392	2	12	0	1,750	30	28
744	478	444	Glenwood Dr	Minor Arterial	991	2	12	4	1,750	45	28
745	478	479	Glenwood Dr	Minor Arterial	1,110	2	12	4	1,900	45	28
746	479	480	Glenwood Dr	Minor Arterial	853	2	12	4	1,750	45	28
747	480	485	Moulton Pkwy	Major Arterial	1,809	3	12	4	1,750	50	28
748	480	494	Moulton Pkwy	Major Arterial	1,409	3	12	4	1,750	50	28
749	481	444	Argonaut	Minor Arterial	1,112	2	12	4	1,750	30	28
750	482	478	Cedarbrook	Collector	1,080	1	12	4	1,750	30	28
751	483	478	Cedarbrook	Collector	786	1	12	4	1,750	30	28
752	484	485	Aliso Viejo Pkwy	Major Arterial	599	3	12	4	1,750	50	28
753	485	499	Moulton Pkwy	Major Arterial	2,678	3	12	4	1,750	50	28
754	485	500	Aliso Viejo Pkwy	Minor Arterial	1,192	2	12	4	1,750	50	28
755	486	435	Cedarbrook	Collector	708	1	12	4	1,750	30	28
756	487	435	Cedarbrook	Collector	821	1	12	4	1,750	30	28
757	488	489	Alicia Pkwy	Major Arterial	1,178	3	12	4	1,750	50	28
758	489	502	Alicia Pkwy	Major Arterial	1,368	3	12	4	1,750	45	29
759	489	1522	Moulton Pkwy	Major Arterial	1,538	3	12	4	1,750	50	29
760	490	336	Hollyoak	Collector	1,147	1	12	4	1,750	30	28
761	491	488	Ramona St	Collector	543	1	12	4	1,750	30	28
762	492	408	Moulton Pkwy	Major Arterial	2,191	3	12	4	1,750	50	21
763	492	493	Moulton Pkwy	Major Arterial	1,217	3	12	4	1,750	50	21
764	493	492	Moulton Pkwy	Major Arterial	1,217	3	12	4	1,750	50	21
765	493	494	Moulton Pkwy	Major Arterial	507	3	12	4	1,750	50	28

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
766	494	480	Moulton Pkwy	Major Arterial	1,409	3	12	4	1,750	50	28
767	494	493	Moulton Pkwy	Major Arterial	507	3	12	4	1,750	50	28
768	495	408	Via Campo Verde	Collector	1,392	1	12	4	1,750	30	21
769	496	492	Calle Cortez	Minor Arterial	664	2	12	0	1,750	30	21
770	497	493	Via Iglesia	Collector	1,065	1	12	4	1,750	30	28
771	498	494	Calle Aragon	Minor Arterial	1,331	2	12	0	1,750	30	28
772	499	489	Moulton Pkwy	Major Arterial	766	3	12	4	1,750	50	28
773	500	577	Aliso Viejo Pkwy	Minor Arterial	1,199	2	12	4	1,900	50	28
774	501	499	Via Lomas	Collector	1,340	1	12	4	1,750	30	28
775	502	579	Alicia Pkwy	Major Arterial	1,826	3	12	4	1,750	45	29
776	503	321	La Paz Rd	Major Arterial	896	3	12	4	1,750	45	37
777	503	505	Moulton Pkwy	Major Arterial	1,393	2	12	4	1,750	50	37
778	503	506	La Paz Rd	Major Arterial	979	3	12	4	1,900	45	29
779	504	321	SR-73 Off-Ramp	Freeway Ramp	521	2	12	4	1,750	45	37
780	504	760	SR-73 On-Ramp	Freeway Ramp	590	2	12	4	1,900	30	36
781	505	503	Moulton Pkwy	Major Arterial	1,393	1	12	4	1,750	50	37
782	505	516	Oso Pkwy	Major Arterial	2,204	3	12	4	1,900	50	37
783	506	507	La Paz Rd	Minor Arterial	1,199	2	12	4	1,900	50	29
784	507	583	La Paz Rd	Minor Arterial	2,650	2	12	4	1,900	50	29
785	508	424	Deerhurst	Collector	1,525	1	12	4	1,750	30	36
786	509	319	Pacific Park Dr	Major Arterial	1,209	3	12	4	1,750	50	36
787	510	509	Heather Ridge	Collector	1,186	1	12	4	1,750	30	36
788	511	512	Pacific Park Dr	Major Arterial	1,250	3	12	4	1,750	50	37
789	512	505	Pacific Park Dr	Major Arterial	571	3	12	4	1,750	50	37
790	513	511	Aliso Niguel	Collector	893	1	12	4	1,750	30	37
791	514	512	Mareblu	Collector	675	1	12	4	1,750	30	37
792	515	312	Nellie Gail Rd	Collector	1,197	1	12	4	1,750	30	37
793	516	563	Oso Pkwy	Major Arterial	942	3	12	4	1,750	50	37
794	517	518	Crown Valley Pkwy	Major Arterial	1,830	3	12	4	1,900	45	43
795	518	519	Crown Valley Pkwy	Major Arterial	1,489	3	12	4	1,750	45	37
796	519	520	Crown Valley Pkwy	Major Arterial	2,346	3	12	4	1,750	45	37
797	519	523	Greenfield Dr	Minor Arterial	632	2	12	4	1,750	45	37

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
798	520	519	Crown Valley Pkwy	Major Arterial	2,374	1	12	4	1,750	45	37
799	520	521	Crown Valley Pkwy	Major Arterial	847	4	12	4	1,750	45	38
800	520	549	Cabot Rd	Minor Arterial	1,331	2	12	4	1,900	45	38
801	521	522	Crown Valley Pkwy	Major Arterial	906	5	12	4	1,750	45	38
802	522	554	I-5 On Ramp	Freeway Ramp	652	2	12	4	1,900	45	38
803	522	555	Crown Valley Pkwy	Major Arterial	452	5	12	4	1,900	45	38
804	523	519	Greenfield Dr	Minor Arterial	639	2	12	4	1,750	45	37
805	523	524	Greenfield Dr	Minor Arterial	863	2	12	4	1,750	45	37
806	524	526	SR-73 On Ramp	Freeway Ramp	621	1	12	4	1,700	45	37
807	524	528	Greenfield Dr	Collector	351	1	12	4	1,750	40	37
808	525	308	Rancho De Linda	Collector	1,199	1	12	4	1,350	30	43
809	526	755	SR-73 On Ramp	Freeway Ramp	639	1	12	4	1,700	45	37
810	527	524	SR-73 Off Ramp	Freeway Ramp	469	1	12	4	1,750	45	37
811	528	524	Greenfield Dr	Collector	351	1	12	4	1,750	40	37
812	528	531	SR-73 On Ramp	Freeway Ramp	561	2	12	4	1,900	45	37
813	529	528	Greenfield Dr	Collector	918	1	12	4	1,750	40	37
814	530	528	SR-73 Off Ramp	Freeway Ramp	416	1	12	4	1,750	45	37
815	531	756	SR-73 On Ramp	Freeway Ramp	812	1	12	4	1,700	45	37
816	532	533	Paseo de Colinas	Minor Arterial	2,085	2	12	4	1,750	45	43
817	533	534	Paseo de Colinas	Minor Arterial	1,049	2	12	4	1,750	45	44
818	533	538	Cabot Rd	Minor Arterial	1,657	2	12	4	1,900	40	44
819	534	535	Paseo de Colinas	Minor Arterial	611	2	12	4	1,900	45	44
820	535	539	Paseo de Colinas	Minor Arterial	426	2	12	4	1,750	30	44
821	536	139	Del Cerro	Collector	762	1	12	4	1,750	30	43
822	537	534	Star Dr	Collector	922	1	12	4	1,750	30	44
823	538	520	Cabot Rd	Minor Arterial	1,375	2	12	4	1,750	40	38
824	538	533	Cabot Rd	Minor Arterial	1,657	1	12	4	1,750	40	44
825	539	541	Camino Capistrano	Minor Arterial	707	2	12	4	1,750	35	44
826	540	539	Camino Capistrano	Minor Arterial	1,091	2	12	4	1,750	35	44
827	541	542	Avery Pkwy	Minor Arterial	216	2	12	4	1,750	35	44
828	541	548	Camino Capistrano	Collector	1,561	1	12	4	1,700	45	44
829	542	541	Avery Pkwy	Minor Arterial	216	1	12	4	1,750	35	44

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
830	542	543	Avery Pkwy	Minor Arterial	333	1	12	4	1,750	35	44
831	542	546	I-5 On Ramp	Freeway Ramp	521	2	12	4	1,900	45	44
832	543	544	I-5 On Ramp	Freeway Ramp	710	2	12	4	1,900	45	44
833	544	199	I-5 On Ramp	Freeway Ramp	387	1	12	4	1,700	45	44
834	545	542	I-5 Off Ramp	Freeway Ramp	729	2	12	4	1,750	45	44
835	546	198	I-5 On Ramp	Freeway Ramp	296	1	12	4	1,700	45	44
836	547	543	I-5 Off Ramp	Freeway Ramp	559	1	12	4	1,750	45	44
837	548	648	Camino Capistrano	Collector	2,482	1	12	4	1,700	45	44
838	549	520	Cabot Rd	Minor Arterial	1,337	2	12	4	1,750	45	38
839	549	550	Cabot Rd	Minor Arterial	1,907	2	12	4	1,750	45	38
840	550	549	Cabot Rd	Minor Arterial	1,900	2	12	4	1,900	45	38
841	550	558	Cabot Rd	Minor Arterial	270	2	12	4	1,750	45	38
842	551	521	Forbes Rd	Collector	1,076	1	12	4	1,750	30	38
843	552	521	Forbes Rd	Collector	1,160	1	12	4	1,750	30	38
844	553	522	I-5 Off Ramp	Freeway Ramp	577	1	12	4	1,750	45	38
845	554	200	I-5 On Ramp	Freeway Ramp	506	1	12	4	1,700	45	38
846	555	556	I-5 On Ramp	Freeway Ramp	605	2	12	4	1,900	30	38
847	555	1732	Crown Valley Pkwy	Major Arterial	4,809	4	12	4	1,425	45	38
848	556	201	I-5 On Ramp	Freeway Ramp	462	1	12	4	1,350	30	38
849	557	559	Cabot Rd	Minor Arterial	2,864	2	12	4	1,750	45	38
850	558	550	Cabot Rd	Minor Arterial	270	2	12	4	1,750	45	38
851	558	557	Cabot Rd	Minor Arterial	2,371	2	12	4	1,750	45	38
852	559	572	Oso Pkwy	Major Arterial	535	3	12	4	1,750	50	30
853	559	644	Cabot Rd	Minor Arterial	903	2	12	4	1,750	30	30
854	560	550	Cobot Park Parking Lot	Local Roadway	472	1	12	4	1,750	25	38
855	561	558	Rapid Falls Rd	Collector	758	1	12	4	1,750	30	38
856	562	557	Vista Viejo Rd	Collector	1,452	1	12	4	1,750	30	38
857	563	566	Oso Pkwy	Major Arterial	1,982	3	12	4	1,900	50	37
858	564	563	Nellie Gail Rd	Collector	1,198	1	12	4	1,750	30	37
859	565	563	Nellie Gail Rd	Collector	892	1	12	4	1,750	30	37
860	566	567	Oso Pkwy	Major Arterial	1,269	3	12	4	1,750	50	29
861	567	559	Oso Pkwy	Major Arterial	2,622	3	12	4	1,750	50	30

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
862	568	567	Bridlewood Dr	Collector	1,203	1	12	4	1,750	30	29
863	569	567	Bridlewood Dr	Collector	1,044	1	12	4	1,750	30	29
864	571	570	Oso Pkwy	Major Arterial	7,360	3	12	4	1,425	50	30
865	571	575	I-5 On Ramp	Freeway Ramp	747	2	12	4	1,900	30	30
866	572	571	Oso Pkwy	Major Arterial	862	3	12	4	1,750	50	30
867	572	574	I-5 On Ramp	Freeway Ramp	573	2	12	4	1,900	45	30
868	573	572	I-5 Off Ramp	Freeway Ramp	756	2	12	4	1,750	45	30
869	574	205	I-5 On Ramp	Freeway Ramp	643	1	12	4	1,700	45	30
870	575	207	I-5 Off Ramp	Freeway Ramp	727	1	12	4	1,350	30	30
871	575	571	I-5 Off Ramp	Freeway Ramp	767	2	12	4	1,750	45	30
872	576	500	Indian Hill Ln	Collector	942	1	12	4	1,750	30	28
873	577	578	Aliso Viejo Pkwy	Minor Arterial	1,470	2	12	4	1,750	50	29
874	578	582	Paseo De Valencia	Major Arterial	1,545	2	12	4	1,750	45	29
875	578	588	Paseo De Valencia	Major Arterial	1,551	3	12	4	1,750	45	29
876	579	582	Alicia Pkwy	Major Arterial	712	3	12	4	1,750	45	29
877	580	502	Aliso Hills Rd	Collector	1,514	1	12	4	1,750	30	29
878	581	579	Driveway	Local Roadway	853	1	12	4	1,750	30	29
879	582	611	Alicia Pkwy	Major Arterial	1,733	3	12	4	1,750	45	29
880	582	626	Paseo De Valencia	Minor Arterial	1,202	2	12	4	1,900	45	29
881	583	584	La Paz Rd	Minor Arterial	1,532	2	12	4	1,750	50	29
882	584	585	La Paz Rd	Minor Arterial	1,159	2	12	4	1,900	50	29
883	585	586	La Paz Rd	Minor Arterial	836	2	12	4	1,750	50	29
884	586	627	Paseo De Valencia	Minor Arterial	2,158	2	12	4	1,900	45	29
885	586	628	La Paz Rd	Minor Arterial	1,941	2	12	4	1,750	45	29
886	586	642	Paseo De Valencia	Minor Arterial	2,757	2	12	4	1,900	45	29
887	587	584	Aliso Hills Dr	Collector	1,512	1	12	4	1,750	30	29
888	588	578	Paseo De Valencia	Minor Arterial	1,545	2	12	4	1,750	45	29
889	588	589	Paseo De Valencia	Major Arterial	588	3	12	4	1,750	45	29
890	589	588	Paseo De Valencia	Minor Arterial	588	2	12	4	1,750	45	29
891	589	590	Paseo De Valencia	Major Arterial	1,236	3	12	4	1,750	45	22
892	590	591	Paseo De Valencia	Major Arterial	1,640	3	12	4	1,750	45	22
893	590	596	Los Alisos Blvd	Major Arterial	1,475	3	12	4	1,750	45	22

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
894	591	592	Paseo De Valencia	Major Arterial	1,130	3	12	4	1,750	45	21
895	592	414	Paseo De Valencia	Major Arterial	765	3	12	4	1,750	45	21
896	593	588	Beckenham St	Collector	1,494	1	12	4	1,750	30	29
897	594	588	Beckenham St	Minor Arterial	1,644	2	12	4	1,750	30	29
898	595	589	Kennington Dr	Collector	422	1	12	4	1,750	30	22
899	596	590	Los Alisos Blvd	Minor Arterial	1,484	1	12	4	1,750	45	22
900	596	597	Los Alisos Blvd	Minor Arterial	3,502	2	12	4	1,425	45	22
901	598	596	Avenida De La Carlota	Minor Arterial	981	2	12	4	1,750	30	22
902	599	591	Via Estrada	Collector	904	1	12	4	1,750	30	21
903	600	592	Calle De La Magdalena	Collector	651	1	12	4	1,750	30	21
904	601	414	Calle De La Plata	Collector	852	1	12	4	1,750	30	21
905	602	400	Avenida De La Carlota	Minor Arterial	609	2	12	4	1,750	45	21
906	602	605	I-5 On Ramp	Freeway Ramp	376	2	12	4	1,900	45	21
907	603	602	I-5 Off Ramp	Freeway Ramp	594	2	12	4	1,750	45	21
908	604	602	Avenida De La Carlota	Minor Arterial	934	2	12	4	1,750	45	21
909	605	218	I-5 On Ramp	Freeway Ramp	261	1	12	4	1,700	45	21
910	606	215	I-5 On Ramp	Freeway Ramp	549	1	12	4	1,700	45	22
911	607	606	I-5 On Ramp	Freeway Ramp	496	2	12	4	1,900	45	21
912	607	608	El Toro Rd	Major Arterial	590	3	12	4	1,750	45	21
913	608	609	El Toro Rd	Major Arterial	524	3	12	4	1,425	45	21
914	608	610	I-5 On Ramp	Freeway Ramp	544	2	12	4	1,900	45	21
915	609	1699	El Toro Rd	Major Arterial	3,544	3	12	4	1,425	45	22
916	610	216	I-5 Off Ramp	Freeway Ramp	571	1	12	4	1,350	30	21
917	610	608	I-5 Off Ramp	Freeway Ramp	538	2	12	4	1,750	45	21
918	611	612	Alicia Pkwy	Major Arterial	1,653	3	12	4	1,750	45	29
919	612	613	Alicia Pkwy	Major Arterial	953	3	12	4	1,750	45	29
920	613	614	Alicia Pkwy	Major Arterial	217	4	12	4	1,900	45	22
921	614	619	I-5 On Ramp	Freeway Ramp	274	1	12	4	1,700	45	22
922	614	620	Alicia Pkwy	Major Arterial	282	4	12	4	1,750	45	22
923	615	611	Wilkes Pl	Collector	1,157	1	12	4	1,750	30	29
924	616	612	Costeau St	Collector	1,109	1	12	4	1,750	30	29
925	617	613	Hon Ave	Collector	989	1	12	4	1,750	30	22

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
926	618	620	I-5 Off Ramp	Freeway Ramp	621	2	12	4	1,750	45	22
927	619	783	I-5 On Ramp	Freeway Ramp	498	2	12	4	1,900	45	22
928	620	621	Alicia Pkwy	Major Arterial	634	4	12	4	1,900	45	22
929	621	622	Alicia Pkwy	Major Arterial	326	3	12	4	1,750	45	22
930	621	624	I-5 On Ramp	Freeway Ramp	505	2	12	4	1,900	30	22
931	622	625	Alicia Pkwy	Major Arterial	3,561	3	12	4	1,425	45	22
932	623	622	I-5 Off Ramp	Freeway Ramp	661	2	12	4	1,750	45	22
933	624	213	I-5 On Ramp	Freeway Ramp	728	1	12	4	1,350	30	22
934	626	582	Paseo De Valencia	Minor Arterial	1,200	1	12	4	1,750	45	29
935	626	627	Paseo De Valencia	Minor Arterial	1,474	2	12	4	1,900	45	29
936	627	586	Paseo De Valencia	Minor Arterial	2,141	2	12	4	1,750	45	29
937	627	626	Paseo De Valencia	Minor Arterial	1,473	2	12	4	1,900	45	29
938	628	629	La Paz Rd	Minor Arterial	849	2	12	4	1,750	45	30
939	629	630	La Paz Rd	Major Arterial	203	3	12	4	1,900	40	30
940	630	631	La Paz Rd	Major Arterial	389	3	12	4	1,900	40	30
941	630	637	I-5 On Ramp	Freeway Ramp	516	2	12	4	1,900	45	30
942	631	632	La Paz Rd	Minor Arterial	401	2	12	4	1,750	40	30
943	631	638	I-5 On Ramp	Freeway Ramp	404	1	12	4	1,350	30	30
944	632	633	La Paz Rd	Minor Arterial	4,073	2	12	4	1,425	40	30
945	634	628	McIntyre St	Collector	1,193	1	12	4	1,750	30	30
946	635	629	I-5 Off Ramp	Freeway Ramp	501	1	12	4	1,750	45	30
947	636	629	Cabot Rd	Minor Arterial	976	2	12	4	1,750	40	30
948	637	209	I-5 On Ramp	Freeway Ramp	426	1	12	4	1,700	45	30
949	638	639	I-5 On Ramp	Freeway Ramp	430	2	12	4	1,900	30	30
950	639	210	I-5 On Ramp	Freeway Ramp	503	1	12	4	1,350	30	30
951	640	632	Muirlands Blvd	Minor Arterial	1,017	2	12	4	1,750	40	30
952	641	636	Cabot Rd	Minor Arterial	1,624	2	12	4	1,900	40	30
953	641	645	Cabot Rd	Minor Arterial	328	2	12	4	1,900	40	30
954	642	641	Paseo De Valencia	Collector	321	1	12	4	1,750	45	30
955	642	645	Paseo De Valencia	Freeway Ramp	493	1	12	4	1,700	45	30
956	643	644	Cabot Rd	Minor Arterial	1,801	2	12	4	1,750	40	30
957	643	645	Cabot Rd	Minor Arterial	639	2	12	4	1,900	40	30

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
958	644	559	Cabot Rd	Minor Arterial	903	1	12	4	1,750	30	30
959	644	643	Cabot Rd	Minor Arterial	1,801	2	12	4	1,750	40	30
960	645	641	Cabot Rd	Minor Arterial	328	2	12	4	1,750	40	30
961	645	643	Cabot Rd	Major Arterial	639	3	12	4	1,750	40	30
962	646	643	Nellie Gail Rd	Collector	754	1	12	4	1,750	35	30
963	647	644	El Paseo	Minor Arterial	782	2	12	4	1,750	40	30
964	648	649	Camino Capistrano	Collector	2,636	1	12	4	1,700	45	44
965	649	650	Camino Capistrano	Collector	1,603	1	12	4	1,700	45	44
966	650	651	Camino Capistrano	Collector	1,317	1	12	4	1,700	45	49
967	651	652	Camino Capistrano	Collector	1,286	1	12	4	1,750	45	49
968	652	653	Junipero Serra Rd	Minor Arterial	508	2	12	4	1,750	35	49
969	652	661	Camino Capistrano	Collector	1,426	1	12	4	1,750	45	49
970	653	652	Junipero Serra Rd	Minor Arterial	508	1	12	4	1,750	35	49
971	653	654	Junipero Serra Rd	Minor Arterial	424	2	12	4	1,750	35	49
972	654	655	Junipero Serra Rd	Minor Arterial	514	1	12	4	1,750	35	49
973	654	657	I-5 On Ramp	Freeway Ramp	709	2	12	4	1,900	45	49
974	655	659	I-5 On Ramp	Freeway Ramp	643	2	12	4	1,900	45	49
975	656	654	I-5 Off Ramp	Freeway Ramp	655	2	12	4	1,750	45	49
976	657	192	I-5 On Ramp	Freeway Ramp	675	1	12	4	1,700	45	49
977	658	655	I-5 Off Ramp	Freeway Ramp	535	1	12	4	1,750	45	49
978	659	193	I-5 On Ramp	Freeway Ramp	541	1	12	4	1,700	45	49
979	660	653	J. Serra High	Collector	214	1	12	4	1,750	35	49
980	661	652	Camino Capistrano	Minor Arterial	1,418	1	12	4	1,750	45	49
981	661	1571	Camino Capistrano	Collector	2,719	1	12	4	1,750	45	49
982	662	666	Camino Capistrano	Collector	1,315	1	12	4	1,750	45	49
983	662	1571	Camino Capistrano	Minor Arterial	557	2	12	4	1,750	45	49
984	663	661	Oso Rd	Collector	664	1	12	4	1,750	35	49
985	664	662	La Zanja St	Collector	897	1	12	4	1,750	30	49
986	665	662	La Zanja St	Collector	640	1	12	4	1,750	30	49
987	666	667	Camino Capistrano	Collector	1,092	1	12	4	1,750	45	49
988	667	689	Camino Capistrano	Collector	162	1	12	4	1,750	40	54
989	667	693	Ortega Hwy	Minor Arterial	319	2	12	4	1,750	40	54

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
990	668	666	Acjachema St	Collector	447	1	12	4	1,750	30	49
991	669	670	Camino Del Avion	Minor Arterial	1,673	2	12	4	1,750	45	53
992	670	672	Del Obispo St	Minor Arterial	2,244	2	12	4	1,750	45	53
993	670	728	Del Obispo St	Minor Arterial	2,111	2	12	4	1,750	45	53
994	671	123	Pacific Crest	Collector	869	1	12	4	1,750	30	53
995	672	673	Del Obispo St	Minor Arterial	1,088	2	12	4	1,900	45	54
996	673	674	Del Obispo St	Collector	958	1	12	4	1,750	40	54
997	674	677	Del Obispo St	Minor Arterial	918	2	12	4	1,750	35	54
998	675	672	Driveway	Local Roadway	507	1	12	4	1,750	30	53
999	676	674	Calle Aspero	Collector	1,895	1	12	4	1,750	30	54
1000	677	678	Del Obispo St	Minor Arterial	1,176	2	12	4	1,750	35	54
1001	678	679	Del Obispo St	Minor Arterial	757	2	12	4	1,750	35	54
1002	679	680	Del Obispo St	Minor Arterial	390	2	12	4	1,750	35	54
1003	680	681	Del Obispo St	Minor Arterial	868	2	12	4	1,750	35	54
1004	681	699	Del Obispo St	Minor Arterial	359	2	12	4	1,750	35	54
1005	681	705	Camino Capistrano	Minor Arterial	482	2	12	4	1,750	40	54
1006	682	677	Aguacate Rd	Collector	786	1	12	4	1,750	30	54
1007	683	678	Via Belardes	Collector	821	1	12	4	1,750	30	54
1008	684	678	Via Belardes	Collector	629	1	12	4	1,750	30	54
1009	685	679	Alipaz St	Collector	1,535	1	12	4	1,750	35	54
1010	686	679	Alipaz St	Collector	1,053	1	12	4	1,750	35	54
1011	687	680	Paseo Adelanto	Collector	943	1	12	4	1,750	35	54
1012	688	680	Paseo Adelanto	Collector	1,712	1	12	4	1,750	35	54
1013	689	667	Camino Capistrano	Collector	162	1	12	4	1,750	40	54
1014	689	681	Camino Capistrano	Collector	1,184	1	12	4	1,750	40	54
1015	690	689	Verdugo St	Collector	370	1	12	4	1,750	30	54
1016	691	693	El Camino Real	Collector	401	1	12	4	1,750	30	54
1017	692	693	El Camino Real	Collector	540	1	12	4	1,750	30	54
1018	693	667	Ortega Hwy	Minor Arterial	319	1	12	4	1,750	40	54
1019	693	694	Ortega Hwy	Minor Arterial	498	2	12	4	1,750	40	54
1020	694	695	Ortega Hwy	Major Arterial	236	3	12	4	1,900	45	54
1021	695	696	Ortega Hwy	Major Arterial	131	3	12	4	1,750	45	54

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1022	695	702	I-5 On Ramp	Freeway Ramp	481	2	12	4	1,900	45	54
1023	696	697	Ortega Hwy	Major Arterial	566	3	12	4	1,750	45	49
1024	697	698	Ortega Hwy	Major Arterial	433	3	12	4	1,900	45	49
1025	697	704	I-5 On Ramp	Freeway Ramp	356	2	12	4	1,900	30	54
1026	698	1730	Ortega Hwy	Major Arterial	2,428	3	12	4	1,900	45	49
1027	699	700	Del Obispo St	Minor Arterial	718	2	12	4	1,900	35	54
1028	700	694	Del Obispo St	Minor Arterial	795	2	12	4	1,750	35	54
1029	701	699	Plaza Dr	Collector	728	1	12	4	1,750	30	54
1030	702	189	I-5 On Ramp	Freeway Ramp	397	1	12	4	1,700	45	54
1031	703	696	I-5 Off Ramp	Freeway Ramp	391	2	12	4	1,750	45	49
1032	704	190	I-5 On Ramp	Freeway Ramp	640	1	12	4	1,350	30	54
1033	704	697	I-5 Off Ramp	Freeway Ramp	363	2	12	4	1,750	45	54
1034	705	706	Camino Capistrano	Minor Arterial	1,262	2	12	4	1,750	40	54
1035	706	707	Camino Capistrano	Minor Arterial	544	2	12	4	1,750	40	54
1036	707	708	San Juan Creek Rd	Collector	458	1	12	4	1,750	40	54
1037	707	711	Camino Capistrano	Minor Arterial	495	2	12	4	1,750	40	54
1038	708	707	San Juan Creek Rd	Collector	458	1	12	4	1,750	30	54
1039	708	716	Valle Rd	Collector	1,163	1	12	4	1,575	35	54
1040	709	705	Avenida Golondrina	Collector	367	1	12	4	1,750	30	54
1041	710	706	Avenida Padre	Collector	421	1	12	4	1,750	30	54
1042	711	713	I-5 On Ramp	Freeway Ramp	579	2	12	4	1,900	30	54
1043	711	714	Camino Capistrano	Minor Arterial	1,162	2	12	4	1,900	40	54
1044	712	711	I-5 Off Ramp	Freeway Ramp	432	1	12	4	1,750	30	54
1045	713	187	I-5 On Ramp	Freeway Ramp	559	1	12	4	1,700	45	54
1046	714	718	Camino Capistrano	Minor Arterial	2,870	2	12	4	1,750	45	54
1047	715	708	San Juan Creek Rd	Minor Arterial	650	2	12	4	1,750	40	54
1048	716	708	Valle Rd	Collector	1,160	1	12	4	1,750	35	54
1049	716	717	I-5 On Ramp	Freeway Ramp	488	1	12	4	1,350	30	54
1050	717	188	I-5 On Ramp	Freeway Ramp	1,320	1	12	4	1,700	45	54
1051	718	720	Camino Capistrano	Minor Arterial	3,155	2	12	4	1,750	45	57
1052	719	718	Avenida Aeropuerto	Collector	731	1	12	4	1,750	30	54
1053	720	731	I-5 On Ramp	Freeway Ramp	614	2	12	4	1,900	45	57

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1054	720	732	Camino Capistrano	Minor Arterial	1,506	2	12	4	1,750	40	57
1055	721	722	Stonehill Dr	Minor Arterial	1,027	2	12	8	1,750	45	56
1056	722	723	Stonehill Dr	Minor Arterial	672	2	12	8	1,750	45	56
1057	723	720	Stonehill Dr	Minor Arterial	3,004	2	12	8	1,750	45	56
1058	723	728	Del Obispo St	Minor Arterial	2,310	2	12	4	1,750	45	53
1059	723	1480	Dana Point Harbor Dr	Minor Arterial	708	2	12	4	1,900	45	56
1060	724	117	Selva Rd	Collector	1,074	1	12	4	1,750	30	56
1061	725	721	Ocean Hill Dr	Collector	1,346	1	12	4	1,750	30	53
1062	726	722	Palo Alto St	Collector	1,283	1	12	4	1,750	30	53
1063	727	722	Palo Alto St	Collector	662	1	12	4	1,750	30	56
1064	728	670	Del Obispo St	Minor Arterial	2,111	2	12	4	1,750	45	53
1065	728	723	Del Obispo St	Minor Arterial	2,308	2	12	4	1,750	45	53
1066	729	728	Blue Fin Dr	Collector	984	1	12	4	1,750	30	53
1067	730	728	Blue Fin Dr	Collector	439	1	12	4	1,750	30	53
1068	731	184	I-5 On Ramp	Freeway Ramp	802	1	12	4	1,700	45	57
1069	732	741	Doheny Park Rd	Minor Arterial	1,240	2	12	4	1,750	40	57
1070	733	88	Dana Point Harbor Dr	Minor Arterial	1,043	2	12	4	1,750	45	56
1071	733	1480	Dana Point Harbor Dr	Minor Arterial	1,093	2	12	4	1,750	45	56
1072	734	88	Village Rd	Collector	690	1	12	4	1,750	30	56
1073	735	89	SR-1	Minor Arterial	1,384	2	12	4	1,750	45	56
1074	735	736	SR-1	Minor Arterial	523	2	12	4	1,900	50	56
1075	736	738	SR-1	Minor Arterial	1,170	2	12	4	1,900	50	57
1076	737	746	SR-1 On Ramp	Freeway Ramp	448	1	12	8	1,350	30	56
1077	738	735	SR-1	Minor Arterial	1,693	2	12	4	1,900	50	56
1078	738	1272	SR-1	Minor Arterial	820	2	12	4	1,900	50	57
1079	739	747	SR-1	Minor Arterial	318	2	12	4	1,750	50	57
1080	739	748	I-5 On Ramp	Freeway Ramp	654	1	12	4	1,700	45	57
1081	740	89	Doheny Park Plaza	Collector	271	1	12	4	1,750	30	56
1082	741	742	Doheny Park Rd	Minor Arterial	709	2	12	4	1,750	40	56
1083	742	737	Doheny Park Rd	Collector	457	1	12	4	1,700	40	56
1084	743	732	Driveway	Local Roadway	532	1	12	4	1,750	30	57
1085	744	741	Victoria Blvd	Collector	822	1	12	4	1,750	35	57

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1086	745	742	SR-1 Off Ramp	Freeway Ramp	574	1	12	4	1,750	45	56
1087	746	736	SR-1 On Ramp	Freeway Ramp	369	1	12	8	1,350	30	56
1088	747	752	SR-1	Collector	575	1	12	4	1,700	55	57
1089	748	180	I-5 On Ramp	Freeway Ramp	530	1	12	4	1,700	45	57
1090	749	750	I-5 On Ramp	Freeway Ramp	663	1	12	4	1,350	30	57
1091	750	751	I-5 On Ramp	Freeway Ramp	856	2	12	4	1,900	45	57
1092	751	182	I-5 On Ramp	Freeway Ramp	635	1	12	4	1,700	45	57
1093	752	749	I-5 On Ramp	Freeway Ramp	563	1	12	4	1,350	30	57
1094	753	747	I-5 Off Ramp	Freeway Ramp	561	2	12	4	1,750	45	57
1095	754	755	SR-73	Freeway	2,368	3	12	4	2,250	70	38
1096	754	780	SR-73	Freeway	2,633	3	12	4	2,250	70	44
1097	755	754	SR-73	Freeway	2,350	3	12	4	2,250	70	38
1098	755	756	SR-73	Freeway	2,600	3	12	8	2,250	70	37
1099	756	755	SR-73	Freeway	2,598	3	12	8	2,250	70	37
1100	756	757	SR-73	Freeway	1,799	3	12	8	2,250	70	37
1101	757	756	SR-73	Freeway	1,805	3	12	8	2,250	70	37
1102	757	758	SR-73	Freeway	1,733	3	12	8	2,250	70	37
1103	758	757	SR-73	Freeway	1,733	3	12	8	2,250	70	37
1104	758	759	SR-73	Freeway	3,175	3	12	8	2,250	70	37
1105	759	758	SR-73	Freeway	3,175	3	12	8	2,250	70	37
1106	759	760	SR-73	Freeway	779	3	12	8	2,250	70	36
1107	760	759	SR-73	Freeway	779	3	12	8	2,250	70	36
1108	760	762	SR-73	Freeway	823	4	12	8	2,250	70	36
1109	761	762	SR-73	Freeway	3,602	3	12	8	2,250	70	28
1110	761	763	SR-73	Freeway	922	4	12	8	2,250	70	28
1111	762	760	SR-73	Freeway	823	3	12	8	2,250	70	36
1112	762	761	SR-73	Freeway	3,595	4	12	8	2,250	70	28
1113	763	761	SR-73	Freeway	922	3	12	8	2,250	70	28
1114	763	764	SR-73	Freeway	1,139	4	12	8	2,250	70	28
1115	764	763	SR-73	Freeway	1,139	3	12	8	2,250	70	28
1116	764	765	SR-73	Freeway	3,293	4	12	8	2,250	70	28
1117	765	764	SR-73	Freeway	3,287	3	12	8	2,250	70	28

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1118	765	766	SR-73	Freeway	1,660	4	12	10	2,250	70	27
1119	766	765	SR-73	Freeway	1,660	4	12	10	2,250	70	27
1120	766	767	SR-73	Freeway	1,900	4	12	10	2,250	70	27
1121	767	766	SR-73	Freeway	1,902	3	12	10	2,250	70	27
1122	767	768	SR-73	Freeway	3,832	4	12	10	2,250	70	27
1123	768	767	SR-73	Freeway	3,832	3	12	10	2,250	70	27
1124	768	769	SR-73	Freeway	2,109	4	12	10	2,250	70	26
1125	769	768	SR-73	Freeway	2,112	3	12	10	2,250	70	26
1126	769	770	SR-73	Freeway	2,806	4	12	10	2,250	70	26
1127	770	769	SR-73	Freeway	2,799	3	12	10	2,250	70	26
1128	770	775	SR-73	Freeway	2,574	3	12	10	2,250	70	26
1129	771	763	SR-73 On Ramp	Freeway Ramp	696	1	12	4	1,700	45	28
1130	772	761	SR-73 On Ramp	Freeway Ramp	883	1	12	4	1,700	45	28
1131	773	765	SR-73 On Ramp	Freeway Ramp	626	1	12	4	1,700	45	27
1132	774	766	SR-73 On Ramp	Freeway Ramp	1,078	2	12	4	1,900	45	27
1133	775	770	SR-73	Freeway	2,575	3	12	10	2,250	70	26
1134	775	776	SR-73	Freeway	2,655	3	12	10	2,250	70	17
1135	776	775	SR-73	Freeway	2,641	3	12	10	2,250	70	17
1136	776	777	SR-73	Freeway	3,939	3	12	10	2,250	70	17
1137	777	776	SR-73	Freeway	3,940	3	12	10	2,250	70	17
1138	777	778	SR-73	Freeway	4,093	3	12	10	2,250	70	17
1139	778	777	SR-73	Freeway	4,079	3	12	10	2,250	70	17
1140	778	779	SR-73	Freeway	3,110	4	12	10	2,250	70	16
1141	779	778	SR-73	Freeway	3,154	4	12	10	2,250	70	16
1142	779	1247	SR-73	Freeway	1,271	4	12	10	2,250	70	16
1143	780	754	SR-73	Freeway	2,633	3	12	4	2,250	70	44
1144	780	782	I-5 On Ramp	Freeway Ramp	2,834	3	12	4	1,900	45	44
1145	781	780	SR-73 On Ramp	Freeway Ramp	1,945	3	12	4	1,900	45	44
1146	782	196	I-5 On Ramp	Freeway Ramp	1,423	2	12	4	1,900	45	44
1147	783	212	I-5 On Ramp	Freeway Ramp	769	1	12	4	1,700	45	22
1148	784	785	SR-133	Minor Arterial	1,920	2	12	10	1,900	65	17
1149	785	786	SR-133	Minor Arterial	1,825	2	12	10	1,900	65	17

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1150	786	787	SR-133	Minor Arterial	2,060	2	12	10	1,900	65	17
1151	787	788	SR-133	Minor Arterial	1,511	2	12	10	1,900	65	17
1152	788	789	SR-133	Minor Arterial	2,337	2	12	10	1,900	65	20
1153	789	790	SR-133	Minor Arterial	1,722	2	12	10	1,900	65	17
1154	790	791	SR-133	Minor Arterial	2,230	2	12	8	1,900	65	17
1155	791	792	SR-133	Major Arterial	1,163	3	12	6	1,750	65	17
1156	792	793	SR-133	Major Arterial	1,825	3	12	4	1,750	65	17
1157	792	798	Lake Forest Dr	Minor Arterial	1,424	2	12	4	1,750	50	18
1158	793	794	SR-133	Major Arterial	847	3	12	4	1,900	65	17
1159	794	800	SR-133	Major Arterial	607	4	12	4	1,900	65	17
1160	795	796	SR-133	Minor Arterial	961	2	12	4	1,900	65	11
1161	796	797	SR-133	Major Arterial	1,964	3	12	4	1,900	65	11
1162	797	1228	I-5 On Ramp	Freeway Ramp	527	2	12	4	1,900	45	11
1163	797	1229	SR-133	Minor Arterial	2,455	2	12	4	1,900	70	11
1164	798	792	Lake Forest Dr	Minor Arterial	1,424	2	12	4	1,750	50	18
1165	798	813	Lake Forest Dr	Minor Arterial	3,195	1	12	4	1,750	50	18
1166	799	793	Laguna Canyon Rd	Minor Arterial	852	2	12	4	1,750	40	17
1167	800	795	SR-133	Minor Arterial	3,790	2	12	4	1,900	65	11
1168	800	801	I-405 On Ramp	Freeway Ramp	1,248	2	12	4	1,900	45	17
1169	801	869	I-405 On Ramp	Freeway Ramp	1,267	1	12	4	1,700	45	11
1170	801	883	I-405 On Ramp	Freeway Ramp	885	1	12	4	1,700	45	11
1171	802	409	Moulton Pkwy	Major Arterial	1,425	3	12	4	1,900	50	21
1172	802	803	Moulton Pkwy	Major Arterial	1,184	3	12	4	1,750	50	21
1173	803	802	Moulton Pkwy	Major Arterial	1,184	3	12	4	1,900	50	21
1174	803	804	Moulton Pkwy	Major Arterial	1,375	3	12	4	1,750	50	21
1175	804	803	Moulton Pkwy	Major Arterial	1,377	3	12	4	1,750	50	21
1176	804	805	Moulton Pkwy	Major Arterial	1,535	3	12	4	1,750	50	21
1177	805	806	Moulton Pkwy	Major Arterial	1,567	3	12	4	1,750	50	19
1178	806	811	Lake Forest Dr	Major Arterial	1,399	3	12	4	1,750	50	19
1179	806	822	Irvine Center Dr	Major Arterial	1,461	3	12	4	1,750	50	19
1180	806	825	Lake Forest Dr	Major Arterial	968	3	12	4	1,750	50	19
1181	807	803	Santa Maria Ave	Minor Arterial	1,767	2	12	4	1,750	40	20

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1182	808	804	Ridge Rte Dr	Collector	2,166	1	12	4	1,750	40	21
1183	809	804	Ridge Rte Dr	Collector	745	1	12	4	1,750	40	20
1184	809	814	Mill Creek Dr	Collector	2,070	1	12	4	1,575	35	20
1185	810	805	El Pacifico Dr	Collector	685	1	12	4	1,750	35	19
1186	811	806	Lake Forest Dr	Major Arterial	1,399	3	12	4	1,750	50	19
1187	811	812	Lake Forest Dr	Major Arterial	1,584	3	12	4	1,750	50	18
1188	812	811	Lake Forest Dr	Major Arterial	1,584	3	12	4	1,750	50	18
1189	812	813	Lake Forest Dr	Major Arterial	2,266	3	12	4	1,750	50	18
1190	813	798	Lake Forest Dr	Minor Arterial	3,200	2	12	4	1,750	50	18
1191	813	818	Bake Pkwy	Major Arterial	1,244	3	12	4	1,900	45	18
1192	814	811	Mill Creek Dr	Collector	1,236	1	12	4	1,750	35	18
1193	815	811	Mill Creek Dr	Collector	773	1	12	4	1,750	35	18
1194	815	822	Mill Creek Dr	Collector	590	1	12	4	1,750	35	18
1195	816	812	Santa Vittoria Dr	Collector	1,100	1	12	4	1,750	35	18
1196	817	812	Tesla	Collector	1,190	1	12	4	1,750	35	18
1197	817	823	Tesla	Collector	851	1	12	4	1,750	35	18
1198	818	813	Bake Pkwy	Major Arterial	1,242	2	12	4	1,750	45	18
1199	818	819	Bake Pkwy	Major Arterial	1,171	3	12	4	1,750	45	18
1200	819	835	Bake Pkwy	Major Arterial	1,402	3	12	4	1,750	45	18
1201	819	844	Irvine Center Dr	Major Arterial	1,216	3	12	4	1,750	50	18
1202	820	798	Romana	Collector	685	1	12	4	1,750	25	18
1203	821	798	Hidden Canyon	Collector	838	1	12	4	1,750	20	18
1204	822	823	Irvine Center Dr	Major Arterial	1,137	3	12	4	1,750	50	18
1205	823	819	Irvine Center Dr	Major Arterial	1,970	3	12	4	1,750	50	18
1206	824	822	Mill Creek Dr	Collector	1,010	1	12	4	1,750	35	19
1207	825	826	Lake Forest Dr	Major Arterial	928	3	12	4	1,750	45	19
1208	826	830	Lake Forest Dr	Major Arterial	272	4	12	4	1,900	45	19
1209	827	825	Research Dr	Collector	952	1	12	4	1,750	35	19
1210	828	825	Research Dr	Collector	992	1	12	4	1,750	35	19
1211	829	826	I-5 Off Ramp	Freeway Ramp	976	2	12	4	1,750	45	19
1212	830	831	Lake Forest Dr	Major Arterial	1,365	3	12	4	1,750	45	19
1213	830	833	I-5 On Ramp	Freeway Ramp	486	1	12	4	1,700	45	19

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1214	831	832	Lake Forest Dr	Major Arterial	2,404	3	12	4	1,425	45	19
1215	833	857	I-5 On Ramp	Freeway Ramp	500	1	12	4	1,700	45	19
1216	834	831	I-5 Off Ramp	Freeway Ramp	957	1	12	4	1,750	45	19
1217	835	836	Bake Pkwy	Major Arterial	902	3	12	4	1,750	45	18
1218	836	837	I-5 On Ramp	Freeway Ramp	385	1	12	4	1,750	45	18
1219	836	838	Bake Pkwy	Major Arterial	1,478	3	12	4	1,900	45	19
1220	837	858	I-5 On Ramp	Freeway Ramp	722	1	12	4	1,700	45	19
1221	838	839	Bake Pkwy	Major Arterial	311	3	12	4	1,750	45	19
1222	838	841	I-5 On Ramp	Freeway Ramp	507	2	12	4	1,900	30	19
1223	839	840	Bake Pkwy	Major Arterial	4,952	3	12	4	1,425	45	19
1224	841	839	I-5 Off Ramp	Freeway Ramp	390	1	12	4	1,750	30	19
1225	841	860	On Ramp	Freeway Ramp	724	1	12	4	1,350	30	19
1226	842	835	Research Dr	Collector	1,086	1	12	4	1,750	40	18
1227	843	836	I-5 Off Ramp	Freeway Ramp	835	1	12	4	1,750	45	18
1228	844	845	Irvine Center Dr	Major Arterial	1,519	3	12	4	1,750	50	18
1229	845	846	Irvine Center Dr	Major Arterial	784	3	12	4	1,900	50	18
1230	846	847	Irvine Center Dr	Major Arterial	339	3	12	4	1,750	45	18
1231	846	854	I-405 On Ramp	Freeway Ramp	711	1	12	4	1,350	30	18
1232	847	848	Irvine Center Dr	Collector	639	1	12	4	1,700	45	18
1233	848	856	I-405 On Ramp	Freeway Ramp	538	1	12	4	1,350	30	18
1234	851	844	Encanto	Collector	814	1	12	4	1,750	35	18
1235	852	845	Research Dr	Minor Arterial	1,371	1	12	4	1,750	40	18
1236	853	845	Antivo	Collector	1,000	1	12	4	1,750	40	18
1237	854	867	I-405 On Ramp	Freeway Ramp	486	1	12	4	1,700	45	18
1238	855	847	I-405 Off Ramp	Freeway Ramp	510	1	12	4	1,750	45	18
1239	856	868	I-405 On Ramp	Freeway Ramp	604	1	12	4	1,350	30	18
1240	857	219	I-5 On Ramp	Freeway Ramp	813	1	12	4	1,700	45	19
1241	858	859	I-5 On Ramp	Freeway Ramp	2,076	1	12	4	1,700	45	19
1242	859	221	I-5 On Ramp	Freeway Ramp	792	1	12	4	1,700	45	19
1243	860	861	On Ramp	Freeway Ramp	953	2	12	4	1,900	45	19
1244	861	862	On Ramp	Freeway Ramp	1,329	3	12	4	1,900	45	19
1245	862	224	I-5 On Ramp	Freeway Ramp	2,010	2	12	4	1,900	45	18

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1246	862	863	I-405 On Ramp	Freeway Ramp	1,100	2	12	4	1,900	45	18
1247	863	866	I-405 On Ramp	Freeway Ramp	1,437	2	12	4	1,900	45	18
1248	864	865	I-405 On Ramp	Freeway Ramp	1,483	3	12	4	1,900	45	18
1249	865	223	I-5 On Ramp	Freeway Ramp	2,273	4	12	4	1,900	45	18
1250	865	1625	I-405	Freeway	803	4	12	10	2,250	70	18
1251	866	865	I-405	Freeway	1,281	4	12	10	2,250	70	18
1252	866	867	I-405	Freeway	780	6	12	10	2,250	70	18
1253	867	866	I-405	Freeway	780	5	12	10	2,250	70	18
1254	867	868	I-405	Freeway	1,283	6	12	10	2,250	70	18
1255	868	867	I-405	Freeway	1,283	6	12	10	2,250	70	18
1256	868	869	I-405	Freeway	2,864	6	12	10	2,250	70	18
1257	869	868	I-405	Freeway	2,864	5	12	10	2,250	70	18
1258	869	870	I-405	Freeway	3,188	6	12	10	2,250	70	11
1259	870	869	I-405	Freeway	3,188	5	12	10	2,250	70	11
1260	870	871	I-405	Freeway	1,665	6	12	10	2,250	70	11
1261	871	870	I-405	Freeway	1,664	5	12	10	2,250	70	11
1262	871	872	I-405	Freeway	2,243	5	12	10	2,250	70	11
1263	872	871	I-405	Freeway	2,243	5	12	10	2,250	70	11
1264	872	873	I-405	Freeway	1,414	5	12	10	2,250	70	11
1265	873	872	I-405	Freeway	1,414	5	12	10	2,250	70	11
1266	873	874	I-405	Freeway	2,988	5	12	10	2,250	70	10
1267	874	873	I-405	Freeway	2,977	5	12	10	2,250	70	10
1268	874	875	I-405	Freeway	1,058	5	12	10	2,250	70	10
1269	875	874	I-405	Freeway	1,058	5	12	10	2,250	70	10
1270	875	876	I-405	Freeway	2,060	5	12	6	2,250	70	10
1271	876	875	I-405	Freeway	2,060	5	12	6	2,250	70	10
1272	876	877	I-405	Freeway	4,740	5	12	6	2,250	70	10
1273	877	876	I-405	Freeway	4,744	5	12	6	2,250	70	10
1274	877	878	I-405	Freeway	1,204	5	12	6	2,250	70	9
1275	878	877	I-405	Freeway	1,204	5	12	6	2,250	70	9
1276	878	879	I-405	Freeway	980	5	12	10	2,250	70	9
1277	879	878	I-405	Freeway	980	5	12	10	2,250	70	9

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1278	879	880	I-405	Freeway	5,505	5	12	10	2,250	70	9
1279	880	879	I-405	Freeway	5,505	5	12	10	2,250	70	9
1280	880	881	I-405	Freeway	1,357	6	12	10	2,250	70	4
1281	881	880	I-405	Freeway	1,357	6	12	10	2,250	70	4
1282	881	882	I-405	Freeway	4,808	6	12	10	2,250	70	4
1283	882	881	I-405	Freeway	4,808	6	12	10	2,250	70	4
1284	882	1246	I-405	Freeway	2,888	6	12	10	2,250	70	4
1285	883	884	I-405 On Ramp	Freeway Ramp	928	1	12	4	1,700	45	11
1286	884	870	I-405 On Ramp	Freeway Ramp	1,423	1	12	4	1,700	45	11
1287	885	39	SR-1	Minor Arterial	1,290	2	12	4	1,750	40	39
1288	885	886	SR-1	Minor Arterial	733	2	12	4	1,750	40	39
1289	886	885	SR-1	Minor Arterial	733	2	12	4	1,750	40	39
1290	886	887	SR-1	Minor Arterial	547	2	12	4	1,750	40	39
1291	887	886	SR-1	Minor Arterial	547	2	12	4	1,750	40	39
1292	887	888	SR-1	Minor Arterial	1,533	2	12	4	1,750	40	39
1293	888	887	SR-1	Minor Arterial	1,533	2	12	4	1,750	40	39
1294	888	889	SR-1	Minor Arterial	185	2	12	4	1,750	35	39
1295	889	888	SR-1	Minor Arterial	185	2	12	4	1,750	35	39
1296	889	890	SR-1	Minor Arterial	1,488	2	12	4	1,900	45	39
1297	890	889	SR-1	Minor Arterial	1,493	2	12	4	1,750	45	39
1298	890	898	SR-1	Minor Arterial	1,765	2	12	4	1,900	45	33
1299	891	1382	Aster St	Local Roadway	634	1	10	0	900	20	39
1300	892	1381	Myrtle St	Local Roadway	640	1	10	0	900	20	39
1301	893	886	Boat Canyon Dr	Local Roadway	422	1	10	0	1,750	20	39
1302	894	887	Beverly St	Local Roadway	588	1	10	0	1,750	20	39
1303	895	888	Cliff Dr	Local Roadway	650	1	12	4	1,750	25	39
1304	896	889	Viejo St	Local Roadway	569	1	12	4	1,750	25	39
1305	897	901	SR-1	Minor Arterial	691	2	12	4	1,900	50	32
1306	897	903	SR-1	Minor Arterial	738	2	12	4	1,900	55	32
1307	898	890	SR-1	Minor Arterial	1,761	2	12	4	1,900	45	33
1308	898	1371	SR-1	Minor Arterial	675	2	12	4	1,900	45	32
1309	899	900	SR-1	Minor Arterial	1,762	2	12	4	1,900	55	32

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1310	899	1407	SR-1	Minor Arterial	1,268	2	12	4	1,900	50	32
1311	900	899	SR-1	Minor Arterial	1,761	2	12	4	1,900	55	32
1312	900	901	SR-1	Minor Arterial	1,171	2	12	4	1,900	55	32
1313	901	897	SR-1	Minor Arterial	691	2	12	4	1,750	50	32
1314	901	900	SR-1	Minor Arterial	1,169	2	12	4	1,900	55	32
1315	902	897	School / State Park	Minor Arterial	1,757	2	12	4	1,750	35	32
1316	903	897	SR-1	Minor Arterial	738	2	12	4	1,750	55	32
1317	903	904	SR-1	Major Arterial	856	3	12	4	1,750	55	32
1318	904	903	SR-1	Major Arterial	856	3	12	4	1,900	55	32
1319	904	905	SR-1	Major Arterial	2,367	3	12	4	1,750	55	32
1320	905	904	SR-1	Major Arterial	2,369	3	12	4	1,750	55	32
1321	905	907	SR-1	Major Arterial	1,104	3	12	4	1,900	55	24
1322	906	908	SR-1	Major Arterial	891	3	12	4	1,900	50	24
1323	906	918	SR-1	Major Arterial	2,217	3	12	4	1,900	50	24
1324	907	905	SR-1	Major Arterial	1,104	3	12	4	1,750	55	24
1325	907	908	SR-1	Major Arterial	1,459	3	12	4	1,900	55	24
1326	908	906	SR-1	Major Arterial	892	3	12	4	1,750	50	24
1327	908	907	SR-1	Major Arterial	1,460	3	12	4	1,900	55	24
1328	909	904	Reef Point Dr	Collector	890	1	12	0	1,750	30	32
1329	910	905	Crystal Heights	Collector	863	1	12	4	1,750	35	32
1330	911	912	Newport Coast Dr	Minor Arterial	385	2	12	4	1,900	50	24
1331	911	918	SR-1	Major Arterial	311	3	12	4	1,900	45	24
1332	911	920	SR-1	Major Arterial	333	3	12	4	1,900	45	24
1333	912	911	Newport Coast Dr	Minor Arterial	385	2	12	4	1,750	50	24
1334	912	919	Newport Coast Dr	Major Arterial	1,476	3	12	4	1,750	60	24
1335	912	920	Newport Coast Dr	Freeway Ramp	537	1	12	4	1,700	45	24
1336	913	914	SR-1	Minor Arterial	1,424	2	12	4	1,750	40	24
1337	913	920	SR-1	Major Arterial	2,009	3	12	4	1,900	50	24
1338	914	913	SR-1	Minor Arterial	1,424	2	12	4	1,750	40	24
1339	914	915	SR-1	Minor Arterial	1,331	2	12	4	1,750	40	24
1340	915	914	SR-1	Minor Arterial	1,331	2	12	4	1,750	40	24
1341	915	916	SR-1	Minor Arterial	1,626	2	12	4	1,750	40	24

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1342	916	915	SR-1	Minor Arterial	1,626	2	12	4	1,750	40	24
1343	916	926	SR-1	Minor Arterial	1,527	2	12	4	1,750	40	24
1344	917	906	Los Trancos	Collector	492	1	12	4	1,750	30	24
1345	918	906	SR-1	Major Arterial	2,217	3	12	4	1,750	50	24
1346	918	911	SR-1	Major Arterial	311	3	12	4	1,750	45	24
1347	918	912	SR-1	Freeway Ramp	523	1	12	4	1,700	45	24
1348	919	912	Newport Coast Dr	Major Arterial	1,465	1	12	4	1,900	60	24
1349	919	986	Newport Coast Dr	Major Arterial	1,557	3	12	4	1,750	60	24
1350	920	911	SR-1	Major Arterial	332	3	12	4	1,750	45	24
1351	920	913	SR-1	Major Arterial	2,008	3	12	4	1,750	50	24
1352	921	913	Pelican Point Dr	Collector	764	1	12	4	1,750	30	24
1353	922	914	Cameo Highlands Dr	Collector	1,357	1	12	4	1,750	30	24
1354	923	914	Cameo Highlands Dr	Collector	897	1	12	4	1,750	30	24
1355	924	915	Morning Canyon Rd	Collector	620	1	12	4	1,750	30	24
1356	925	915	Morning Canyon Rd	Collector	720	1	12	4	1,750	30	24
1357	926	916	SR-1	Minor Arterial	1,529	2	12	4	1,750	40	24
1358	926	927	SR-1	Minor Arterial	946	2	12	4	1,750	40	24
1359	926	935	Marguerite Ave	Collector	452	1	12	4	1,350	30	24
1360	927	926	SR-1	Minor Arterial	946	2	12	4	1,750	40	24
1361	927	928	SR-1	Minor Arterial	786	2	12	4	1,750	40	12
1362	928	927	SR-1	Minor Arterial	786	2	12	4	1,750	40	12
1363	928	929	SR-1	Minor Arterial	105	2	12	4	1,750	40	12
1364	929	928	SR-1	Minor Arterial	105	2	12	4	1,750	40	12
1365	929	930	SR-1	Minor Arterial	844	2	12	4	1,900	40	12
1366	930	929	SR-1	Minor Arterial	844	2	12	4	1,750	40	12
1367	930	931	SR-1	Major Arterial	321	3	12	4	1,750	40	12
1368	930	939	SR-1	Freeway Ramp	663	1	12	4	1,700	45	12
1369	931	930	SR-1	Major Arterial	321	3	12	4	1,900	40	12
1370	931	932	SR-1	Major Arterial	332	3	12	4	1,900	40	12
1371	931	939	MacArthur Blvd	Major Arterial	420	2	12	4	1,900	45	12
1372	932	931	SR-1	Major Arterial	332	3	12	4	1,750	40	12
1373	932	940	SR-1	Major Arterial	485	3	12	4	1,750	40	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1374	933	916	Poppy Ave	Collector	1,032	1	12	4	1,750	30	24
1375	934	916	Poppy Ave	Collector	883	1	12	4	1,750	30	24
1376	935	926	Marguerite Ave	Collector	452	1	12	4	1,750	30	24
1377	935	1016	Marguerite Ave	Collector	376	1	12	4	1,350	30	24
1378	936	927	Iris Ave	Collector	780	1	12	4	1,750	30	24
1379	937	928	Goldenrod Ave	Collector	506	1	12	4	1,750	30	12
1380	938	929	Goldenrod Ave	Local Roadway	605	1	12	4	1,750	30	12
1381	939	931	MacArthur Blvd	Major Arterial	420	2	12	4	1,750	45	12
1382	939	932	MacArthur Blvd	Freeway Ramp	544	1	12	4	1,700	45	12
1383	939	1212	MacArthur Blvd	Major Arterial	1,959	2	12	4	1,900	55	12
1384	940	932	SR-1	Major Arterial	485	3	12	4	1,900	40	12
1385	940	941	SR-1	Major Arterial	1,170	3	12	4	1,750	45	12
1386	941	940	SR-1	Major Arterial	1,170	3	12	4	1,750	45	12
1387	941	942	SR-1	Major Arterial	1,127	3	12	4	1,750	45	12
1388	942	941	SR-1	Major Arterial	1,127	3	12	4	1,750	45	12
1389	942	943	SR-1	Major Arterial	1,777	3	12	4	1,900	45	12
1390	943	942	SR-1	Major Arterial	1,774	3	12	4	1,750	45	12
1391	943	944	SR-1	Major Arterial	871	4	12	4	1,900	45	12
1392	944	943	SR-1	Major Arterial	871	4	12	4	1,900	45	12
1393	944	945	SR-1	Major Arterial	364	4	12	4	1,750	45	12
1394	944	952	SR-1	Collector	393	1	12	4	1,700	45	12
1395	945	944	SR-1	Major Arterial	364	4	12	4	1,900	45	12
1396	945	951	SR-1	Major Arterial	369	4	12	4	1,900	45	12
1397	945	952	Jamboree Rd	Major Arterial	281	3	12	4	1,900	55	12
1398	946	940	Avocado Ave	Minor Arterial	663	2	12	4	1,750	35	12
1399	947	940	Avocado Ave	Collector	772	1	12	4	1,750	35	12
1400	948	941	Newport Center Dr	Minor Arterial	1,204	2	12	4	1,750	40	12
1401	949	942	Clubhouse Dr	Collector	685	1	12	4	1,750	30	12
1402	950	942	Clubhouse Dr	Collector	642	1	12	4	1,750	30	12
1403	951	945	SR-1	Major Arterial	369	4	12	4	1,750	45	12
1404	951	954	SR-1	Major Arterial	634	4	12	4	1,750	50	12
1405	952	945	Jamboree Rd	Major Arterial	281	1	12	4	1,750	55	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1406	952	951	Jamboree Rd	Freeway Ramp	528	1	12	4	1,700	45	12
1407	952	953	Jamboree Rd	Major Arterial	742	3	12	4	1,750	55	12
1408	953	952	Jamboree Rd	Major Arterial	742	3	12	4	1,900	55	12
1409	953	1215	Jamboree Rd	Major Arterial	667	3	12	4	1,750	55	12
1410	954	951	SR-1	Major Arterial	634	4	12	4	1,900	50	12
1411	954	955	SR-1	Major Arterial	1,508	4	12	4	1,900	50	12
1412	955	954	SR-1	Major Arterial	1,515	4	12	4	1,750	50	12
1413	955	1728	SR-1	Major Arterial	343	4	12	4	1,235	50	12
1414	960	954	Promontory Dr	Collector	417	1	12	4	1,750	30	12
1415	974	1728	SR-1	Major Arterial	1,085	3	12	4	1,235	50	12
1416	986	919	Newport Coast Dr	Major Arterial	1,548	3	12	4	1,750	60	24
1417	986	987	Newport Coast Dr	Major Arterial	2,096	3	12	4	1,900	60	25
1418	987	986	Newport Coast Dr	Major Arterial	2,048	3	12	4	1,750	60	24
1419	987	988	Newport Coast Dr	Major Arterial	2,752	3	12	4	1,750	60	25
1420	988	987	Newport Coast Dr	Major Arterial	2,752	3	12	4	1,900	60	25
1421	988	989	Newport Coast Dr	Major Arterial	1,736	3	12	4	1,900	60	25
1422	989	988	Newport Coast Dr	Major Arterial	1,743	3	12	4	1,750	60	25
1423	989	990	Newport Coast Dr	Major Arterial	1,629	3	12	4	1,750	60	16
1424	990	989	Newport Coast Dr	Major Arterial	1,629	3	12	4	1,900	60	16
1425	990	991	Newport Coast Dr	Major Arterial	1,097	3	12	4	1,750	60	16
1426	991	990	Newport Coast Dr	Major Arterial	1,097	3	12	4	1,750	60	16
1427	991	992	Newport Coast Dr	Major Arterial	1,153	3	12	4	1,750	60	16
1428	992	991	Newport Coast Dr	Major Arterial	1,142	3	12	4	1,750	60	16
1429	992	1000	Newport Coast Dr	Major Arterial	2,350	3	12	4	1,750	60	16
1430	993	919	Pelican Hill Rd S	Collector	877	1	12	4	1,750	30	24
1431	994	986	Provence	Collector	240	1	12	4	1,750	30	24
1432	995	988	Pelican Hill Rd N	Collector	1,788	1	12	4	1,750	35	24
1433	996	988	Pelican Hill Rd N	Collector	747	1	12	4	1,750	35	25
1434	997	990	Vista Ridge Rd	Collector	1,514	1	12	4	1,750	45	16
1435	998	991	Ridge Park Rd	Collector	1,342	2	12	4	1,750	30	16
1436	999	991	Ridge Park Rd	Collector	886	1	12	4	1,750	30	16
1437	1000	1001	Newport Coast Dr	Major Arterial	710	3	12	4	1,750	60	16

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1438	1001	1003	Newport Coast Dr	Major Arterial	2,486	3	12	4	1,900	60	16
1439	1003	1004	Newport Coast Dr	Minor Arterial	452	2	12	4	1,750	60	14
1440	1003	1008	SR-73 On Ramp	Freeway Ramp	613	2	12	4	1,900	30	14
1441	1004	1005	Newport Coast Dr	Minor Arterial	1,669	2	12	4	1,750	65	14
1442	1005	1012	Newport Coast Dr	Minor Arterial	1,446	2	12	4	1,750	65	14
1443	1006	1000	Driveway	Local Roadway	498	1	12	4	1,750	30	16
1444	1007	1001	Sage Hill	Collector	801	1	12	4	1,750	30	16
1445	1008	1010	SR-73 On Ramp	Freeway Ramp	460	2	12	4	1,900	30	14
1446	1009	1249	SR-73 On Ramp	Freeway Ramp	1,234	1	12	4	1,700	45	14
1447	1010	1009	SR-73 On Ramp	Freeway Ramp	506	2	12	4	1,900	45	14
1448	1011	1004	SR-73 Off Ramp	Freeway Ramp	486	1	12	4	1,750	45	14
1449	1012	1013	Newport Coast Dr	Minor Arterial	772	2	12	4	1,750	60	14
1450	1013	1063	Bonita Canyon Dr	Minor Arterial	1,395	3	12	8	1,750	45	13
1451	1013	1065	Culver Dr	Minor Arterial	1,498	2	12	4	1,750	55	14
1452	1014	1065	Turtle Ridge Dr	Minor Arterial	819	2	12	4	1,750	30	14
1453	1014	1587	Turtle Ridge Dr	Collector	882	1	12	4	1,750	30	14
1454	1015	1012	Turtle Crest Dr	Collector	558	1	12	4	1,750	30	14
1455	1016	935	Marguerite Ave	Collector	376	1	12	4	1,350	30	24
1456	1016	1017	Marguerite Ave	Collector	379	1	12	4	1,350	30	24
1457	1017	1016	Marguerite Ave	Collector	379	1	12	4	1,350	30	24
1458	1017	1018	Marguerite Ave	Collector	381	1	12	4	1,350	30	12
1459	1018	1017	Marguerite Ave	Collector	381	1	12	4	1,350	30	12
1460	1018	1021	Marguerite Ave	Collector	533	1	12	4	1,700	40	12
1461	1019	1016	3rd Ave	Collector	653	1	12	4	1,350	30	24
1462	1020	1018	5th Ave	Collector	598	1	12	4	1,350	30	12
1463	1021	1018	Marguerite Ave	Collector	536	1	12	4	1,700	40	12
1464	1021	1022	Marguerite Ave	Minor Arterial	1,593	2	12	4	1,900	40	12
1465	1022	1021	Marguerite Ave	Minor Arterial	1,635	2	12	4	1,900	40	12
1466	1022	1023	Marguerite Ave	Minor Arterial	766	2	12	4	1,900	40	15
1467	1023	1022	Marguerite Ave	Minor Arterial	766	2	12	4	1,900	40	15
1468	1023	1448	Marguerite Ave	Minor Arterial	516	2	12	4	1,750	40	15
1469	1024	1033	San Joaquin Hills Rd	Major Arterial	1,603	3	12	4	1,750	55	15

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1470	1024	1035	San Joaquin Hills Rd	Minor Arterial	917	2	12	4	1,900	55	15
1471	1024	1448	Marguerite Ave	Minor Arterial	613	2	12	4	1,900	40	15
1472	1025	1022	Sausalito Dr	Collector	596	1	12	4	1,350	30	15
1473	1026	1027	San Joaquin Hills Rd	Minor Arterial	1,565	2	12	4	1,900	55	15
1474	1026	1030	Spy Glass Hill Rd	Collector	1,101	1	12	4	1,700	40	15
1475	1026	1035	San Joaquin Hills Rd	Minor Arterial	1,855	2	12	4	1,900	55	15
1476	1027	1026	San Joaquin Hills Rd	Minor Arterial	1,569	2	12	4	1,750	55	15
1477	1027	1028	San Joaquin Hills Rd	Minor Arterial	2,796	2	12	4	1,750	55	15
1478	1028	1027	San Joaquin Hills Rd	Minor Arterial	2,789	2	12	4	1,900	55	15
1479	1028	1029	San Joaquin Hills Rd	Minor Arterial	2,270	2	12	4	1,750	55	16
1480	1029	992	San Joaquin Hills Rd	Minor Arterial	1,135	2	12	4	1,750	55	16
1481	1030	1026	Spy Glass Hill Rd	Collector	1,105	1	12	4	1,750	40	15
1482	1030	1050	Spy Glass Hill Rd	Collector	1,322	1	12	4	1,700	40	15
1483	1031	1028	Newport Ridge Dr W	Collector	1,714	1	12	4	1,750	30	15
1484	1032	1029	Newport Ridge Dr E	Collector	1,210	1	12	4	1,750	30	16
1485	1033	1034	San Joaquin Hills Rd	Major Arterial	915	3	12	4	1,750	55	12
1486	1034	1037	San Joaquin Hills Rd	Major Arterial	1,063	2	12	4	1,750	55	12
1487	1034	1208	San Miguel Dr	Minor Arterial	651	2	12	4	1,750	50	12
1488	1034	1213	San Miguel Dr	Minor Arterial	1,385	2	12	4	1,750	50	12
1489	1035	1024	San Joaquin Hills Rd	Major Arterial	917	3	12	4	1,750	55	15
1490	1035	1026	San Joaquin Hills Rd	Minor Arterial	1,855	2	12	4	1,750	55	15
1491	1036	1033	Crown Dr N	Collector	1,051	1	12	4	1,750	30	12
1492	1037	1038	San Joaquin Hills Rd	Major Arterial	1,589	3	12	4	1,750	55	12
1493	1037	1200	MacArthur Blvd	Major Arterial	2,504	3	12	4	1,900	55	12
1494	1037	1213	MacArthur Blvd	Major Arterial	1,446	3	12	4	1,750	55	12
1495	1038	1039	San Joaquin Hills Rd	Major Arterial	2,252	3	12	4	1,750	55	12
1496	1039	1040	San Joaquin Hills Rd	Major Arterial	781	3	12	4	1,900	55	12
1497	1040	1041	San Joaquin Hills Rd	Major Arterial	773	2	12	4	1,750	55	12
1498	1040	1046	San Joaquin Hills Rd	Freeway Ramp	1,048	1	12	4	1,700	45	12
1499	1041	1046	Jamboree Rd	Major Arterial	609	3	12	4	1,900	55	12
1500	1041	1216	Jamboree Rd	Major Arterial	977	3	12	4	1,750	55	12
1501	1042	1038	Santa Rosa Dr	Collector	888	1	12	4	1,750	30	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1502	1043	1039	Santa Cruz Dr	Collector	1,403	1	12	4	1,750	30	12
1503	1044	1039	Santa Cruz Dr	Collector	1,021	1	12	4	1,750	30	12
1504	1045	1038	Santa Rosa Dr	Collector	884	1	12	4	1,750	30	12
1505	1046	1041	Jamboree Rd	Major Arterial	609	3	12	4	1,750	55	12
1506	1046	1217	Jamboree Rd	Major Arterial	1,961	3	12	4	1,750	55	12
1507	1047	1052	San Miguel Dr	Minor Arterial	1,723	2	12	4	1,750	45	15
1508	1047	1209	San Miguel Dr	Minor Arterial	2,589	2	12	4	1,750	50	15
1509	1048	1047	Spy Glass Hill Rd	Collector	1,271	1	12	4	1,750	40	15
1510	1049	1048	Spy Glass Hill Rd	Collector	1,112	1	12	4	1,700	40	15
1511	1049	1050	Spy Glass Hill Rd	Collector	863	1	12	4	1,700	40	15
1512	1050	1030	Spy Glass Hill Rd	Collector	1,308	1	12	4	1,700	40	15
1513	1050	1049	Spy Glass Hill Rd	Collector	865	1	12	4	1,700	40	15
1514	1051	1049	Ridgeline Dr	Collector	830	1	12	4	1,350	30	15
1515	1052	1053	San Miguel Dr	Minor Arterial	302	2	12	4	1,900	40	13
1516	1053	1054	San Miguel Dr	Collector	499	1	12	4	1,700	40	13
1517	1054	1055	Prairie Rd	Minor Arterial	495	2	12	4	1,750	35	13
1518	1055	1059	Bonita Canyon Dr	Major Arterial	1,408	3	12	4	1,750	45	13
1519	1055	1203	Bonita Canyon Dr	Minor Arterial	1,678	2	12	4	1,750	45	13
1520	1056	1054	Ford Rd	Collector	356	1	12	4	1,575	35	13
1521	1057	1052	Port Ramsey Pl	Collector	421	1	12	4	1,750	30	13
1522	1058	1056	Ford Rd	Collector	654	1	12	4	1,575	35	13
1523	1059	1055	Bonita Canyon Dr	Minor Arterial	1,409	2	12	4	1,750	45	13
1524	1059	1060	Bonita Canyon Dr	Major Arterial	678	2	12	4	1,750	45	13
1525	1060	1059	Bonita Canyon Dr	Minor Arterial	680	2	12	4	1,750	45	13
1526	1060	1063	Bonita Canyon Dr	Major Arterial	1,156	2	12	4	1,750	45	13
1527	1061	1059	Chambord	Collector	1,114	1	12	4	1,750	30	13
1528	1062	1060	SR-73 Off Ramp	Freeway Ramp	557	1	12	4	1,750	30	13
1529	1063	1013	Bonita Canyon Dr	Minor Arterial	1,395	2	12	8	1,750	45	13
1530	1063	1060	Bonita Canyon Dr	Major Arterial	1,175	2	12	4	1,750	45	13
1531	1063	1064	SR-73 On Ramp	Freeway Ramp	305	2	12	4	1,900	30	13
1532	1064	1063	SR-73 Off Ramp	Freeway Ramp	305	1	12	4	1,750	30	13
1533	1064	1262	SR-73 On Ramp	Freeway Ramp	446	2	12	4	1,900	30	13

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1534	1065	1013	Culver Dr	Minor Arterial	1,498	2	12	4	1,750	55	14
1535	1065	1066	Culver Dr	Minor Arterial	1,170	2	12	4	1,750	55	14
1536	1066	1065	Culver Dr	Minor Arterial	1,157	2	12	4	1,750	55	14
1537	1066	1067	Culver Dr	Minor Arterial	1,152	2	12	4	1,900	55	14
1538	1067	1066	Culver Dr	Minor Arterial	1,146	2	12	4	1,750	55	14
1539	1067	1068	Culver Dr	Minor Arterial	2,210	2	12	4	1,750	55	14
1540	1068	1067	Culver Dr	Minor Arterial	2,201	2	12	4	1,900	55	14
1541	1068	1069	Culver Dr	Minor Arterial	2,933	2	12	4	1,750	55	14
1542	1069	1068	Culver Dr	Minor Arterial	2,918	2	12	4	1,750	55	14
1543	1069	1088	Culver Dr	Major Arterial	1,493	3	12	4	1,750	55	9
1544	1070	1066	Shady Canyon Dr	Minor Arterial	1,251	2	12	4	1,750	30	14
1545	1071	1066	Shady Canyon Dr	Collector	2,024	1	12	4	1,750	30	14
1546	1072	1068	Vista Del Campo Rd	Collector	724	1	12	4	1,750	30	14
1547	1073	1069	Campus Dr	Collector	1,988	1	12	2	1,750	45	9
1548	1074	1069	Campus Dr	Minor Arterial	1,741	2	12	2	1,750	45	9
1549	1075	1074	Campus Dr	Minor Arterial	708	2	12	2	1,750	45	9
1550	1076	1075	Campus Dr	Minor Arterial	949	2	12	2	1,750	45	14
1551	1076	1077	Campus Dr	Minor Arterial	804	2	12	2	1,750	45	14
1552	1077	1076	Campus Dr	Minor Arterial	794	2	12	4	1,750	45	14
1553	1077	1078	Campus Dr	Minor Arterial	1,608	2	12	2	1,750	45	8
1554	1078	1079	Campus Dr	Minor Arterial	1,709	2	12	2	1,750	45	8
1555	1079	1108	University Dr	Major Arterial	2,139	3	12	4	1,750	50	8
1556	1079	1109	University Dr	Major Arterial	964	2	12	4	1,750	50	8
1557	1079	1117	Campus Dr	Minor Arterial	938	2	12	4	1,900	50	8
1558	1080	1074	California Ave	Collector	1,036	1	12	4	1,750	30	9
1559	1080	1088	Harvard Ave	Collector	1,585	1	12	4	1,750	30	9
1560	1081	1074	California Ave	Collector	741	1	12	4	1,750	30	14
1561	1082	1075	Cornell	Collector	443	1	12	4	1,750	30	9
1562	1083	1076	Berkeley Ave	Collector	1,279	1	12	4	1,750	35	9
1563	1084	1076	Berkeley Ave	Collector	1,078	1	12	4	1,750	35	14
1564	1085	1077	Stanford	Collector	826	1	12	4	1,750	30	8
1565	1086	1078	Bridge Rd	Collector	669	1	12	4	1,750	30	8

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1566	1087	1078	W Peltason Dr	Collector	751	1	12	4	1,750	30	8
1567	1088	1089	Culver Dr	Major Arterial	1,387	3	12	4	1,750	55	9
1568	1089	1090	Culver Dr	Major Arterial	1,736	3	12	4	1,750	55	9
1569	1089	1093	University Dr	Minor Arterial	1,069	2	12	4	1,900	50	9
1570	1089	1094	University Dr	Minor Arterial	1,923	2	12	4	1,750	50	9
1571	1090	1091	Culver Dr	Major Arterial	1,420	3	12	4	1,750	55	9
1572	1091	1092	Culver Dr	Major Arterial	1,016	3	12	4	1,900	50	9
1573	1092	1236	Culver Dr	Major Arterial	160	3	12	4	1,750	50	9
1574	1092	1240	I-405 On Ramp	Freeway Ramp	667	1	12	4	1,700	45	9
1575	1093	1089	University Dr	Minor Arterial	1,069	2	12	4	1,750	50	9
1576	1093	1108	University Dr	Major Arterial	2,309	3	12	4	1,750	50	9
1577	1094	1096	University Dr	Minor Arterial	1,138	2	12	4	1,900	50	9
1578	1095	1097	University Dr	Minor Arterial	2,028	2	12	4	1,750	50	10
1579	1096	1095	University Dr	Minor Arterial	1,242	2	12	4	1,750	50	9
1580	1097	1098	University Dr	Minor Arterial	1,837	2	12	4	1,750	50	10
1581	1098	1099	University Dr	Minor Arterial	1,654	2	12	4	1,900	50	10
1582	1099	1100	University Dr	Major Arterial	376	3	12	4	1,750	50	10
1583	1099	1234	I-405 On Ramp	Freeway Ramp	677	1	12	4	1,700	45	10
1584	1100	1231	University Dr	Major Arterial	957	3	12	4	1,900	50	10
1585	1101	1090	Ethel Coplen Way	Collector	904	1	12	4	1,750	30	9
1586	1102	1091	Michelson Dr	Collector	703	1	12	4	1,750	30	9
1587	1103	1091	Michelson Dr	Collector	1,616	1	12	4	1,750	30	9
1588	1104	1094	Goldenglow St	Collector	718	1	12	4	1,750	30	9
1589	1105	1095	Yale Ave	Collector	782	1	12	4	1,750	30	9
1590	1106	1097	Ridgeline Dr	Collector	747	1	12	4	1,750	30	10
1591	1107	1098	Strawberry Farm Rd	Collector	833	1	12	4	1,750	30	10
1592	1108	1079	University Dr	Major Arterial	2,233	3	12	4	1,750	50	8
1593	1108	1093	University Dr	Major Arterial	2,309	3	12	4	1,900	50	9
1594	1109	1079	University Dr	Minor Arterial	964	2	12	4	1,750	50	8
1595	1109	1110	University Dr	Major Arterial	2,195	2	12	4	1,750	50	8
1596	1110	1109	University Dr	Minor Arterial	2,210	2	12	4	1,750	50	8
1597	1110	1111	University Dr	Major Arterial	1,602	2	12	4	1,750	50	8

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1598	1111	1110	University Dr	Major Arterial	1,602	2	12	4	1,750	50	8
1599	1111	1112	University Dr	Major Arterial	708	3	12	4	1,750	45	8
1600	1111	1124	MacArthur Blvd On Ramp	Freeway Ramp	578	2	12	4	1,700	45	8
1601	1112	1113	University Dr	Major Arterial	396	3	12	4	1,750	45	8
1602	1113	1114	University Dr	Major Arterial	988	3	12	4	1,750	45	7
1603	1114	1116	University Dr	Major Arterial	440	3	12	4	1,900	45	12
1604	1115	1161	Jamboree Rd	Major Arterial	2,130	3	12	4	1,750	55	7
1605	1115	1218	Jamboree Rd	Major Arterial	3,042	3	12	4	1,750	55	12
1606	1116	1115	University Dr	Major Arterial	262	2	12	4	1,750	45	12
1607	1117	1118	Campus Dr	Collector	1,763	1	12	4	1,700	50	8
1608	1118	1119	Campus Dr	Collector	1,223	1	12	4	1,750	50	8
1609	1119	1457	Campus Dr	Minor Arterial	606	2	12	4	1,750	45	8
1610	1120	1152	Campus Dr	Minor Arterial	729	2	12	4	1,750	45	8
1611	1120	1456	Jamboree Rd	Major Arterial	851	3	12	4	1,750	55	8
1612	1121	1452	Carlson Ave	Collector	553	1	12	4	1,350	30	8
1613	1122	1109	Mesa Rd	Collector	919	1	12	4	1,750	30	8
1614	1123	1110	California Ave	Collector	698	2	12	4	1,750	30	8
1615	1124	1111	MacArthur Blvd Off Ramp	Freeway Ramp	578	2	12	4	1,750	45	8
1616	1124	1168	MacArthur Blvd On Ramp	Freeway Ramp	563	1	12	4	1,350	30	8
1617	1125	1112	MacArthur Blvd Off Ramp	Freeway Ramp	586	1	12	4	1,750	45	8
1618	1126	1113	SR-73 Off Ramp	Freeway Ramp	1,071	1	12	4	1,750	45	8
1619	1127	1114	La Vida	Collector	904	1	12	4	1,750	30	12
1620	1128	1129	Jamboree Rd	Major Arterial	1,718	3	12	4	1,750	55	8
1621	1129	1130	Jamboree Rd	Major Arterial	1,411	3	12	4	1,750	55	4
1622	1129	1140	Michelson Dr	Major Arterial	689	3	12	4	1,750	40	4
1623	1130	1132	Jamboree Rd	Major Arterial	888	3	12	4	1,900	55	4
1624	1132	1267	Jamboree Rd	Major Arterial	184	3	12	4	1,750	55	4
1625	1132	1386	I-405 On Ramp	Freeway Ramp	403	1	12	4	1,350	30	4
1626	1133	1120	Jamboree Rd	Major Arterial	811	3	12	4	1,750	55	8
1627	1134	1133	Jamboree Rd	Major Arterial	1,831	3	12	4	1,750	55	8
1628	1135	1134	Jamboree Rd	Major Arterial	530	3	12	4	1,750	55	8
1629	1136	1135	Jamboree Rd	Major Arterial	448	3	12	4	1,750	55	8

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1630	1137	1136	Jamboree Rd	Major Arterial	345	3	12	4	1,900	55	8
1631	1137	1173	MacArthur Blvd	Major Arterial	1,775	3	12	4	1,750	55	8
1632	1138	1128	Dupont Dr	Collector	700	1	12	4	1,750	30	8
1633	1138	1140	Teller Ave	Collector	1,736	1	12	4	1,750	30	8
1634	1139	1129	Michelson Dr	Major Arterial	1,077	3	12	4	1,750	40	8
1635	1140	1143	Michelson Dr	Minor Arterial	701	2	12	4	1,750	40	4
1636	1141	1130	I-405 Off Ramp	Freeway Ramp	803	2	12	4	1,750	45	4
1637	1143	1144	Michelson Dr	Minor Arterial	741	2	12	4	1,750	40	4
1638	1144	1145	Michelson Dr	Minor Arterial	819	2	12	4	1,750	40	4
1639	1145	1146	Michelson Dr	Minor Arterial	658	2	12	4	1,750	40	4
1640	1146	1147	Michelson Dr	Minor Arterial	796	1	12	4	1,750	40	4
1641	1147	1179	MacArthur Blvd	Major Arterial	1,069	4	12	4	1,750	45	4
1642	1148	1143	Obsidian St	Collector	1,011	1	12	4	1,750	30	4
1643	1149	1144	Von Karman Ave	Collector	904	1	12	4	1,750	30	4
1644	1150	1145	Bixby	Collector	392	1	12	4	1,750	30	4
1645	1151	1146	Dupont Dr	Collector	831	1	12	4	1,750	30	4
1646	1152	1153	Campus Dr	Minor Arterial	1,277	2	12	4	1,750	45	8
1647	1153	1154	Campus Dr	Minor Arterial	1,076	2	12	4	1,750	45	8
1648	1154	2	Campus Dr	Minor Arterial	602	1	12	4	1,750	45	8
1649	1155	1152	Teller Ave	Collector	867	1	12	4	1,750	30	8
1650	1156	1153	Von Karman Ave	Collector	879	1	12	4	1,750	30	8
1651	1157	1154	Martin	Collector	881	1	12	4	1,750	30	8
1652	1158	1133	Birch St	Collector	447	1	12	4	1,750	30	8
1653	1159	1134	Fairchild Rd	Collector	1,079	1	12	4	1,750	30	8
1654	1159	1170	Fairchild Rd	Collector	1,766	1	12	4	1,750	30	8
1655	1160	1135	Koll	Collector	526	1	12	4	1,750	30	8
1656	1161	1162	Jamboree Rd	Major Arterial	841	3	12	4	1,750	55	7
1657	1162	1163	Jamboree Rd	Major Arterial	493	3	12	4	1,900	55	7
1658	1163	1137	Jamboree Rd	Major Arterial	816	3	12	4	1,750	55	7
1659	1163	1385	SR-73 On Ramp	Freeway Ramp	407	2	12	4	1,900	30	7
1660	1165	1162	Bristol St S	Collector	1,014	1	12	4	1,750	45	7
1661	1166	1161	Bayview Way	Minor Arterial	749	2	12	4	1,750	35	7

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1662	1167	1727	MacArthur Blvd	Major Arterial	407	5	12	4	1,900	55	13
1663	1168	1169	MacArthur Blvd	Major Arterial	1,379	4	12	4	1,900	55	8
1664	1169	1170	MacArthur Blvd	Major Arterial	661	3	12	4	1,750	55	8
1665	1169	1172	SR-73 On Ramp	Freeway Ramp	372	2	12	4	1,900	45	8
1666	1170	1137	MacArthur Blvd	Major Arterial	1,347	3	12	4	1,750	55	8
1667	1171	1263	SR-73 On Ramp	Freeway Ramp	327	1	12	4	1,700	45	7
1668	1172	1171	SR-73 On Ramp	Freeway Ramp	904	1	12	4	1,700	45	8
1669	1173	1174	MacArthur Blvd	Major Arterial	2,449	3	12	4	1,750	55	7
1670	1174	2	MacArthur Blvd	Major Arterial	928	4	12	4	1,750	55	7
1671	1175	1173	Von Karman Av	Collector	1,050	1	12	2	1,750	30	8
1672	1176	1174	Birch St	Collector	739	1	12	4	1,750	30	7
1673	1177	2	Campus Dr	Major Arterial	593	1	12	4	1,750	45	7
1674	1178	1147	MacArthur Blvd	Major Arterial	1,144	4	12	4	1,750	45	4
1675	1179	1180	MacArthur Blvd	Major Arterial	1,541	2	12	4	1,900	45	4
1676	1180	1181	I-405 On Ramp	Freeway Ramp	574	2	12	10	1,900	30	4
1677	1181	882	I-405 On Ramp	Freeway Ramp	680	1	12	10	1,350	30	4
1678	1182	1178	Douglas	Collector	675	1	12	4	1,750	30	4
1679	1183	1179	I-405 Off Ramp	Freeway Ramp	528	1	12	4	1,750	45	4
1680	1184	1185	MacArthur Blvd	Major Arterial	620	4	12	10	1,900	55	13
1681	1184	1189	Bison Ave	Minor Arterial	788	2	12	4	1,750	45	13
1682	1184	1225	Bison Ave	Major Arterial	831	3	12	4	1,750	55	12
1683	1185	1186	SR-73 On Ramp	Freeway Ramp	784	2	12	4	1,900	45	13
1684	1185	1188	MacArthur Blvd	Major Arterial	1,785	3	12	4	1,900	55	13
1685	1186	1187	SR-73 On Ramp	Freeway Ramp	975	2	12	4	1,900	45	13
1686	1187	1255	SR-73 On Ramp	Freeway Ramp	864	2	12	4	1,900	45	13
1687	1188	1167	MacArthur Blvd	Major Arterial	978	3	12	4	1,900	55	13
1688	1189	1184	Bison Ave	Minor Arterial	788	3	12	4	1,750	45	13
1689	1189	1190	Bison Ave	Minor Arterial	592	2	12	4	1,750	45	13
1690	1190	1189	Bison Ave	Minor Arterial	591	2	12	4	1,750	45	13
1691	1190	1191	Bison Ave	Minor Arterial	644	1	12	4	1,750	45	13
1692	1191	1190	Bison Ave	Minor Arterial	644	2	12	4	1,750	45	13
1693	1191	1194	SR-73 On Ramp	Freeway Ramp	993	2	12	4	1,900	45	13

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1694	1192	1191	SR-73 Off Ramp	Freeway Ramp	616	1	12	4	1,750	45	13
1695	1193	1191	Bison Ave	Collector	1,111	1	12	4	1,750	45	13
1696	1194	1254	SR-73 On Ramp	Freeway Ramp	832	1	12	4	1,700	45	13
1697	1195	1190	SR-73 Off Ramp	Freeway Ramp	744	2	12	4	1,750	45	13
1698	1196	1189	Bayswater	Collector	290	1	12	4	1,750	30	13
1699	1197	1184	MacArthur Blvd	Major Arterial	1,369	4	12	4	1,750	55	13
1700	1198	1197	MacArthur Blvd	Major Arterial	1,334	4	12	4	1,750	55	12
1701	1199	1198	MacArthur Blvd	Major Arterial	306	4	12	4	1,900	55	12
1702	1199	1201	MacArthur Blvd	Major Arterial	1,597	4	12	4	1,900	55	13
1703	1199	1729	Ford Rd	Minor Arterial	1,304	2	12	4	1,900	50	12
1704	1200	1037	MacArthur Blvd	Major Arterial	2,490	3	12	4	1,750	55	12
1705	1200	1201	MacArthur Blvd	Major Arterial	1,982	3	12	4	1,900	55	15
1706	1201	1199	MacArthur Blvd	Major Arterial	1,597	4	12	4	1,750	55	13
1707	1201	1200	MacArthur Blvd	Major Arterial	1,972	3	12	4	1,900	55	15
1708	1202	1197	Vilaggio	Collector	612	1	12	4	1,750	30	13
1709	1203	1055	Bonita Canyon Dr	Minor Arterial	1,677	2	12	4	1,750	45	13
1710	1203	1204	Bonita Canyon Dr	Minor Arterial	2,056	2	12	4	1,900	45	13
1711	1204	1198	Bonita Canyon Dr	Collector	506	1	12	4	1,700	45	13
1712	1204	1199	Bonita Canyon Dr	Minor Arterial	309	2	12	4	1,750	50	13
1713	1205	1203	Mesa View Dr	Collector	1,295	1	12	4	1,750	30	13
1714	1206	1203	Mesa View Dr	Minor Arterial	597	2	12	4	1,750	30	13
1715	1207	1055	Prairie Rd	Minor Arterial	561	2	12	4	1,750	30	13
1716	1208	1034	San Miguel Dr	Minor Arterial	650	2	12	4	1,750	50	12
1717	1208	1209	San Miguel Dr	Minor Arterial	2,265	2	12	4	1,750	50	15
1718	1209	1047	San Miguel Dr	Minor Arterial	2,598	2	12	4	1,750	50	15
1719	1209	1208	San Miguel Dr	Minor Arterial	2,251	2	12	4	1,750	50	15
1720	1210	1209	Yacht Coquette	Collector	878	1	12	4	1,750	30	15
1721	1211	1208	Pacific View Dr	Collector	796	1	12	4	1,750	30	12
1722	1212	939	MacArthur Blvd	Major Arterial	1,959	1	12	4	1,900	55	12
1723	1212	1213	MacArthur Blvd	Major Arterial	530	3	12	4	1,750	55	12
1724	1213	1034	San Miguel Dr	Minor Arterial	1,385	2	12	4	1,750	50	12
1725	1213	1037	MacArthur Blvd	Major Arterial	1,440	3	12	4	1,750	55	12

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1726	1213	1212	MacArthur Blvd	Major Arterial	530	3	12	4	1,900	55	12
1727	1214	1213	San Miguel Dr	Major Arterial	963	3	12	4	1,750	50	12
1728	1215	953	Jamboree Rd	Major Arterial	667	3	12	4	1,750	55	12
1729	1215	1216	Jamboree Rd	Major Arterial	3,067	3	12	4	1,750	55	12
1730	1216	1041	Jamboree Rd	Major Arterial	977	3	12	4	1,750	55	12
1731	1216	1215	Jamboree Rd	Major Arterial	3,067	3	12	4	1,750	55	12
1732	1217	1046	Jamboree Rd	Major Arterial	1,963	3	12	4	1,900	55	12
1733	1217	1218	Jamboree Rd	Major Arterial	3,274	3	12	4	1,750	55	12
1734	1218	1115	Jamboree Rd	Major Arterial	3,040	3	12	4	1,750	55	12
1735	1218	1217	Jamboree Rd	Major Arterial	3,273	3	12	4	1,750	55	12
1736	1218	1225	Bison Ave	Major Arterial	1,641	3	12	4	1,750	55	12
1737	1219	953	Back Bay Dr	Collector	1,244	1	12	4	1,750	30	12
1738	1220	1215	Hyatt Regency	Minor Arterial	465	2	12	4	1,750	30	12
1739	1221	1216	Santa Barbara Dr	Major Arterial	1,043	3	12	4	1,750	35	12
1740	1222	1217	Ford Rd	Minor Arterial	1,016	2	12	4	1,750	50	12
1741	1223	1217	Eastbluff Dr	Minor Arterial	1,294	2	12	4	1,750	50	12
1742	1224	1218	Bison Ave	Collector	1,236	1	12	4	1,750	30	12
1743	1225	1184	Bison Ave	Major Arterial	831	3	12	4	1,750	55	12
1744	1225	1218	Bison Ave	Major Arterial	1,635	3	12	4	1,750	55	12
1745	1226	1225	Belcount Dr	Collector	1,179	1	12	4	1,750	30	12
1746	1227	228	I-5 On Ramp	Freeway Ramp	1,859	2	12	4	1,900	45	11
1747	1228	1227	I-5 On Ramp	Freeway Ramp	937	2	12	4	1,900	45	11
1748	1229	1230	SR-133	Minor Arterial	1,589	2	12	4	1,900	70	11
1749	1231	1232	I-405 On Ramp	Freeway Ramp	568	1	12	4	1,350	30	10
1750	1231	1701	University Dr	Major Arterial	2,506	3	12	4	1,425	50	10
1751	1232	875	I-405 On Ramp	Freeway Ramp	444	1	12	4	1,350	30	10
1752	1233	1100	I-405 Off Ramp	Freeway Ramp	753	1	12	4	1,750	45	10
1753	1234	1235	I-405 On Ramp	Freeway Ramp	684	1	12	4	1,700	45	10
1754	1235	874	I-405 On Ramp	Freeway Ramp	754	1	12	4	1,700	45	10
1755	1236	1237	Culver Dr	Major Arterial	730	3	12	4	1,900	50	9
1756	1237	1388	I-405 On Ramp	Freeway Ramp	502	1	12	4	1,350	30	9
1757	1237	1700	Culver Dr	Major Arterial	2,757	3	12	4	1,425	50	9

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1758	1239	1236	I-405 Off Ramp	Freeway Ramp	639	1	12	4	1,750	45	9
1759	1240	878	I-405 On Ramp	Freeway Ramp	825	1	12	4	1,700	45	9
1760	1241	1242	I-405	Freeway	1,817	6	12	10	2,250	70	2
1761	1242	1241	I-405	Freeway	1,817	6	12	10	2,250	70	2
1762	1242	1243	I-405	Freeway	2,195	6	12	10	2,250	70	2
1763	1242	1266	SR-73 On Ramp	Freeway Ramp	1,714	3	12	4	1,900	45	2
1764	1243	1242	I-405	Freeway	2,195	6	12	10	2,250	70	2
1765	1243	1244	I-405	Freeway	3,826	6	12	10	2,250	70	2
1766	1244	1243	I-405	Freeway	3,826	6	12	10	2,250	70	2
1767	1244	1245	I-405	Freeway	2,795	6	12	10	2,250	70	3
1768	1245	1244	I-405	Freeway	2,795	6	12	10	2,250	70	3
1769	1245	1246	I-405	Freeway	3,172	6	12	10	2,250	70	3
1770	1246	882	I-405	Freeway	2,888	6	12	10	2,250	70	4
1771	1246	1245	I-405	Freeway	3,177	4	12	10	2,250	70	3
1772	1246	1715	Costa Mesa Fwy	Freeway Ramp	486	2	12	4	1,700	45	3
1773	1247	779	SR-73	Freeway	1,270	4	12	10	2,250	70	16
1774	1247	1248	SR-73	Freeway	1,612	4	12	10	2,250	70	16
1775	1247	1722	SR-73 Off Ramp	Freeway Ramp	1,248	1	12	4	1,700	45	16
1776	1248	1247	SR-73	Freeway	1,598	4	12	10	2,250	70	16
1777	1248	1249	SR-73	Freeway	2,785	4	12	10	2,250	70	16
1778	1249	1248	SR-73	Freeway	2,811	4	12	10	2,250	70	16
1779	1249	1250	SR-73	Freeway	2,452	5	12	10	2,250	70	14
1780	1250	1064	SR-73 Off Ramp	Freeway Ramp	510	1	12	4	1,700	45	13
1781	1250	1249	SR-73	Freeway	2,440	4	12	10	2,250	70	14
1782	1250	1251	SR-73	Freeway	1,128	4	12	12	2,250	70	13
1783	1251	1250	SR-73	Freeway	1,128	4	12	12	2,250	70	13
1784	1251	1252	SR-73	Freeway	2,371	4	12	10	2,250	70	13
1785	1252	1251	SR-73	Freeway	2,371	4	12	10	2,250	70	13
1786	1252	1253	SR-73	Freeway	1,451	4	12	10	2,250	70	13
1787	1253	1252	SR-73	Freeway	1,451	4	12	10	2,250	70	13
1788	1253	1724	SR-73	Freeway	1,368	4	12	10	2,250	70	13
1789	1254	1255	SR-73	Freeway	1,206	3	12	10	2,250	70	13

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1790	1254	1724	SR-73	Freeway	1,517	3	12	10	2,250	70	13
1791	1255	1254	SR-73	Freeway	1,210	3	12	10	2,250	70	13
1792	1255	1256	SR-73	Freeway	1,566	4	12	10	2,250	70	13
1793	1256	1255	SR-73	Freeway	1,566	3	12	10	2,250	70	13
1794	1256	1263	SR-73	Freeway	2,294	3	12	10	2,250	70	8
1795	1257	1258	SR-73	Freeway	5,751	4	12	10	2,250	70	7
1796	1257	1263	SR-73	Freeway	289	3	12	10	2,250	70	7
1797	1258	1257	SR-73	Freeway	5,751	3	12	10	2,250	70	7
1798	1258	1702	SR-73	Freeway	1,217	5	12	10	2,250	70	7
1799	1259	1260	SR-73	Freeway	2,508	3	12	4	2,250	70	3
1800	1259	1702	SR-73	Freeway	917	3	12	10	2,250	70	7
1801	1259	1707	Costa Mesa On-Ramp	Freeway Ramp	967	1	12	4	1,700	45	7
1802	1260	1259	SR-73	Freeway	2,508	3	12	4	2,250	70	3
1803	1260	1264	SR-73	Freeway	1,955	4	12	4	2,250	70	2
1804	1261	1264	SR-73	Freeway	2,422	3	12	4	2,250	70	2
1805	1261	1265	I-405 On Ramp	Freeway Ramp	1,293	3	12	4	1,900	45	2
1806	1262	1251	SR-73 On Ramp	Freeway Ramp	479	1	12	4	1,700	45	13
1807	1263	1256	SR-73	Freeway	2,281	3	12	10	2,250	70	8
1808	1263	1257	SR-73	Freeway	289	4	12	4	2,250	70	7
1809	1264	1260	SR-73	Freeway	1,955	4	12	4	2,250	70	2
1810	1264	1261	SR-73	Freeway	2,422	3	12	4	2,250	70	2
1811	1265	1242	I-405 On Ramp	Freeway Ramp	1,571	3	12	4	1,900	45	2
1812	1266	1261	SR-73 On Ramp	Freeway Ramp	1,004	3	12	4	1,900	45	2
1813	1267	1269	Jamboree Rd	Major Arterial	537	3	12	4	1,900	55	4
1814	1268	1267	I-405 Off Ramp	Freeway Ramp	581	1	12	4	1,750	45	4
1815	1270	1271	SR-1 On Ramp	Freeway Ramp	1,661	2	12	4	1,900	45	57
1816	1271	1272	SR-1 On Ramp	Freeway Ramp	908	1	12	4	1,700	45	57
1817	1272	738	SR-1	Minor Arterial	812	2	12	4	1,900	50	57
1818	1272	739	SR-1	Minor Arterial	780	2	12	4	1,900	55	57
1819	1273	1274	Alta Laguna Blvd	Local Roadway	859	1	10	0	900	20	34
1820	1274	1276	Alta Laguna Blvd	Local Roadway	472	1	10	0	900	20	34
1821	1275	1274	Ridge Dr	Local Roadway	597	1	10	0	900	20	34

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1822	1276	1277	Alta Laguna Blvd	Minor Arterial	529	2	12	2	1,900	30	35
1823	1276	1281	Park Ave	Local Roadway	624	1	12	4	1,575	35	34
1824	1277	1276	Alta Laguna Blvd	Local Roadway	529	1	12	2	1,350	30	35
1825	1277	1278	Alta Laguna Blvd	Minor Arterial	780	2	12	2	1,900	30	35
1826	1278	1277	Alta Laguna Blvd	Minor Arterial	785	2	12	2	1,900	30	35
1827	1278	1279	Alta Laguna Blvd	Local Roadway	682	1	12	2	1,350	30	41
1828	1278	1282	Cresta Way	Local Roadway	857	1	12	2	1,125	25	41
1829	1279	1278	Alta Laguna Blvd	Minor Arterial	682	2	12	2	1,900	30	41
1830	1279	1282	Temple Hills Dr	Local Roadway	841	1	12	2	1,350	30	41
1831	1280	1277	Tyrol Dr	Local Roadway	713	1	10	0	1,125	25	35
1832	1281	1297	Park Ave	Local Roadway	1,168	1	12	4	1,575	35	40
1833	1282	1286	Temple Hills Dr	Local Roadway	689	1	12	1	1,350	30	40
1834	1284	1279	Temple Hills Dr	Local Roadway	373	1	12	2	1,350	30	41
1835	1285	1279	Alta Laguna Blvd	Minor Arterial	680	2	12	2	1,900	30	41
1836	1286	1287	Temple Hills Dr	Local Roadway	482	1	12	1	1,350	30	40
1837	1287	1288	Temple Hills Dr	Local Roadway	1,002	1	12	1	1,350	30	40
1838	1288	1289	Temple Hills Dr	Local Roadway	591	1	12	1	1,350	30	40
1839	1289	1290	Temple Hills Dr	Local Roadway	1,615	1	12	1	1,350	30	40
1840	1290	1291	Temple Hills Dr	Local Roadway	654	1	12	1	1,350	30	40
1841	1291	1292	Temple Hills Dr	Local Roadway	493	1	12	1	1,350	30	40
1842	1292	1293	Temple Hills Dr	Local Roadway	348	1	12	1	1,350	30	40
1843	1293	1414	Temple Hills Dr	Local Roadway	223	1	12	1	1,350	30	40
1844	1294	1295	Temple Hills Dr	Local Roadway	626	1	12	0	675	15	40
1845	1295	47	Temple Hills Dr	Local Roadway	1,115	1	12	0	1,350	30	40
1846	1296	47	Temple Hills Dr	Local Roadway	783	1	12	0	1,350	30	40
1847	1297	1298	Park Ave	Local Roadway	740	1	12	4	1,575	35	40
1848	1298	1299	Park Ave	Local Roadway	343	1	12	2	1,125	25	40
1849	1298	1317	Tahiti Ave	Local Roadway	492	1	10	0	1,125	25	40
1850	1299	1300	Park Ave	Local Roadway	295	1	12	2	1,125	25	40
1851	1300	1301	Park Ave	Local Roadway	517	1	12	2	1,125	25	40
1852	1301	1302	Park Ave	Local Roadway	1,090	1	12	2	1,575	35	40
1853	1302	1303	Park Ave	Local Roadway	2,059	1	12	2	1,575	35	40

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1854	1303	1304	Park Ave	Local Roadway	452	1	12	2	1,575	35	40
1855	1303	1306	Wendt Terrace	Local Roadway	1,085	1	10	0	900	20	40
1856	1304	1305	Park Ave	Local Roadway	591	1	12	2	1,575	35	40
1857	1305	43	Park Ave	Local Roadway	798	1	12	2	1,575	35	40
1858	1306	1303	Wendt Terrace	Local Roadway	1,087	1	10	0	900	20	40
1859	1306	1307	Wendt Terrace	Local Roadway	609	1	10	0	900	20	40
1860	1307	1306	Wendt Terrace	Local Roadway	610	1	10	0	900	20	40
1861	1307	1315	Thalia St	Local Roadway	610	1	12	4	1,125	25	40
1862	1308	1309	Bluebird Canyon Dr	Local Roadway	556	1	12	0	1,350	30	40
1863	1309	1310	Bluebird Canyon Dr	Local Roadway	1,529	1	12	0	1,350	30	40
1864	1310	1311	Bluebird Canyon Dr	Local Roadway	1,060	1	12	2	1,125	25	40
1865	1311	1312	Bluebird Canyon Dr	Local Roadway	270	1	12	0	1,125	25	40
1866	1311	1313	Cress St	Local Roadway	600	1	12	4	1,125	25	40
1867	1312	51	Bluebird Canyon Dr	Local Roadway	314	1	12	0	1,125	25	40
1868	1313	49	Cress St	Local Roadway	310	1	12	4	1,125	25	40
1869	1314	1389	Cress St	Local Roadway	288	1	12	4	1,750	25	40
1870	1315	1316	Thalia St	Local Roadway	724	1	12	4	1,125	25	40
1871	1316	1431	Catalina St	Local Roadway	1,122	1	12	0	1,350	30	40
1872	1316	1635	Thalia St	Local Roadway	195	1	12	4	1,750	25	40
1873	1317	1318	Caribbean Way	Local Roadway	523	1	10	0	1,125	25	40
1874	1318	1319	Atlantic Way	Local Roadway	136	1	10	0	1,125	25	40
1875	1319	1320	Skyline Dr	Local Roadway	911	1	10	0	1,125	25	40
1876	1320	1321	Skyline Dr	Local Roadway	959	1	10	0	1,125	25	40
1877	1321	1322	Skyline Dr	Local Roadway	500	1	10	0	1,125	25	40
1878	1322	1323	Skyline Dr	Local Roadway	553	1	10	0	1,125	25	40
1879	1323	1324	Skyline Dr	Local Roadway	500	1	10	0	1,125	25	40
1880	1324	1325	Skyline Dr	Local Roadway	528	1	10	0	1,125	25	40
1881	1325	1326	Skyline Dr	Local Roadway	462	1	10	0	900	20	40
1882	1326	1327	Skyline Dr	Local Roadway	964	1	10	0	1,125	25	40
1883	1327	1328	Skyline Dr	Local Roadway	478	1	10	0	1,125	25	40
1884	1328	1304	Skyline Dr	Local Roadway	243	1	10	0	1,125	25	40
1885	1329	51	Summit Dr	Local Roadway	698	1	12	0	1,125	25	40

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1886	1330	1329	Summit Dr	Local Roadway	711	1	12	0	1,125	25	40
1887	1331	1330	Summit Dr	Local Roadway	358	1	12	0	900	20	40
1888	1332	1333	Bluebird Canyon Dr	Local Roadway	347	1	12	4	1,125	25	40
1889	1332	1429	Catalina St	Local Roadway	974	1	12	0	1,350	30	40
1890	1333	31	Bluebird Canyon Dr	Local Roadway	347	1	12	4	1,750	25	40
1891	1333	1640	Glenneyre St	Local Roadway	519	1	12	4	1,125	25	40
1892	1334	34	Legion St	Local Roadway	289	1	12	4	1,750	25	40
1893	1334	1387	Glenneyre St	Minor Arterial	802	2	12	4	1,900	30	40
1894	1335	359	3rd St	Local Roadway	223	1	12	4	1,350	30	40
1895	1335	1387	Laguna Ave	Local Roadway	615	1	12	4	1,350	30	40
1896	1336	1390	Forest Ave	Local Roadway	356	1	12	4	1,750	30	40
1897	1337	1344	Balboa Ave	Local Roadway	384	1	12	0	1,125	25	41
1898	1337	1418	Del Mar Ave	Local Roadway	456	1	12	0	1,125	25	41
1899	1338	1339	Del Mar Ave	Local Roadway	453	1	12	0	1,125	25	40
1900	1338	1418	Del Mar Ave	Local Roadway	1,173	1	12	0	1,125	25	40
1901	1339	1338	Del Mar Ave	Local Roadway	453	1	12	0	1,125	25	40
1902	1339	1340	La Mirada St	Local Roadway	440	1	12	0	1,125	25	40
1903	1340	1341	Summit Dr	Local Roadway	647	1	12	0	1,125	25	40
1904	1341	1342	Summit Dr	Local Roadway	626	1	12	0	1,125	25	40
1905	1342	1343	Summit Dr	Local Roadway	346	1	12	0	900	20	40
1906	1343	1331	Summit Dr	Local Roadway	339	1	12	0	900	20	40
1907	1344	1345	Balboa Ave	Local Roadway	460	1	12	0	1,125	25	41
1908	1345	1346	Balboa Ave	Local Roadway	798	1	12	0	1,125	25	41
1909	1346	1347	Balboa Ave	Local Roadway	1,395	1	12	0	1,125	25	46
1910	1347	1348	Nyes Pl	Local Roadway	364	1	12	0	900	20	46
1911	1348	1349	Nyes Pl	Local Roadway	383	1	12	0	900	20	46
1912	1349	1350	Nyes Pl	Local Roadway	392	1	12	0	900	20	46
1913	1350	1351	Nyes Pl	Local Roadway	869	1	12	2	1,125	25	45
1914	1351	1352	Nyes Pl	Local Roadway	618	1	12	2	1,125	25	45
1915	1352	1353	Nyes Pl	Local Roadway	377	1	12	2	1,125	25	45
1916	1353	54	Nyes Pl	Local Roadway	747	1	12	2	1,125	25	45
1917	1354	58	Monterey S	Local Roadway	821	1	12	0	1,125	25	46

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1918	1355	1356	Alta Vista Way	Local Roadway	336	1	10	0	900	20	45
1919	1356	1357	Alta Vista Way	Local Roadway	173	1	10	0	900	20	45
1920	1357	1358	Alta Vista Way	Local Roadway	251	1	10	0	900	20	45
1921	1358	1359	Alta Vista Way	Local Roadway	247	1	10	0	900	20	45
1922	1359	1360	Alta Vista Way	Local Roadway	188	1	10	0	900	20	45
1923	1360	1361	Alta Vista Way	Local Roadway	396	1	10	0	900	20	45
1924	1361	1362	Alta Vista Way	Local Roadway	225	1	10	0	900	20	45
1925	1362	1363	Alta Vista Way	Local Roadway	285	1	10	0	900	20	45
1926	1363	1366	Alta Vista Way	Local Roadway	270	1	10	0	900	20	45
1927	1364	1365	Solana Way	Local Roadway	449	1	10	0	900	20	45
1928	1364	1417	Solana Way	Local Roadway	544	1	10	0	1,350	30	45
1929	1365	30	Victoria Pl	Local Roadway	124	1	12	0	1,125	25	45
1930	1366	1367	Alta Vista Way	Local Roadway	157	1	10	0	900	20	45
1931	1367	1368	Alta Vista Way	Local Roadway	280	1	10	0	900	20	45
1932	1368	1364	Alta Vista Way	Local Roadway	187	1	10	0	900	20	45
1933	1369	890	Bay Crest Dr	Local Roadway	485	1	12	0	1,125	25	33
1934	1370	890	Bay Crest Dr	Local Roadway	624	1	12	0	1,125	25	33
1935	1371	898	SR-1	Minor Arterial	675	2	12	4	1,900	45	32
1936	1371	1407	SR-1	Minor Arterial	822	2	12	4	1,900	50	32
1937	1372	1371	Emerald Bay	Local Roadway	733	1	12	0	1,125	25	32
1938	1373	388	Artisan Dr	Collector	769	1	12	2	1,750	30	27
1939	1374	390	Calle Corta	Collector	813	1	12	4	1,750	30	20
1940	1375	1376	Diamond St	Local Roadway	323	1	12	4	1,125	25	40
1941	1376	52	Diamond St	Local Roadway	376	1	12	4	1,750	25	40
1942	1376	1641	Glenneyre St	Local Roadway	337	1	12	4	1,125	25	40
1943	1377	1378	Hillcrest Dr	Local Roadway	469	1	10	0	900	20	39
1944	1378	894	Hillcrest Dr	Local Roadway	415	1	10	0	900	20	39
1945	1379	1380	High Dr	Local Roadway	671	1	10	0	900	20	39
1946	1380	892	Myrtle St	Local Roadway	626	1	10	0	900	20	39
1947	1380	1377	High Dr	Local Roadway	830	1	10	0	900	20	39
1948	1381	885	Myrtle St	Local Roadway	289	1	10	0	1,750	20	39
1949	1382	39	Aster St	Local Roadway	339	1	10	0	1,750	20	39

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1950	1383	26	Country Club Dr	Local Roadway	1,176	1	12	1	1,125	25	46
1951	1384	1383	Country Club Dr	Local Roadway	880	1	12	1	1,125	25	46
1952	1385	1257	SR-73 On Ramp	Freeway Ramp	624	1	12	4	1,350	30	7
1953	1386	881	I-405 On Ramp	Freeway Ramp	556	1	12	4	1,350	30	4
1954	1387	35	Laguna Ave	Local Roadway	286	1	12	4	1,750	30	40
1955	1387	1634	Glenneyre St	Minor Arterial	404	2	12	4	1,900	30	40
1956	1388	879	I-405 On Ramp	Freeway Ramp	637	1	12	4	1,350	30	9
1957	1389	32	Cress St	Local Roadway	281	1	12	4	1,750	25	40
1958	1389	1638	Glenneyre St	Minor Arterial	350	2	12	4	1,900	30	40
1959	1390	354	Forest Ave	Local Roadway	223	1	12	4	1,750	30	40
1960	1390	1391	Forest Ave	Collector	431	1	12	4	1,350	30	40
1961	1391	354	SR-133	Minor Arterial	229	2	12	4	1,750	35	40
1962	1391	355	SR-133	Minor Arterial	751	2	12	4	1,750	35	40
1963	1396	1625	I-405 On Ramp HOV	Freeway Ramp	1,102	1	12	4	1,700	40	18
1964	1397	1396	I-405 On Ramp HOV	Freeway Ramp	780	1	12	4	1,700	40	18
1965	1398	52	Diamond St	Local Roadway	262	1	12	4	1,750	25	40
1966	1399	1308	Morningside Dr	Local Roadway	823	1	12	0	1,350	30	40
1967	1400	1309	Bluebird Canyon Dr	Local Roadway	378	1	12	0	1,350	30	40
1968	1401	1310	Oriole Dr	Local Roadway	247	1	12	0	1,350	30	40
1969	1402	367	Sun Valley Dr	Collector	350	1	12	0	1,350	30	34
1970	1404	1421	Alta Laguna Blvd	Local Roadway	244	1	12	0	1,350	30	41
1971	1405	1404	Anns Ln	Local Roadway	204	1	12	0	1,350	30	41
1972	1406	1421	Chillon Way	Local Roadway	348	1	12	0	1,350	30	41
1973	1407	899	SR-1	Minor Arterial	1,266	2	12	4	1,900	50	32
1974	1407	1371	SR-1	Minor Arterial	820	2	12	4	1,900	50	32
1975	1408	1407	Irvine Cove Way	Local Roadway	197	1	12	0	1,350	30	32
1976	1409	1335	Park Ave	Local Roadway	556	1	12	2	1,575	35	40
1977	1410	1409	Blumont St	Local Roadway	221	1	12	0	1,350	30	40
1978	1411	1325	Anacapa Way	Local Roadway	372	1	12	0	1,350	30	40
1979	1412	1320	Pacific Ave	Local Roadway	439	1	12	0	1,350	30	40
1980	1413	1414	Canyon View Dr	Local Roadway	420	1	12	0	1,350	30	40
1981	1414	1294	Temple Hills Dr	Local Roadway	292	1	12	1	1,350	30	40

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
1982	1415	1293	Cerritos Dr	Local Roadway	369	1	12	0	1,350	30	40
1983	1416	1425	SR-1	Minor Arterial	475	2	12	4	1,900	40	45
1984	1416	1427	SR-1	Minor Arterial	261	2	12	4	1,750	40	45
1985	1417	1416	Solana Way	Local Roadway	164	1	10	0	1,350	30	45
1986	1418	1337	Del Mar Ave	Local Roadway	456	1	12	0	1,125	25	41
1987	1418	1338	Del Mar Ave	Local Roadway	1,173	1	12	0	1,125	25	40
1988	1419	1418	Santa Ana St	Local Roadway	401	1	12	0	1,350	30	41
1989	1420	357	SR-133	Collector	1,231	1	12	4	1,700	45	34
1990	1420	362	SR-133	Collector	452	1	12	4	1,700	45	34
1991	1421	1285	Alta Laguna Blvd	Local Roadway	579	1	12	0	1,350	30	41
1992	1422	20	SR-1	Minor Arterial	1,414	2	12	4	1,900	40	51
1993	1422	21	SR-1	Minor Arterial	732	2	12	4	1,750	40	51
1994	1423	1422	9th Ave	Local Roadway	235	1	12	0	1,750	30	51
1995	1424	24	Camel Point Dr	Local Roadway	276	1	12	0	1,350	30	46
1996	1425	30	SR-1	Minor Arterial	651	2	12	4	1,900	40	45
1997	1425	1416	SR-1	Minor Arterial	475	2	12	4	1,750	40	45
1998	1426	1425	Sunset Terrace	Local Roadway	365	1	12	0	1,350	30	45
1999	1427	52	SR-1	Minor Arterial	1,722	2	12	4	1,750	40	45
2000	1427	1416	SR-1	Minor Arterial	260	2	12	4	1,900	40	45
2001	1428	1368	Glenneyre St	Collector	725	1	12	0	1,125	25	45
2002	1428	1427	Upland Rd	Collector	319	1	12	0	1,350	30	45
2003	1429	1375	Catalina St	Local Roadway	362	1	12	0	1,350	30	40
2004	1430	1333	Glenneyre St	Local Roadway	230	1	12	0	1,350	30	40
2005	1431	1314	Catalina St	Local Roadway	320	1	12	0	1,350	30	40
2006	1432	389	Aliso Creek Rd	Minor Arterial	661	2	12	4	1,750	45	27
2007	1433	388	El Toro Rd	Major Arterial	781	3	12	4	1,750	45	27
2008	1433	389	El Toro Rd	Major Arterial	1,343	3	12	4	1,750	45	27
2009	1434	1433	Canyon Hill Dr	Collector	399	1	12	0	1,350	30	27
2010	1435	1407	Irvine Cove Way	Local Roadway	302	1	12	0	1,350	30	32
2011	1435	1437	Irvine Cove Dr	Local Roadway	413	1	12	0	1,350	30	32
2012	1436	1435	Irvine Cove Dr	Local Roadway	181	1	12	0	1,350	30	32
2013	1437	1408	Irvine Cove Cres	Local Roadway	161	1	12	0	1,350	30	32

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2014	1437	1435	Irvine Cove Dr	Local Roadway	413	1	12	0	1,350	30	32
2015	1438	1437	Irvine Cove Cres	Local Roadway	205	1	12	0	1,350	30	32
2016	1439	885	Myrtle St	Local Roadway	336	1	12	0	1,750	30	39
2017	1440	896	Hillcrest Dr	Local Roadway	140	1	12	0	1,350	30	33
2018	1441	1440	Hillcrest Dr	Local Roadway	173	1	12	0	1,350	30	33
2019	1442	1440	Dartmoor St	Local Roadway	348	1	12	0	1,350	30	33
2020	1443	894	Hillcrest Dr	Local Roadway	272	1	12	0	1,350	30	39
2021	1444	41	Beach St	Local Roadway	249	1	12	4	1,350	30	40
2022	1445	953	Back Bay Dr	Collector	357	1	12	4	1,750	30	12
2023	1446	1209	Port Sutton Dr	Collector	417	1	12	0	1,750	30	15
2024	1448	1023	Marguerite Ave	Minor Arterial	516	2	12	4	1,900	40	15
2025	1448	1024	Marguerite Ave	Minor Arterial	612	2	12	4	1,750	40	15
2026	1449	1448	Inlet Dr	Collector	206	2	12	0	1,350	30	15
2027	1450	1114	Baypointe Dr	Collector	246	1	12	0	1,750	30	7
2028	1451	1225	Camelback St	Collector	729	2	12	0	1,750	30	12
2029	1452	1119	Carlson Ave	Collector	1,014	1	12	4	1,750	30	8
2030	1453	1452	Buena Vista	Collector	357	1	12	0	1,350	30	8
2031	1454	1128	Dupont Dr	Collector	393	1	12	4	1,750	30	8
2032	1455	1456	Diploma	Collector	293	1	12	0	1,350	30	8
2033	1456	1128	Jamboree Rd	Major Arterial	549	3	12	4	1,750	55	8
2034	1457	1120	Campus Dr	Minor Arterial	606	2	12	4	1,750	45	8
2035	1458	1457	Graduate	Collector	319	1	12	0	1,350	30	8
2036	1459	1139	Carlson Ave	Collector	329	1	12	0	1,350	30	8
2037	1460	799	Laguna Canyon Rd	Minor Arterial	1,677	2	12	4	1,900	40	17
2038	1461	1460	Quail Hill Parkway	Minor Arterial	1,509	2	12	4	1,900	40	17
2039	1461	1463	Quail Hill Parkway	Minor Arterial	1,784	2	12	4	1,750	40	11
2040	1462	1461	W Knollcrest	Collector	474	1	12	4	1,750	30	17
2041	1463	1461	Quail Hill Parkway	Minor Arterial	1,784	2	12	4	1,750	40	11
2042	1463	1470	Quail Hill Parkway	Minor Arterial	1,308	2	12	4	1,900	40	11
2043	1464	1463	W Knollcrest	Collector	490	1	12	4	1,750	30	11
2044	1465	1466	Spyglass	Collector	1,717	1	12	4	1,350	30	17
2045	1466	1461	Knollcrest	Collector	582	1	12	0	1,750	30	17

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2046	1466	1469	Knollcrest	Collector	602	1	12	0	1,350	30	17
2047	1468	1469	Pine Needles	Collector	1,562	1	12	0	1,350	30	17
2048	1469	1466	Knollcrest	Collector	602	1	12	0	1,350	30	17
2049	1469	1471	Knollcrest	Collector	2,120	1	12	0	1,350	30	17
2050	1470	1476	Quail Hill Parkway	Minor Arterial	571	2	12	4	1,900	40	11
2051	1471	1463	Knollcrest	Collector	412	1	12	0	1,750	30	11
2052	1473	872	I-405 On Ramp	Freeway Ramp	1,248	1	12	0	1,350	30	11
2053	1474	1475	Shady Canyon Dr	Collector	647	1	12	0	1,350	30	11
2054	1475	1476	Shady Canyon Dr	Collector	160	1	12	0	1,350	30	11
2055	1476	1477	Sand Canyon Ave	Minor Arterial	186	2	12	4	1,900	40	11
2056	1477	1478	Sand Canyon Ave	Minor Arterial	1,498	2	12	0	1,900	40	11
2057	1478	1473	Sand Canyon Ave	Collector	248	1	12	0	1,700	40	11
2058	1479	74	La Cresta Dr	Collector	528	1	12	0	1,350	30	55
2059	1480	723	Dana Point Harbor Dr	Minor Arterial	709	2	12	4	1,750	45	56
2060	1480	733	Dana Point Harbor Dr	Minor Arterial	1,093	2	12	4	1,900	45	56
2061	1481	1480	Lighthouse Dr	Collector	303	1	12	4	1,350	30	56
2062	1482	670	Camino Del Avion	Minor Arterial	835	2	12	4	1,750	45	53
2063	1483	1482	Camino Del Avion	Minor Arterial	1,227	2	12	4	1,700	45	54
2064	1484	1482	Avenida Descanso	Collector	342	1	12	0	1,350	30	53
2065	1485	1483	Via Del Amo	Collector	369	1	12	0	1,350	30	54
2066	1486	1483	Camino Del Avion	Minor Arterial	452	2	12	4	1,700	45	54
2067	1487	685	Alipaz St	Collector	971	1	12	4	1,575	35	54
2068	1488	1487	Alipaz St	Collector	1,030	1	12	4	1,575	35	54
2069	1489	1488	Paseo Toscana	Collector	279	1	12	0	1,350	30	54
2070	1490	1488	Alipaz St	Collector	529	1	12	4	1,575	35	54
2071	1491	685	Avenida Leandro	Collector	370	1	12	0	1,350	30	54
2072	1492	1493	Ritz Pointe Dr	Collector	483	1	12	0	1,350	30	52
2073	1493	236	Niguel Rd	Minor Arterial	1,223	2	12	4	1,750	40	52
2074	1494	162	South Peak	Collector	410	1	12	0	1,750	30	52
2075	1495	16	SR-1	Minor Arterial	1,435	2	12	4	1,900	45	52
2076	1495	17	SR-1	Minor Arterial	858	2	12	4	1,750	45	52
2077	1496	1495	Pointe Monarch Dr	Collector	280	1	12	0	1,350	30	52

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2078	1497	1498	Josiah Dr	Collector	394	1	12	0	1,350	30	53
2079	1498	94	Golden Lantern	Minor Arterial	192	2	12	4	1,900	45	53
2080	1498	1501	Golden Lantern	Minor Arterial	393	2	12	4	1,750	45	53
2081	1499	95	Golden Lantern	Minor Arterial	553	2	12	4	1,750	45	53
2082	1499	1501	Golden Lantern	Minor Arterial	372	2	12	4	1,900	45	53
2083	1500	1499	Seabrook Dr	Collector	314	1	12	0	1,350	30	53
2084	1501	1498	Golden Lantern	Minor Arterial	392	2	12	4	1,900	45	53
2085	1501	1499	Golden Lantern	Minor Arterial	372	2	12	4	1,750	45	53
2086	1502	1501	Gate	Collector	242	1	12	0	1,350	30	53
2087	1503	94	Dana Woods	Collector	565	1	12	0	1,350	30	53
2088	1504	1505	W Nine Dr	Collector	240	1	12	0	1,350	30	47
2089	1505	145	Crown Valley Pkwy	Major Arterial	1,213	3	12	6	1,900	55	52
2090	1505	146	Crown Valley Pkwy	Major Arterial	1,069	3	12	6	1,900	55	47
2091	1506	145	National Park Dr	Collector	359	1	12	0	1,350	30	52
2092	1507	276	Pacific Island Dr	Minor Arterial	799	2	12	6	1,900	45	47
2093	1508	1507	Starview Ln	Collector	617	1	12	0	1,350	30	47
2094	1509	273	Flying Cloud Dr	Collector	615	1	12	0	1,350	30	47
2095	1510	276	Ocean Way	Collector	615	1	12	0	1,350	30	46
2096	1511	1512	Ocean Way	Collector	417	1	12	0	1,350	30	46
2097	1512	1510	Ocean Way	Collector	237	1	12	0	1,350	30	46
2098	1513	1512	Isle Vista	Collector	549	1	12	0	1,350	30	46
2099	1514	293	Niguel Rd	Minor Arterial	523	2	12	4	1,900	40	42
2100	1515	1514	Niguel Rd	Minor Arterial	689	2	12	4	1,900	40	42
2101	1516	578	Stockport St	Collector	500	1	12	0	1,750	30	29
2102	1517	498	Calle Aragon	Collector	791	1	12	0	1,350	30	21
2103	1518	1517	Calle Aragon	Collector	882	1	12	0	1,350	30	21
2104	1519	498	Avenida Sevilla	Collector	865	1	12	0	1,350	30	21
2105	1520	498	Avenida Sevilla	Collector	710	1	12	0	1,350	30	28
2106	1521	507	Alameda Ave	Collector	415	1	12	0	1,350	30	29
2107	1522	503	Moulton Pkwy	Major Arterial	1,623	3	12	4	1,750	50	29
2108	1523	499	Via Lomas	Collector	408	1	12	0	1,750	30	28
2109	1524	432	Windsong	Collector	404	1	12	4	1,350	30	28

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2110	1525	1524	Cedarbrook	Collector	331	1	12	0	1,350	30	28
2111	1526	434	Polaris Way	Collector	337	1	12	0	1,750	30	28
2112	1527	445	Eastwing	Collector	657	1	12	4	1,350	30	27
2113	1528	447	Westwing	Collector	684	1	12	4	1,350	30	27
2114	1529	448	Westwing	Collector	729	1	12	0	1,350	30	20
2115	1529	1531	Calle Corta	Collector	306	1	12	0	1,350	30	20
2116	1530	404	Canyon Wren Ln	Collector	705	1	12	0	1,350	30	20
2117	1531	403	Calle Corta	Collector	309	1	12	0	1,350	30	20
2118	1532	474	Wood Vista Way	Collector	306	1	12	0	1,350	30	27
2119	1534	474	Canyon Vistas	Collector	1,539	1	12	4	1,350	30	27
2120	1536	1532	Wood Vista Way	Collector	564	1	12	0	1,350	30	27
2121	1537	1532	Alder Dr	Collector	281	1	12	0	1,350	30	27
2122	1538	456	Wood Canyon Dr	Collector	1,045	1	12	4	1,350	30	27
2123	1539	473	Chase	Collector	745	1	12	0	1,350	30	27
2124	1540	471	Sanborn	Collector	974	1	12	0	1,350	30	35
2125	1541	470	Oak Grove	Collector	626	1	12	0	1,750	30	35
2126	1542	1541	Oak Grove	Collector	461	1	12	0	1,350	30	35
2127	1543	1541	Huntington Ln	Collector	302	1	12	0	1,350	30	35
2128	1544	470	Westridge Dr	Collector	867	1	12	0	1,750	30	35
2129	1545	1544	Oak View Dr	Collector	627	1	12	0	1,350	30	35
2130	1546	470	Wood Canyon Dr	Minor Arterial	656	2	12	4	1,750	30	35
2131	1547	1542	Boundary Oak	Collector	1,406	1	12	0	1,350	30	35
2132	1548	1547	Weybridge Way	Collector	309	1	12	0	1,350	30	35
2133	1549	1546	Wood Canyon Dr	Minor Arterial	1,893	2	12	4	1,900	30	35
2134	1550	343	Wood Canyon Dr	Collector	835	1	12	4	1,350	30	42
2135	1551	296	Kite Hill Dr N	Collector	662	1	12	0	1,350	30	42
2136	1552	294	Kite Hill Dr S	Collector	561	1	12	4	1,350	30	42
2137	1553	306	Aliso Creek Rd	Collector	480	1	12	0	1,750	30	37
2138	1554	1553	Aliso Creek Rd	Collector	843	1	12	0	1,350	30	37
2139	1555	1536	Wood Vista Way	Collector	252	1	12	0	1,350	30	27
2140	1556	1102	Michelson Dr	Collector	1,338	1	12	4	1,350	30	9
2141	1557	1556	Michelson Dr	Collector	322	1	12	4	1,350	30	9

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2142	1558	1101	Ethel Coplen Way	Collector	332	1	12	0	1,350	30	9
2143	1559	1105	Yale Ave	Collector	1,536	1	12	4	1,350	30	10
2144	1560	1097	Rosa Drew Ln	Collector	358	1	12	0	1,750	30	10
2145	1561	1098	Michelson Dr	Collector	505	1	12	0	1,750	30	10
2146	1562	1106	Concordia	Collector	600	1	12	0	1,350	30	10
2147	1563	1106	Ridgeline Dr	Collector	1,965	1	12	4	1,350	30	10
2148	1564	1563	Ridgeline Dr	Collector	1,508	1	12	4	1,350	30	10
2149	1565	809	Ridge Rte Dr	Collector	2,350	1	12	4	1,350	40	20
2150	1566	807	San Remo Dr	Collector	505	1	12	0	1,350	30	20
2151	1567	807	Santa Maria Ave	Minor Arterial	913	2	12	4	1,900	40	20
2152	1568	406	Via Vista	Collector	320	1	12	0	1,350	30	20
2153	1569	1567	Santa Maria Ave	Minor Arterial	1,294	2	12	4	1,900	40	20
2154	1570	1569	Santa Maria Ave	Minor Arterial	718	2	12	4	1,900	40	20
2155	1571	661	Camino Capistrano	Minor Arterial	2,718	2	12	4	1,750	45	49
2156	1571	662	Camino Capistrano	Collector	556	1	12	4	1,750	45	49
2157	1572	664	Avenida De La Vista	Collector	511	1	12	4	1,350	30	49
2158	1573	1572	Avenida De La Vista	Collector	333	1	12	4	1,350	30	49
2159	1574	686	Alipaz St	Collector	1,347	1	12	4	1,575	35	54
2160	1575	265	Parc Vista	Collector	930	1	12	4	1,350	30	48
2161	1576	267	Parc Vista	Collector	1,184	1	12	4	1,350	30	48
2162	1577	256	Marina Hills Dr	Minor Arterial	837	2	12	4	1,750	45	48
2163	1577	262	Marina Hills Dr	Minor Arterial	497	2	12	4	1,750	45	48
2164	1578	1577	Niguel Ranch Rd	Collector	776	1	12	0	1,350	30	48
2165	1579	138	Hidden Hills Rd	Collector	1,149	1	12	4	1,575	35	43
2166	1580	1073	Turtle Rock Dr	Collector	1,555	1	12	0	1,750	45	9
2167	1581	1081	California Ave	Collector	945	1	12	4	1,350	30	14
2168	1582	1071	California Ave	Collector	1,794	1	12	4	1,750	30	14
2169	1583	1071	Anteater Dr	Collector	1,181	1	12	4	1,750	30	14
2170	1584	1193	Bison Ave	Collector	1,510	1	12	4	1,350	30	13
2171	1585	1584	Peltason Dr	Collector	1,275	1	12	4	1,350	30	13
2172	1586	1585	Peltason Dr	Collector	1,391	1	12	4	1,350	30	13
2173	1587	1005	Turtle Ridge Dr	Collector	686	1	12	4	1,750	30	14

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2174	1587	1014	Turtle Ridge Dr	Minor Arterial	882	2	12	4	1,900	30	14
2175	1588	1587	Summit Canyon Dr	Collector	1,022	1	12	4	1,750	30	14
2176	1589	1588	Summit Park Dr	Collector	899	1	12	4	1,350	30	14
2177	1590	1589	Summit Park Dr	Collector	1,821	1	12	4	1,350	30	14
2178	1591	1590	Summit Park Dr	Collector	1,516	1	12	0	1,350	30	14
2179	1592	1474	Shady Canyon Dr	Collector	1,477	1	12	0	1,350	30	11
2180	1593	1592	Shady Canyon Dr	Collector	1,233	1	12	0	1,350	30	17
2181	1594	1593	Shady Canyon Dr	Collector	1,430	1	12	0	1,350	30	17
2182	1595	1594	Shady Canyon Dr	Collector	878	1	12	0	1,350	30	17
2183	1596	1595	Shady Canyon Dr	Collector	1,287	1	12	0	1,350	30	17
2184	1597	1596	Shady Canyon Dr	Collector	812	1	12	0	1,350	30	17
2185	1598	1597	Shady Canyon Dr	Collector	978	1	12	4	1,350	30	17
2186	1599	1598	Shady Canyon Dr	Collector	1,270	1	12	4	1,350	30	17
2187	1600	1599	Shady Canyon Dr	Collector	499	1	12	4	1,350	30	17
2188	1601	1600	Shady Canyon Dr	Collector	1,209	1	12	4	1,350	30	17
2189	1601	1605	Shady Canyon Dr	Collector	1,877	1	12	4	1,350	30	17
2190	1602	1600	Copper Creek	Collector	751	1	12	4	1,350	30	17
2191	1603	1070	Shady Canyon Dr	Collector	1,383	1	12	4	1,350	30	14
2192	1604	1603	Shady Canyon Dr	Collector	1,486	1	12	4	1,350	30	14
2193	1605	1604	Shady Canyon Dr	Collector	1,916	1	12	4	1,350	30	14
2194	1606	1601	Sunnyhill	Collector	898	2	12	4	1,350	30	17
2195	1607	1606	Turtle Rock Dr	Collector	723	1	12	4	1,350	30	17
2196	1608	1606	Turtle Rock Dr	Collector	739	1	12	4	1,350	30	17
2197	1609	1073	Turtle Rock Dr	Collector	678	1	12	0	1,750	30	9
2198	1610	1580	Turtle Rock Dr	Collector	895	1	12	0	1,350	30	14
2199	1611	892	Monterey Dr	Local Roadway	333	1	12	0	1,350	30	39
2200	1612	892	Monterey Dr	Local Roadway	317	1	12	0	1,350	30	39
2201	1613	274	Talavera Dr	Collector	307	1	12	0	1,350	30	47
2202	1614	674	Calle Aspero	Collector	240	1	12	4	1,750	30	54
2203	1615	684	Via Belardes	Collector	391	1	12	4	1,350	30	54
2204	1616	509	Heather Ridge	Collector	469	1	12	4	1,750	30	36
2205	1617	1618	The Palms at Laguna Beach	Collector	290	1	12	4	1,350	30	37

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2206	1618	305	Moulton Pkwy	Major Arterial	1,010	3	12	4	1,750	50	37
2207	1618	306	Moulton Pkwy	Major Arterial	1,563	3	12	4	1,750	50	37
2208	1619	305	Rancho Niguel Rd	Collector	540	1	12	4	1,750	40	43
2209	1620	150	Via Valle	Collector	302	1	12	0	1,350	30	47
2210	1621	93	Golden Lantern	Minor Arterial	626	2	12	4	1,750	45	53
2211	1621	94	Golden Lantern	Minor Arterial	1,672	2	12	4	1,900	45	53
2212	1622	1621	Priscilla Dr	Collector	486	1	12	4	1,350	30	53
2213	1623	1208	Pacific View Dr	Collector	256	1	12	4	1,750	30	12
2214	1624	356	Canyon Acres Dr	Local Roadway	412	1	12	4	1,750	30	34
2215	1625	866	I-405	Freeway	481	4	12	10	2,250	70	18
2216	1626	215	I-5	Freeway	436	6	12	8	2,250	70	22
2217	1627	1420	Laguna College of Art and Design	Collector	183	1	12	0	1,350	30	34
2218	1628	362	SR-133	Collector	599	1	12	4	1,700	45	34
2219	1628	363	SR-133	Collector	539	1	12	4	1,700	45	34
2220	1629	1628	Laguna College of Art and Design	Collector	155	1	12	0	1,350	30	34
2221	1630	363	SR-133	Collector	686	1	12	4	1,700	45	34
2222	1630	364	SR-133	Collector	721	1	12	4	1,700	45	34
2223	1631	1630	Laguna College of Art and Design	Collector	162	1	12	0	1,350	30	34
2224	1632	1554	Aliso Creek Rd	Collector	584	1	12	0	1,350	30	37
2225	1633	1307	Thalia St	Local Roadway	255	1	12	4	1,125	25	40
2226	1633	1313	Temple Terrace	Local Roadway	1,641	1	12	4	1,350	30	40
2227	1634	1444	Forest Ave	Local Roadway	235	1	12	4	1,350	30	40
2228	1635	44	Glenneyre St	Minor Arterial	706	2	12	4	1,900	30	40
2229	1635	46	Thalia St	Local Roadway	353	1	12	4	1,750	25	40
2230	1636	1635	Glenneyre St	Minor Arterial	443	2	12	4	1,900	30	40
2231	1637	1636	Glenneyre St	Minor Arterial	380	2	12	4	1,900	30	40
2232	1638	1637	Glenneyre St	Minor Arterial	336	2	12	4	1,900	30	40
2233	1639	1389	Glenneyre St	Minor Arterial	311	2	12	4	1,900	30	40
2234	1640	1639	Glenneyre St	Minor Arterial	434	2	12	4	1,900	30	40

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2235	1641	1642	Glenneyre St	Local Roadway	379	1	12	4	1,125	25	40
2236	1642	1643	Glenneyre St	Local Roadway	670	1	12	4	1,125	25	40
2237	1643	1428	Glenneyre St	Collector	387	1	12	0	1,125	25	45
2238	1644	1652	I-5	Freeway	1,129	2	12	4	2,250	70	21
2239	1645	1646	I-5	Freeway	1,411	2	12	4	2,250	70	19
2240	1646	221	I-5	Freeway	1,413	2	12	4	2,250	70	19
2241	1647	1648	I-5	Freeway	1,606	2	12	4	2,250	70	19
2242	1648	1649	I-5	Freeway	3,302	2	12	4	2,250	70	21
2243	1648	1650	I-5	Freeway	970	1	12	4	2,250	70	21
2244	1649	217	I-5	Freeway	1,061	2	12	4	2,250	70	21
2245	1650	219	I-5	Freeway	951	6	12	4	2,250	70	21
2246	1650	1645	I-5	Freeway	1,060	1	12	4	2,250	70	21
2247	1650	1651	I-5	Freeway	1,645	6	12	4	2,250	70	21
2248	1651	217	I-5	Freeway	1,750	6	12	4	2,250	70	21
2249	1651	1649	I-5	Freeway	773	1	12	4	2,250	70	21
2250	1651	1650	I-5	Freeway	1,645	6	12	4	2,250	70	21
2251	1652	1645	I-5	Freeway	3,725	2	12	4	2,250	70	21
2252	1652	1651	I-5	Freeway	1,035	1	12	4	2,250	70	21
2253	1653	909	Reef Point Dr	Collector	701	1	12	0	1,350	30	32
2254	1654	1653	Reef Point Dr	Collector	334	1	12	0	1,350	30	32
2255	1655	1654	Reef Point Dr	Collector	1,765	1	12	0	1,350	30	32
2256	1656	1655	Reef Point Dr	Collector	1,248	1	12	0	1,350	30	32
2257	1657	1656	Reef Point Dr	Collector	630	1	12	0	1,350	30	25
2258	1658	1657	Reef Point Dr	Collector	935	1	12	0	1,350	30	25
2259	1659	1658	Reef Point Dr	Collector	1,005	1	12	0	1,350	30	25
2260	1660	1659	Reef Point Dr	Collector	910	1	12	0	1,350	30	25
2261	1661	1660	Reef Point Dr	Collector	688	1	12	0	1,350	30	25
2262	1662	1663	Archipelago Dr	Collector	887	1	12	0	1,125	25	32
2263	1663	1664	Archipelago Dr	Collector	872	1	12	0	1,125	25	32
2264	1664	910	Crystal Heights	Collector	779	1	12	4	1,350	30	32
2265	1665	995	Pelican Hill Rd N	Collector	952	1	12	2	1,350	30	24
2266	1666	1665	Pelican Hill Rd N	Collector	1,179	1	12	2	1,350	30	15

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2267	1666	1671	Pelican Hill Rd S	Collector	1,370	1	12	2	1,350	30	24
2268	1667	1666	Pelican Hill Cir	Collector	894	1	12	2	1,125	25	15
2269	1668	1667	Pelican Hill Cir	Collector	766	1	12	2	1,125	25	15
2270	1669	1670	Pelican Hill Cir	Collector	1,013	1	12	2	1,125	25	24
2271	1670	1671	Pelican Hill Cir	Collector	745	1	12	2	1,125	25	24
2272	1671	1666	Pelican Hill Rd N	Collector	1,370	1	12	2	1,350	30	24
2273	1671	1672	Pelican Hill Rd S	Collector	994	1	12	2	1,350	30	24
2274	1672	1673	Pelican Hill Rd S	Collector	785	1	12	2	1,750	30	24
2275	1673	1674	Pelican Hill Rd S	Collector	908	1	12	2	1,350	30	24
2276	1674	1675	Pelican Hill Rd S	Collector	780	1	12	2	1,750	30	24
2277	1675	993	Pelican Hill Rd S	Collector	1,262	1	12	2	1,350	30	24
2278	1676	1673	Pelican Hill Resort Entrance	Collector	597	1	12	0	1,750	30	24
2279	1677	1675	The Resort at Pelican Hill Entrance	Collector	627	1	12	4	1,750	25	24
2280	1678	997	Vista Ridge Rd	Collector	773	1	12	2	1,700	45	16
2281	1679	1678	Vista Ridge Rd	Collector	1,064	1	12	2	1,700	45	25
2282	1680	1679	Vista Ridge Rd	Collector	1,029	1	12	2	1,700	45	25
2283	1681	1680	Vista Ridge Rd	Collector	1,427	1	12	2	1,700	45	16
2284	1682	1681	Vista Ridge Rd	Collector	1,936	1	12	2	1,700	45	16
2285	1682	1684	Ridge Park Rd	Collector	1,545	1	12	2	1,700	45	16
2286	1683	998	Ridge Park Rd	Collector	479	1	12	2	1,700	45	16
2287	1684	1683	Ridge Park Rd	Collector	1,218	1	12	2	1,700	45	16
2288	1685	1682	Ridge Park Rd	Collector	1,319	1	12	2	1,700	45	16
2289	1686	1687	Cliff Dr	Local Roadway	575	1	10	2	1,350	30	39
2290	1687	1688	Cliff Dr	Local Roadway	485	1	10	2	1,350	30	39
2291	1688	887	Cliff Dr	Local Roadway	208	1	12	0	1,750	30	39
2292	1689	1690	Cliff Dr	Local Roadway	432	1	10	4	1,350	30	39
2293	1690	39	Cliff Dr	Local Roadway	442	1	10	4	1,750	30	39
2294	1691	1692	Stonehill Dr	Minor Arterial	1,088	2	12	4	1,900	40	55
2295	1692	118	Stonehill Dr	Minor Arterial	1,321	2	12	4	1,750	40	55
2296	1693	1694	Emerald Bay	Local Roadway	405	1	10	0	1,125	25	33
2297	1694	1695	Emerald Bay	Local Roadway	231	1	10	0	1,125	25	33

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2298	1695	1696	Emerald Bay	Local Roadway	294	1	10	0	1,125	25	33
2299	1696	1697	Emerald Bay	Local Roadway	500	1	10	0	1,125	25	33
2300	1697	1369	Emerald Bay	Local Roadway	489	1	10	0	1,125	25	33
2301	1698	1372	Emerald Bay	Local Roadway	622	1	10	0	1,125	25	32
2302	1702	1258	SR-73	Freeway	1,219	3	12	10	2,250	70	7
2303	1702	1259	SR-73	Freeway	917	4	12	10	2,250	70	7
2304	1702	1703	Costa Mesa On-Ramp	Freeway Ramp	461	2	12	4	1,700	45	7
2305	1703	1704	Costa Mesa On-Ramp	Freeway Ramp	1,040	2	12	4	1,700	45	7
2306	1704	1705	Costa Mesa On-Ramp	Freeway Ramp	907	2	12	4	1,700	45	3
2307	1705	1706	Costa Mesa On-Ramp	Freeway Ramp	1,595	2	12	4	1,700	45	3
2308	1706	1710	Costa Mesa Fwy	Freeway	2,364	3	12	4	2,250	70	3
2309	1706	1714	Costa Mesa Fwy	Freeway	736	5	12	4	2,250	70	3
2310	1707	1708	Costa Mesa On-Ramp	Freeway Ramp	697	1	12	4	1,700	45	3
2311	1708	1709	Costa Mesa On-Ramp	Freeway Ramp	481	1	12	4	1,350	30	3
2312	1709	1710	Costa Mesa On-Ramp	Freeway Ramp	618	1	12	4	1,350	30	3
2313	1710	1706	Costa Mesa Fwy	Freeway	2,364	3	12	4	2,250	70	3
2314	1710	1711	Costa Mesa Fwy	Freeway	1,785	4	12	4	2,250	70	7
2315	1711	1710	Costa Mesa Fwy	Freeway	1,785	3	12	4	2,250	70	7
2316	1711	1712	Costa Mesa Fwy	Freeway	1,714	4	12	4	2,250	70	6
2317	1712	1711	Costa Mesa Fwy	Freeway	1,714	4	12	4	2,250	70	6
2318	1713	1714	Costa Mesa Fwy	Freeway	1,882	4	12	4	2,250	70	3
2319	1713	1717	Costa Mesa Fwy	Freeway	3,961	4	12	4	2,250	70	3
2320	1714	1706	Costa Mesa Fwy	Freeway	736	3	12	4	2,250	70	3
2321	1714	1713	Costa Mesa Fwy	Freeway	1,882	4	12	4	2,250	70	3
2322	1715	1716	Costa Mesa Fwy	Freeway Ramp	1,033	2	12	4	1,700	45	3
2323	1715	1718	Costa Mesa On-Ramp	Freeway Ramp	868	1	12	4	1,700	45	3
2324	1716	1717	Costa Mesa Fwy	Freeway Ramp	993	2	12	4	1,700	45	3
2325	1717	1713	Costa Mesa Fwy	Freeway	3,961	3	12	4	2,250	70	3
2326	1717	1720	Costa Mesa Fwy	Freeway	811	5	12	4	2,250	70	3
2327	1718	1719	Costa Mesa On-Ramp	Freeway Ramp	1,674	1	12	4	1,700	45	3
2328	1719	1713	Costa Mesa On-Ramp	Freeway Ramp	1,162	1	12	4	1,700	45	3
2329	1720	1717	Costa Mesa Fwy	Freeway	811	4	12	4	2,250	70	3

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
2330	1720	1721	Costa Mesa Fwy	Freeway	3,165	5	12	4	2,250	70	4
2331	1721	1720	Costa Mesa Fwy	Freeway	3,165	4	12	4	2,250	70	4
2332	1722	1723	SR-73 Off Ramp	Freeway Ramp	867	1	12	4	1,700	45	16
2333	1723	1011	SR-73 Off Ramp	Freeway Ramp	775	1	12	4	1,700	45	14
2334	1724	1253	SR-73	Freeway	1,379	3	12	10	2,250	70	13
2335	1724	1254	SR-73	Freeway	1,516	3	12	10	2,250	70	13
2336	1724	1725	SR-73 Off Ramp	Freeway Ramp	1,264	2	12	4	1,700	45	13
2337	1725	1726	SR-73 Off Ramp	Freeway Ramp	947	3	12	4	1,700	45	13
2338	1726	1167	SR-73 Off Ramp	Freeway Ramp	859	3	12	4	1,700	45	13
2339	1727	1124	SR-73 Off Ramp	Freeway Ramp	572	2	12	4	1,700	45	13
2340	1727	1168	MacArthur Blvd	Major Arterial	478	3	12	4	1,900	55	8
2341	1728	955	SR-1	Major Arterial	343	3	12	4	1,235	50	12
2342	1728	974	SR-1	Major Arterial	1,091	4	12	4	1,235	50	12
2343	1729	1222	Ford Rd	Minor Arterial	1,525	2	12	4	1,900	50	12
2344	1730	1731	Ortega Hwy	Major Arterial	3,800	3	12	4	1,900	45	50
2345	1733	168	Driveway	Local Roadway	555	1	12	4	1,750	25	47
2346	8000	178	I-5	Freeway	2,182	5	12	8	2,250	70	58
2347	8010	230	I-5	Freeway	1,063	6	12	8	2,250	70	11
2348	8012	1241	I-405	Freeway	1,410	6	12	10	2,250	70	2
2349	8013	974	SR-1	Major Arterial	1,434	3	12	4	1,235	50	12
2350	8017	1712	Costa Mesa Fwy	Freeway	2,723	5	12	4	2,250	70	6
2351	8018	1721	Costa Mesa Fwy	Freeway	2,222	5	12	4	2,250	70	1
(exit link)	178	8000	I-5	Freeway	2,189	6	12	8	2,250	70	58
(exit link)	230	8010	I-5	Freeway	1,063	6	12	8	2,250	70	11
(exit link)	570	8002	Oso Pkwy	Major Arterial	645	3	12	4	1,425	50	31
(exit link)	597	8005	Los Alisos Blvd	Minor Arterial	873	2	12	4	1,425	45	22
(exit link)	625	8004	Alicia Pkwy	Major Arterial	1,470	3	12	4	1,425	45	22

Link #	Up-Stream Node	Down-Stream Node	Roadway Name	Roadway Type	Length (ft.)	No. of Lanes	Lane Width (ft.)	Shoulder Width (ft.)	Saturation Flow Rate (pcphpl)	Free Flow Speed (mph)	Grid Number
(exit link)	633	8003	La Paz Rd	Minor Arterial	1,164	2	12	4	1,425	40	30
(exit link)	832	8007	Lake Forest Dr	Major Arterial	890	3	12	4	1,425	45	19
(exit link)	840	8008	Bake Pkwy	Major Arterial	930	3	12	4	1,425	45	19
(exit link)	974	8013	SR-1	Major Arterial	1,443	4	12	4	1,235	50	12
(exit link)	1230	8009	SR-133	Minor Arterial	1,445	2	12	4	1,900	70	11
(exit link)	1241	8012	I-405	Freeway	1,410	6	12	10	2,250	70	2
(exit link)	1269	8011	Jamboree Rd	Major Arterial	798	3	12	4	1,900	55	4
(exit link)	1699	8006	El Toro Rd	Major Arterial	1,222	3	12	4	1,425	45	22
(exit link)	1700	8014	Culver Dr	Major Arterial	1,475	3	12	4	1,425	50	5
(exit link)	1701	8016	University Dr	Major Arterial	1,102	3	12	4	1,425	50	10
(exit link)	1712	8017	Costa Mesa Fwy	Freeway	2,722	4	12	4	2,250	70	6
(exit link)	1721	8018	Costa Mesa Fwy	Freeway	2,221	5	12	4	2,250	70	1
(exit link)	1731	8001	Ortega Hwy	Major Arterial	1,215	3	12	4	1,900	45	50
(exit link)	1732	8019	Crown Valley Pkwy	Major Arterial	793	4	12	4	1,425	45	38

Table H-2. Nodes in the Link-Node Analysis Network which are Controlled

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
1	6123291	2115865	Actuated	56
2	6070620	2191827	Actuated	7
3	6122377	2116142	Actuated	56
4	6121362	2116444	Actuated	56
5	6120065	2116710	Actuated	56
6	6119385	2116553	Actuated	56
7	6118769	2116407	Actuated	56
8	6117698	2116176	Actuated	55
9	6118026	2116258	Actuated	55
11	6117437	2116139	Actuated	55
12	6116765	2116153	Actuated	55
14	6115459	2118015	Actuated	55
15	6114441	2119900	Actuated	55
17	6111884	2123321	Actuated	52
18	6111298	2123974	Actuated	52
19	6108940	2126146	TCP - Actuated	51
21	6106814	2128617	Actuated	51
22	6106180	2129579	Actuated	46
23	6105444	2130721	Actuated	46
24	6104398	2131867	Stop	46
26	6103597	2132994	Stop	46
27	6102864	2133889	Actuated	46
28	6102190	2134870	Actuated	45
29	6100966	2136548	TCP - Actuated	45
30	6100782	2136681	Stop	45
31	6097667	2139823	TCP - Actuated	40
32	6096767	2140733	TCP - Actuated	40
33	6095594	2142655	Actuated	40
34	6095067	2143436	Actuated	40
35	6094626	2144067	Actuated	40
37	6094221	2144323	Actuated	39
38	6093874	2144546	TCP - Actuated	39
39	6092955	2144961	Actuated	39
40	6094335	2145103	TCP - Actuated	39
43	6096178	2144250	Stop	40
44	6095906	2142854	Stop	40
46	6095959	2142033	Actuated	40
47	6097944	2143232	Stop	40
51	6098892	2141045	Stop	40
52	6098576	2138875	Actuated	40
58	6105613	2130792	Stop	46

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
70	6115337	2121142	Actuated	52
71	6114927	2120247	Actuated	55
74	6116118	2118246	Stop	55
84	6120103	2117352	Actuated	56
88	6124083	2116884	Actuated	56
89	6123936	2115631	Actuated	56
90	6120152	2118693	Actuated	56
92	6120227	2120027	Actuated	56
93	6120239	2121007	Actuated	53
94	6120177	2123304	Stop	53
95	6120196	2124817	Actuated	53
96	6120382	2125378	Actuated	53
97	6120810	2126072	Actuated	53
100	6121829	2128715	Actuated	53
101	6122430	2130016	Actuated	48
103	6124517	2131525	Actuated	48
105	6125220	2134403	Actuated	48
106	6124657	2135242	Actuated	48
107	6124084	2136670	Actuated	48
108	6124150	2137545	Actuated	48
109	6124342	2139313	Actuated	43
111	6124163	2142326	Actuated	43
112	6123782	2142823	Actuated	43
113	6122306	2144282	Actuated	43
114	6118982	2118715	Stop	56
117	6122114	2119980	Actuated	56
118	6118919	2120018	Actuated	56
123	6121118	2125012	Actuated	53
124	6119825	2125478	Actuated	53
137	6123439	2137608	Actuated	48
139	6124547	2143471	Actuated	43
142	6112979	2124667	Actuated	52
144	6113426	2126833	Actuated	52
145	6113396	2128509	Stop	52
148	6113802	2133193	Actuated	47
150	6114310	2136268	Stop	47
151	6114904	2136936	Actuated	47
152	6115245	2137288	Actuated	47
153	6116288	2138304	Actuated	47
154	6118123	2139877	Actuated	42
155	6117237	2139340	Actuated	42
156	6119435	2140950	Actuated	43
157	6120266	2141832	Actuated	43

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
158	6120698	2142296	Actuated	43
159	6121421	2143168	Actuated	43
162	6114410	2126804	Actuated	52
166	6114733	2138153	Actuated	47
167	6115446	2138909	Actuated	42
168	6116958	2137684	Actuated	47
174	6119114	2142926	Actuated	43
232	6117839	2118719	Stop	55
235	6117590	2118738	Stop	55
236	6115194	2122208	Actuated	52
237	6115861	2124048	Actuated	52
238	6116204	2124927	Actuated	52
243	6118790	2125284	Actuated	53
244	6115416	2125438	Actuated	52
250	6116791	2125963	Actuated	52
251	6116426	2127265	Actuated	52
253	6117072	2130116	Actuated	47
254	6117255	2131788	Actuated	47
255	6117898	2134433	Actuated	47
256	6118215	2135539	Actuated	47
262	6119528	2135779	Actuated	48
263	6122179	2137089	Actuated	48
269	6117420	2136817	Actuated	47
272	6111479	2134751	Stop	47
273	6111236	2133923	Stop	47
274	6110771	2133529	Stop	47
281	6113726	2137975	Actuated	47
284	6115021	2139310	Actuated	42
286	6115553	2141669	Actuated	42
288	6115343	2143872	Actuated	42
289	6114913	2145664	Actuated	42
291	6114474	2148954	Actuated	36
298	6118896	2145712	Stop	43
301	6116905	2148889	Actuated	36
304	6121081	2145519	Actuated	43
305	6120741	2146975	Actuated	43
306	6119941	2149307	Actuated	37
308	6122157	2147747	Stop	37
309	6118857	2151270	Actuated	37
310	6119298	2152284	Actuated	37
311	6119701	2153328	Actuated	37
312	6120018	2154110	Actuated	37
317	6117515	2151729	Actuated	36

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
318	6117644	2153049	Actuated	36
319	6117687	2153878	Actuated	36
320	6117779	2155009	Actuated	36
321	6118520	2155947	Actuated	37
326	6115009	2150875	Actuated	36
327	6115199	2151534	Actuated	36
328	6115188	2152483	Actuated	36
329	6115378	2153074	Actuated	36
330	6115657	2154614	Actuated	36
331	6116193	2155620	Actuated	36
336	6116813	2156822	Actuated	28
337	6113522	2149111	Actuated	36
338	6112699	2149623	Actuated	36
339	6112200	2150395	Actuated	36
340	6112319	2152104	Actuated	36
341	6112807	2153124	Actuated	36
342	6112866	2154490	Actuated	36
346	6111324	2152808	Actuated	36
349	6116070	2148905	Actuated	36
351	6118460	2148850	Actuated	37
353	6094472	2145284	TCP - Actuated	39
354	6094828	2145846	TCP - Actuated	40
355	6095119	2146776	Actuated	40
356	6096824	2148479	TCP - Actuated	34
359	6095398	2144467	Stop	40
365	6100499	2152976	Stop	34
369	6101380	2159077	TCP - Actuated	26
373	6101985	2162034	Actuated	26
374	6101903	2162910	Actuated	26
382	6104081	2161701	Actuated	27
387	6104539	2162096	Actuated	27
388	6104995	2162920	Actuated	27
389	6105733	2164914	Actuated	27
390	6106667	2165843	Actuated	20
392	6108849	2168133	Actuated	20
393	6110330	2168439	Actuated	20
394	6111134	2168465	Actuated	21
395	6112559	2168837	Actuated	21
396	6113830	2169646	Actuated	21
397	6114649	2169707	Actuated	21
398	6116284	2169653	Actuated	21
399	6117060	2169698	Actuated	21
400	6117540	2170117	Actuated	21

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
406	6109676	2169522	Stop	20
408	6112962	2168145	Actuated	21
414	6116309	2168653	Actuated	21
418	6110683	2154447	Actuated	36
419	6112877	2155558	Actuated	36
420	6112936	2156550	Actuated	28
421	6113339	2157591	Actuated	28
422	6113974	2158441	Actuated	28
423	6111948	2154444	Actuated	36
424	6113709	2154783	Actuated	36
429	6114146	2159433	Actuated	28
430	6113969	2160451	Actuated	28
434	6112424	2160110	Actuated	28
435	6114646	2160573	Actuated	28
436	6112412	2161536	Actuated	28
437	6111395	2162992	Actuated	28
438	6110546	2163583	Actuated	28
439	6108426	2163807	Actuated	27
444	6112388	2163303	Actuated	28
449	6110678	2155597	Actuated	36
450	6110678	2156736	Actuated	28
451	6110771	2157756	Actuated	28
452	6111043	2158394	Actuated	28
453	6111316	2158827	Actuated	28
454	6109368	2154818	Actuated	35
456	6109779	2156693	Stop	27
462	6107800	2157194	Actuated	27
464	6108161	2158469	Actuated	27
466	6109631	2159871	Actuated	27
468	6110200	2161020	Actuated	27
469	6110520	2161674	Actuated	28
470	6108950	2153903	Actuated	35
471	6109939	2156039	Stop	35
474	6107827	2159224	Stop	27
478	6113363	2163479	Actuated	28
480	6115308	2163568	Actuated	28
485	6116155	2161969	Actuated	28
488	6117438	2158054	Actuated	28
489	6118007	2159085	Actuated	28
492	6114293	2166449	Actuated	21
493	6115001	2165459	Actuated	21
494	6115113	2164964	Actuated	28
498	6116372	2165224	Stop	28

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
499	6117482	2159643	Actuated	28
500	6117291	2162281	Actuated	28
502	6118852	2160144	Actuated	29
503	6119336	2156319	Actuated	29
505	6119851	2155024	Actuated	37
507	6121163	2157468	Stop	29
509	6116508	2154051	Actuated	36
511	6118263	2154139	Actuated	36
512	6119325	2154800	Actuated	37
519	6124423	2148109	Actuated	37
520	6126357	2149295	Actuated	38
521	6127117	2149628	Actuated	38
522	6127942	2149982	Actuated	38
523	6124126	2148658	Actuated	37
524	6124257	2149512	Actuated	37
528	6124356	2149850	Actuated	37
533	6126302	2146270	Actuated	44
534	6127296	2145932	Actuated	44
539	6127787	2146399	Actuated	44
541	6127750	2145693	Actuated	44
542	6127965	2145711	Actuated	44
543	6128299	2145706	Actuated	44
550	6127090	2152340	Actuated	38
557	6127827	2154848	Actuated	38
558	6127154	2152602	Actuated	38
559	6127868	2157713	Actuated	30
563	6122868	2155662	Actuated	37
567	6125359	2157552	Actuated	29
571	6129262	2157649	Actuated	30
572	6128399	2157649	Actuated	30
578	6119684	2163440	Actuated	29
579	6120028	2161529	Actuated	29
582	6120410	2162131	Actuated	29
584	6123545	2160779	Actuated	29
586	6124953	2162153	Actuated	29
588	6119557	2164977	Actuated	29
589	6119435	2165553	Actuated	22
590	6119039	2166721	Actuated	22
591	6117661	2167536	Actuated	21
592	6116685	2168011	Actuated	21
596	6120355	2167358	Actuated	22
602	6117104	2170542	Actuated	21
608	6118120	2170640	Actuated	21

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
611	6121451	2163515	Actuated	29
612	6122558	2164743	Actuated	29
613	6122812	2165662	Actuated	22
620	6122925	2166148	Actuated	22
622	6123179	2167074	Actuated	22
628	6126287	2163469	Actuated	30
629	6127070	2163800	Actuated	30
632	6127555	2164659	Actuated	30
641	6127893	2161384	Actuated	30
643	6127935	2160416	Actuated	30
644	6127903	2158615	Actuated	30
645	6127911	2161055	Yield	30
652	6128986	2135743	Actuated	49
653	6129494	2135730	Actuated	49
654	6129899	2135855	Actuated	49
655	6130385	2136023	Actuated	49
661	6129007	2134410	Actuated	49
662	6130117	2131327	Actuated	49
664	6129255	2131115	Stop	49
666	6130558	2130088	Actuated	49
667	6131001	2129097	Actuated	54
670	6124882	2123879	Actuated	53
672	6126008	2125820	Actuated	53
674	6127287	2127359	Actuated	54
677	6127898	2128032	Actuated	54
678	6129032	2127727	Actuated	54
679	6129790	2127699	Actuated	54
680	6130179	2127735	Actuated	54
681	6131047	2127755	Actuated	54
684	6128868	2127126	Stop	54
685	6129035	2126366	Stop	54
689	6131023	2128937	Actuated	54
693	6131321	2129088	Actuated	54
694	6131819	2129089	Actuated	54
696	6132130	2129282	Actuated	54
697	6132669	2129458	Actuated	49
699	6131406	2127736	Actuated	54
705	6131031	2127272	Actuated	54
706	6130988	2126011	Actuated	54
707	6130878	2125487	Actuated	54
708	6131289	2125283	Actuated	54
711	6130635	2125055	Actuated	54
716	6130871	2124209	Yield	54

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
718	6128472	2121674	Actuated	54
720	6127012	2118909	Actuated	57
721	6122494	2120010	Actuated	56
722	6123486	2119908	Actuated	56
723	6124099	2119630	Actuated	56
728	6124061	2121934	Actuated	53
732	6126867	2117413	Actuated	57
741	6126351	2116310	Actuated	57
742	6125934	2115736	Actuated	56
747	6128458	2116202	Actuated	57
792	6101973	2179108	Actuated	17
793	6101557	2180883	Actuated	17
798	6103333	2178696	Actuated	18
803	6110738	2171430	Actuated	21
804	6110640	2172801	Actuated	21
805	6110950	2174305	Actuated	19
806	6111140	2175860	Actuated	19
807	6109013	2171357	Stop	20
811	6109757	2176068	Actuated	18
812	6108197	2176348	Actuated	18
813	6106163	2177237	Actuated	18
819	6107961	2178837	Actuated	18
822	6110554	2177142	Actuated	19
823	6109581	2177732	Actuated	18
825	6112099	2175722	Actuated	19
826	6113014	2175565	Actuated	19
831	6114633	2175437	Actuated	19
835	6109219	2179424	Actuated	18
836	6110121	2179400	Actuated	18
839	6111905	2179261	Actuated	19
844	6107415	2179921	Actuated	18
845	6106779	2181301	Actuated	18
847	6106244	2182289	Actuated	18
885	6091786	2145508	Actuated	39
886	6091137	2145851	Actuated	39
887	6090664	2146125	Actuated	39
888	6089254	2146729	Actuated	39
889	6089080	2146791	Actuated	39
890	6087855	2147595	Stop	33
892	6092185	2146349	Stop	39
897	6081624	2152528	TCP - Actuated	32
904	6080369	2153514	Actuated	32
905	6078604	2155081	Actuated	24

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
906	6076634	2157863	Actuated	24
909	6080840	2154261	Stop	32
910	6079086	2155790	Stop	32
911	6074727	2159525	Actuated	24
913	6072935	2161032	Actuated	24
914	6071798	2161890	Actuated	24
915	6070663	2162586	Actuated	24
916	6069313	2163494	Actuated	24
919	6076368	2159943	Actuated	24
920	6074461	2159725	Yield	24
926	6068128	2164455	Actuated	24
927	6067817	2165346	Actuated	12
928	6067623	2166108	Actuated	12
929	6067601	2166211	Actuated	12
931	6067244	2167318	Actuated	12
932	6067005	2167549	Yield	12
935	6068433	2164788	Stop	24
939	6067466	2167676	Yield	12
940	6066645	2167875	Actuated	12
941	6065772	2168654	Actuated	12
942	6064909	2169381	Actuated	12
945	6062182	2170516	Actuated	12
951	6061825	2170610	Yield	12
952	6062329	2170757	Yield	12
953	6062745	2171372	Actuated	12
954	6061201	2170730	Actuated	12
986	6077877	2159698	Actuated	24
988	6078910	2164042	Actuated	25
990	6080708	2166822	Actuated	16
991	6081446	2167634	Actuated	16
992	6081897	2168680	Actuated	16
1000	6081917	2171030	Actuated	16
1001	6081904	2171740	Actuated	16
1004	6081054	2174522	Actuated	14
1005	6079876	2175702	Actuated	14
1012	6079189	2176955	Actuated	14
1013	6079022	2177709	Actuated	14
1016	6068684	2165068	Stop	24
1017	6068942	2165347	Stop	12
1018	6069162	2165658	Stop	12
1022	6070869	2166725	Stop	15
1024	6071589	2168425	Actuated	15
1026	6074358	2168377	Actuated	15

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
1028	6078649	2168034	Actuated	15
1029	6080764	2168759	Actuated	16
1033	6070275	2169278	Actuated	12
1034	6069886	2170103	Actuated	12
1037	6069408	2171050	Actuated	12
1038	6068353	2172239	Actuated	12
1039	6066965	2174013	Actuated	12
1041	6065758	2174993	Actuated	12
1046	6066136	2175471	Yield	12
1047	6074039	2173286	Actuated	15
1049	6075009	2171325	Stop	15
1052	6074587	2174901	Actuated	13
1054	6074833	2175560	Yield	13
1055	6074769	2176052	Actuated	13
1056	6074499	2175433	Stop	13
1059	6076144	2176361	Actuated	13
1060	6076749	2176658	Actuated	13
1063	6077683	2177313	Actuated	13
1065	6080512	2177831	Actuated	14
1066	6081633	2178105	Actuated	14
1068	6083302	2180971	Actuated	14
1069	6082524	2183757	Actuated	9
1071	6080700	2179798	Actuated	14
1073	6084378	2183525	Actuated	9
1074	6080821	2183392	Actuated	9
1075	6080139	2183199	Actuated	14
1076	6079214	2182987	Actuated	14
1077	6078448	2183167	Actuated	13
1078	6077272	2184193	Actuated	8
1079	6076417	2185633	Actuated	8
1088	6081885	2185106	Actuated	9
1089	6081601	2186435	Actuated	9
1090	6081640	2188171	Actuated	9
1091	6082042	2189496	Actuated	9
1094	6083522	2186352	Actuated	9
1095	6085760	2186576	Actuated	9
1097	6087760	2186730	Actuated	10
1098	6089582	2186753	Stop	10
1100	6091192	2187960	Actuated	10
1106	6088133	2186124	Stop	10
1109	6075755	2184932	Actuated	8
1110	6073758	2184113	Actuated	8
1111	6072159	2184012	Actuated	8

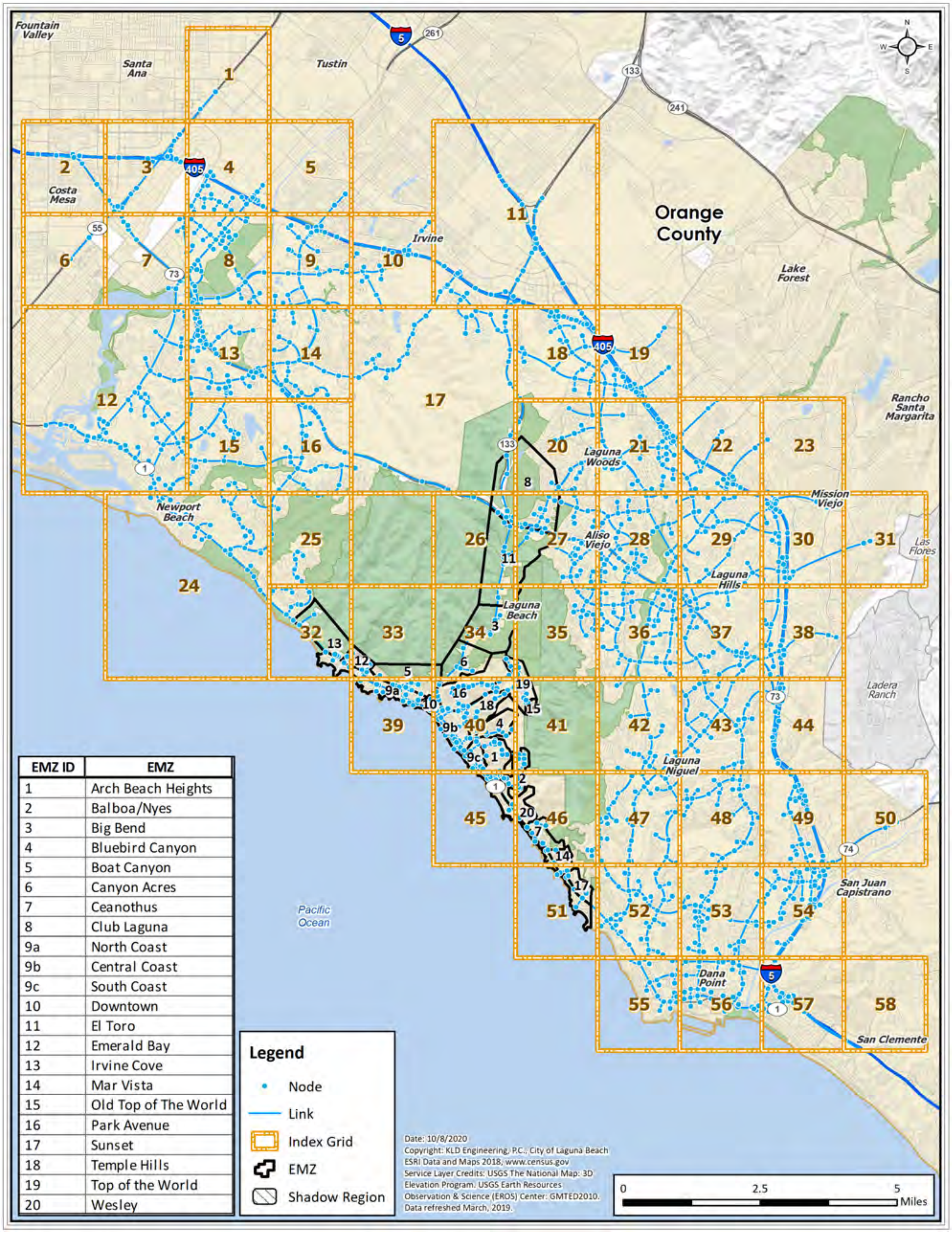
Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
1112	6071455	2183936	Actuated	8
1113	6071099	2183760	Actuated	8
1114	6070297	2183182	Actuated	12
1115	6069668	2182880	Actuated	12
1119	6074488	2188928	Actuated	8
1120	6073572	2189724	Actuated	8
1128	6074472	2190799	Actuated	8
1129	6075590	2192103	Actuated	8
1130	6076527	2193160	Actuated	4
1133	6073037	2189114	Actuated	8
1134	6071842	2187727	Actuated	8
1135	6071507	2187315	Actuated	8
1137	6070988	2186719	Actuated	8
1139	6076449	2191485	Yield	8
1140	6075071	2192557	Actuated	4
1143	6074516	2192986	Actuated	4
1144	6073894	2193390	Actuated	4
1145	6073145	2193712	Actuated	4
1146	6072488	2193666	Actuated	4
1147	6071785	2193988	Actuated	4
1152	6073029	2190211	Actuated	8
1153	6072067	2191052	Actuated	8
1154	6071206	2191699	Actuated	8
1161	6069711	2185010	Actuated	7
1162	6070106	2185749	Actuated	7
1170	6071326	2185434	Actuated	8
1173	6070710	2188472	Actuated	7
1174	6070472	2190910	Actuated	7
1178	6071218	2192995	Actuated	4
1179	6072320	2194915	Actuated	4
1184	6071051	2179359	Actuated	13
1189	6071836	2179280	Actuated	13
1190	6072426	2179324	Actuated	13
1191	6073025	2179562	Actuated	13
1197	6070761	2178030	Actuated	12
1198	6070766	2176712	Yield	12
1199	6070830	2176413	Actuated	13
1203	6073137	2175996	Actuated	13
1208	6070506	2170301	Actuated	12
1209	6072510	2171201	Actuated	15
1213	6068511	2169935	Actuated	12
1215	6063133	2171915	Actuated	12
1216	6065112	2174259	Actuated	12

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
1217	6067238	2177081	Actuated	12
1218	6068694	2180013	Actuated	12
1225	6070223	2179432	Actuated	12
1236	6082776	2190407	Actuated	9
1267	6077248	2193952	Actuated	4
1274	6102065	2148522	Stop	34
1276	6102318	2148122	Stop	34
1277	6102710	2147766	Stop	35
1279	6103118	2146400	Stop	41
1282	6102344	2146497	Stop	40
1293	6098613	2142796	Stop	40
1303	6097860	2144653	Stop	40
1304	6097445	2144473	Yield	40
1307	6097576	2143001	Stop	40
1309	6101204	2142200	Stop	40
1310	6099702	2141939	Stop	40
1311	6098725	2141527	Stop	40
1313	6098125	2141554	Stop	40
1314	6097206	2141095	Stop	40
1315	6097056	2142680	Stop	40
1317	6099761	2146731	Stop	40
1319	6099248	2146926	Stop	40
1320	6098377	2146674	Stop	40
1329	6099495	2140812	Stop	40
1332	6098146	2140326	Stop	40
1333	6097917	2140065	Stop	40
1334	6095307	2143599	Stop	40
1335	6095459	2144252	Stop	40
1336	6095081	2145326	Stop	40
1340	6101195	2140461	Stop	40
1344	6103307	2139574	Stop	41
1345	6103307	2139114	Stop	41
1346	6102868	2138446	Stop	41
1347	6103009	2137106	Stop	46
1365	6100851	2136785	Stop	45
1369	6088126	2147989	Stop	33
1371	6085931	2148863	Stop	32
1372	6086242	2149482	Stop	32
1375	6099079	2139368	Stop	40
1376	6098842	2139148	Stop	40
1377	6091671	2146613	Stop	39
1378	6091284	2146524	Stop	39
1381	6091899	2145775	Stop	39

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
1382	6093089	2145273	Stop	39
1383	6104549	2133395	Stop	46
1387	6094843	2144253	Stop	40
1389	6096980	2140916	Stop	40
1391	6094849	2146075	Yield	40
1407	6085261	2149339	Stop	32
1409	6096020	2144249	Stop	40
1414	6098590	2142573	Stop	40
1416	6099984	2137477	Stop	45
1418	6102827	2139979	Stop	41
1420	6098106	2151336	Stop	34
1421	6103501	2145267	Stop	41
1422	6107394	2128182	Actuated	51
1425	6100317	2137137	Stop	45
1427	6099804	2137666	Stop	45
1429	6098832	2139633	Stop	40
1433	6105276	2163650	Stop	27
1435	6084968	2149265	Stop	32
1437	6085226	2149589	Stop	32
1440	6089232	2147396	Stop	33
1444	6094797	2144837	Stop	40
1448	6071467	2167824	Stop	15
1452	6075117	2189723	Stop	8
1456	6074148	2190352	Stop	8
1457	6074045	2189341	Stop	8
1461	6098644	2182872	Actuated	17
1463	6097463	2184211	Actuated	11
1466	6098282	2182416	Stop	17
1469	6097708	2182234	Stop	17
1476	6095866	2185167	Yield	11
1480	6124227	2118933	Stop	56
1482	6125716	2123845	Stop	53
1483	6126943	2123813	Stop	54
1488	6128043	2124701	Stop	54
1493	6115420	2123389	Stop	52
1495	6112470	2122693	Stop	52
1498	6120180	2123497	Stop	53
1499	6120194	2124262	Stop	53
1501	6120201	2123890	Stop	53
1505	6113445	2129721	Stop	47
1507	6110717	2131908	Stop	47
1512	6109875	2130779	Stop	46
1517	6116641	2165968	Stop	21

Node	X Coordinate (ft)	Y Coordinate (ft)	Control Type	Grid Map Number
1524	6115011	2158953	Stop	28
1532	6108042	2159442	Stop	27
1536	6108286	2159951	Stop	27
1541	6109549	2153718	Stop	35
1542	6109968	2153525	Stop	35
1544	6108105	2153783	Stop	35
1547	6109884	2152167	Stop	35
1554	6121150	2149486	Stop	37
1577	6119033	2135734	Stop	48
1584	6074985	2181295	Stop	13
1587	6080350	2176148	Actuated	14
1595	6092582	2180629	Stop	17
1597	6092021	2178683	Stop	17
1600	6090164	2177107	Stop	17
1601	6088978	2177344	Stop	17
1606	6088721	2178205	Stop	17
1618	6120717	2147982	Stop	37
1621	6120214	2121633	Stop	53
1628	6098862	2152003	Stop	34
1630	6100048	2151780	Stop	34
1634	6094689	2144627	Stop	40
1635	6096251	2142237	Stop	40
1636	6096435	2141833	Stop	40
1637	6096624	2141503	Stop	40
1638	6096785	2141207	Stop	40
1639	6097199	2140694	Stop	40
1640	6097522	2140402	Stop	40
1641	6099086	2138916	Stop	40
1642	6099345	2138638	Stop	40
1643	6099800	2138145	Stop	45
1653	6081472	2154512	Stop	32
1664	6079663	2156315	Stop	25
1666	6075775	2165397	Stop	15
1671	6075043	2164238	Stop	24
1673	6075775	2162739	Actuated	24
1675	6076859	2161562	Actuated	24
1682	6085711	2167949	Stop	16
1688	6090593	2145929	Stop	39
1694	6088114	2148465	Stop	33

[1]Coordinates are in the North American Datum of 1983 California State Plane Zone 6



EMZ ID	EMZ
1	Arch Beach Heights
2	Balboa/Nyes
3	Big Bend
4	Bluebird Canyon
5	Boat Canyon
6	Canyon Acres
7	Ceanothus
8	Club Laguna
9a	North Coast
9b	Central Coast
9c	South Coast
10	Downtown
11	El Toro
12	Emerald Bay
13	Irvine Cove
14	Mar Vista
15	Old Top of The World
16	Park Avenue
17	Sunset
18	Temple Hills
19	Top of the World
20	Wesley

Figure H-1. Wildfire Egress Study Link-Node Analysis Network

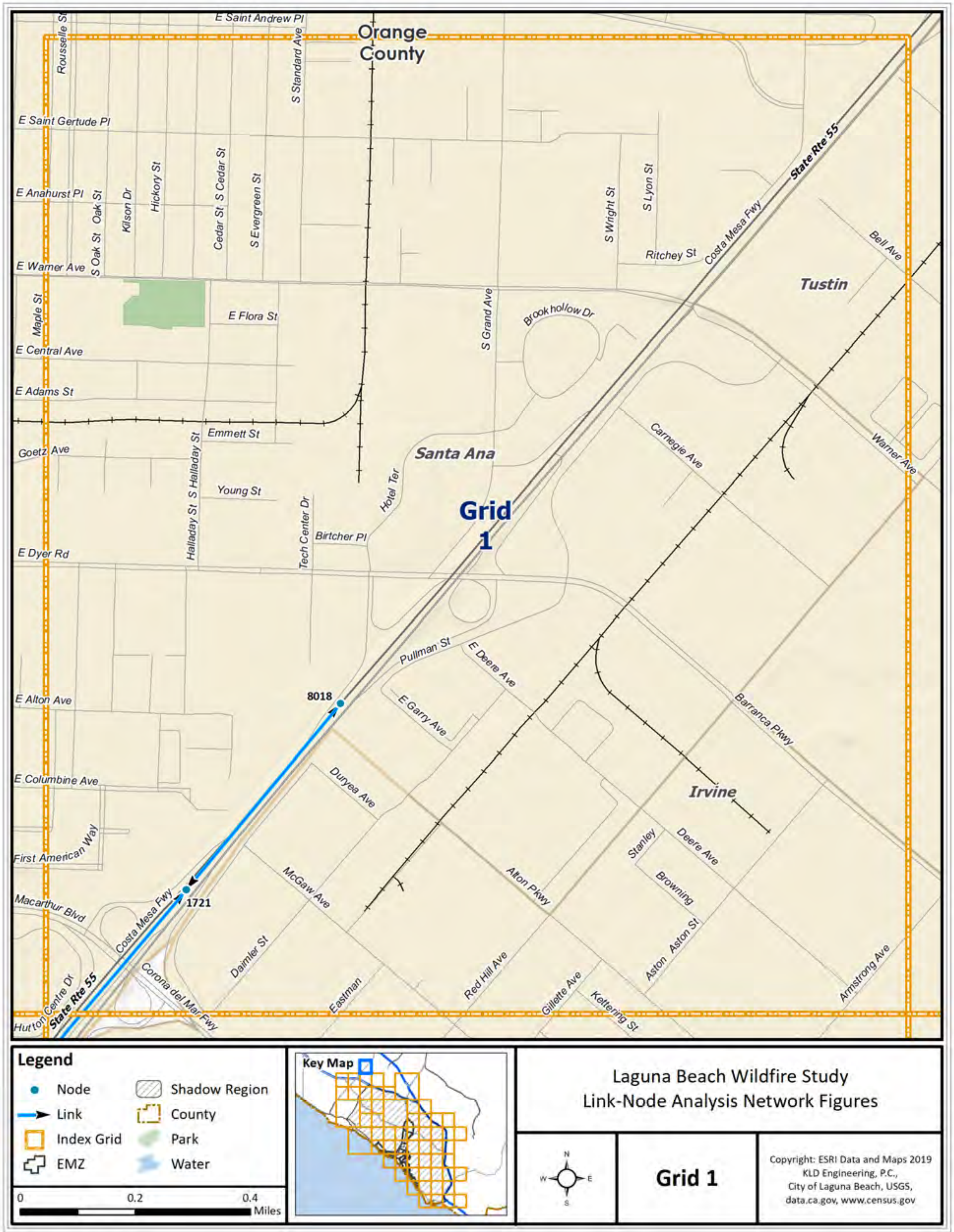


Figure H-2. Link-Node Analysis Network – Grid 1

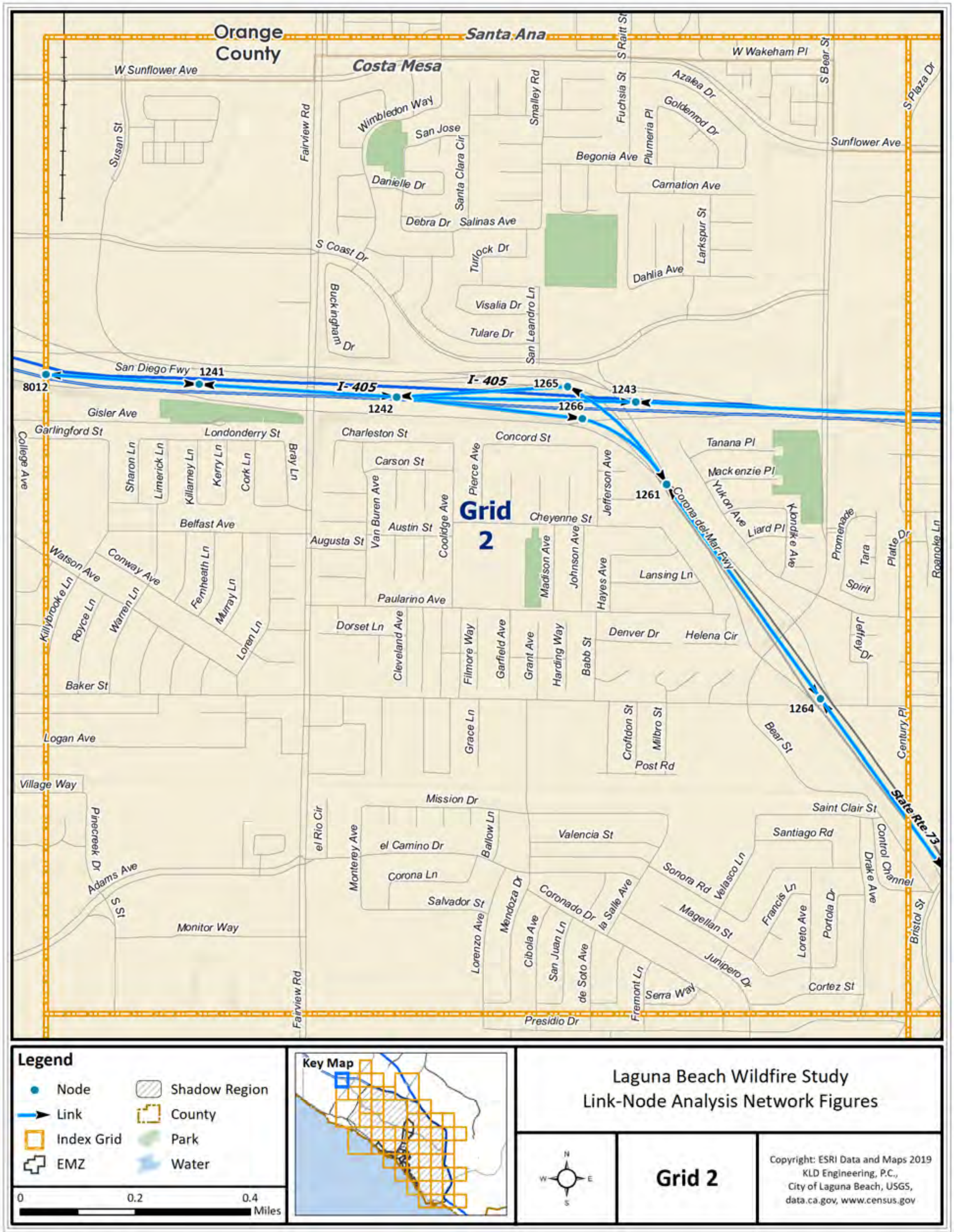


Figure H-3. Link-Node Analysis Network – Grid 2

Figure H-4. Link-Node Analysis Network – Grid 3

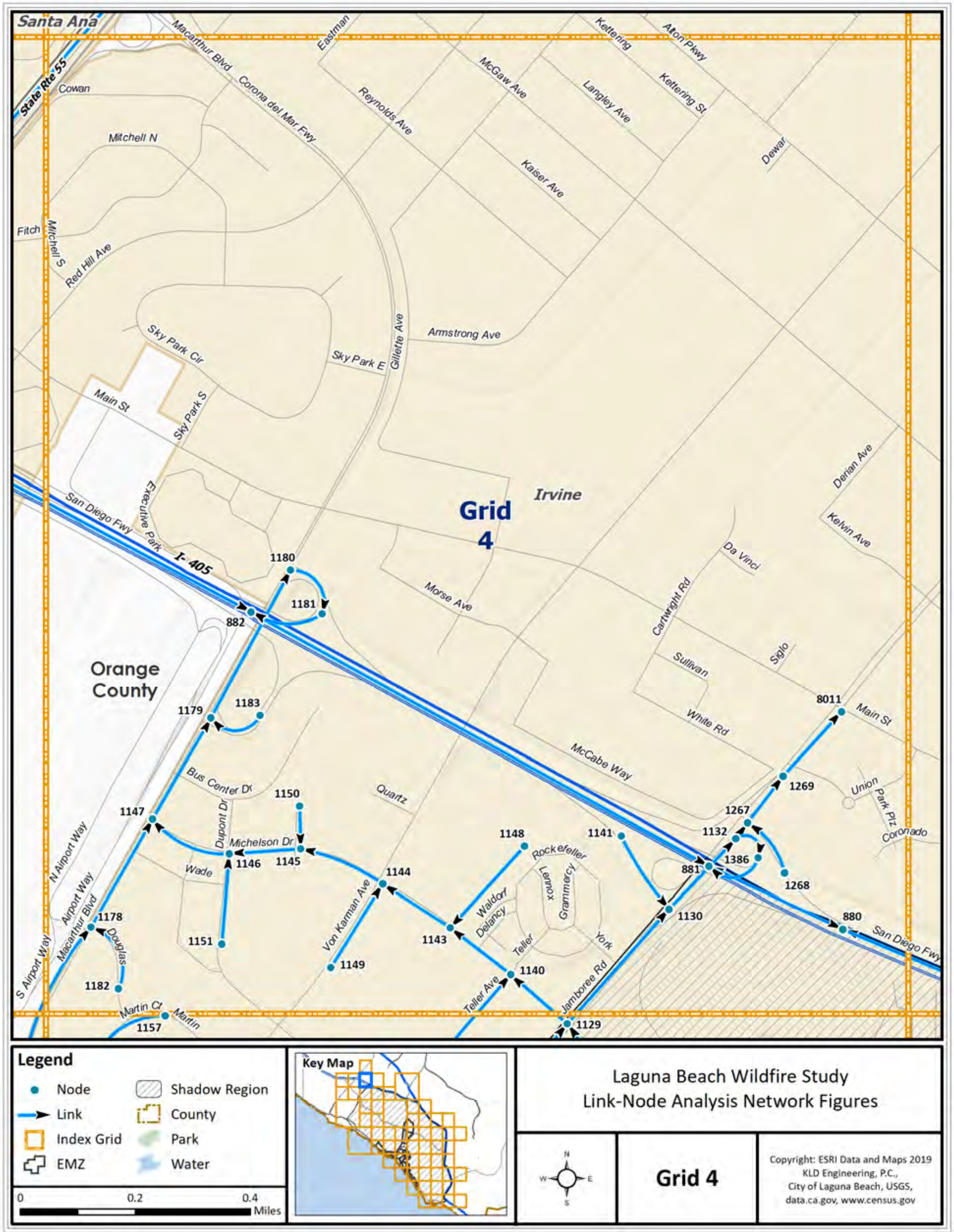


Figure H-5. Link-Node Analysis Network – Grid 4

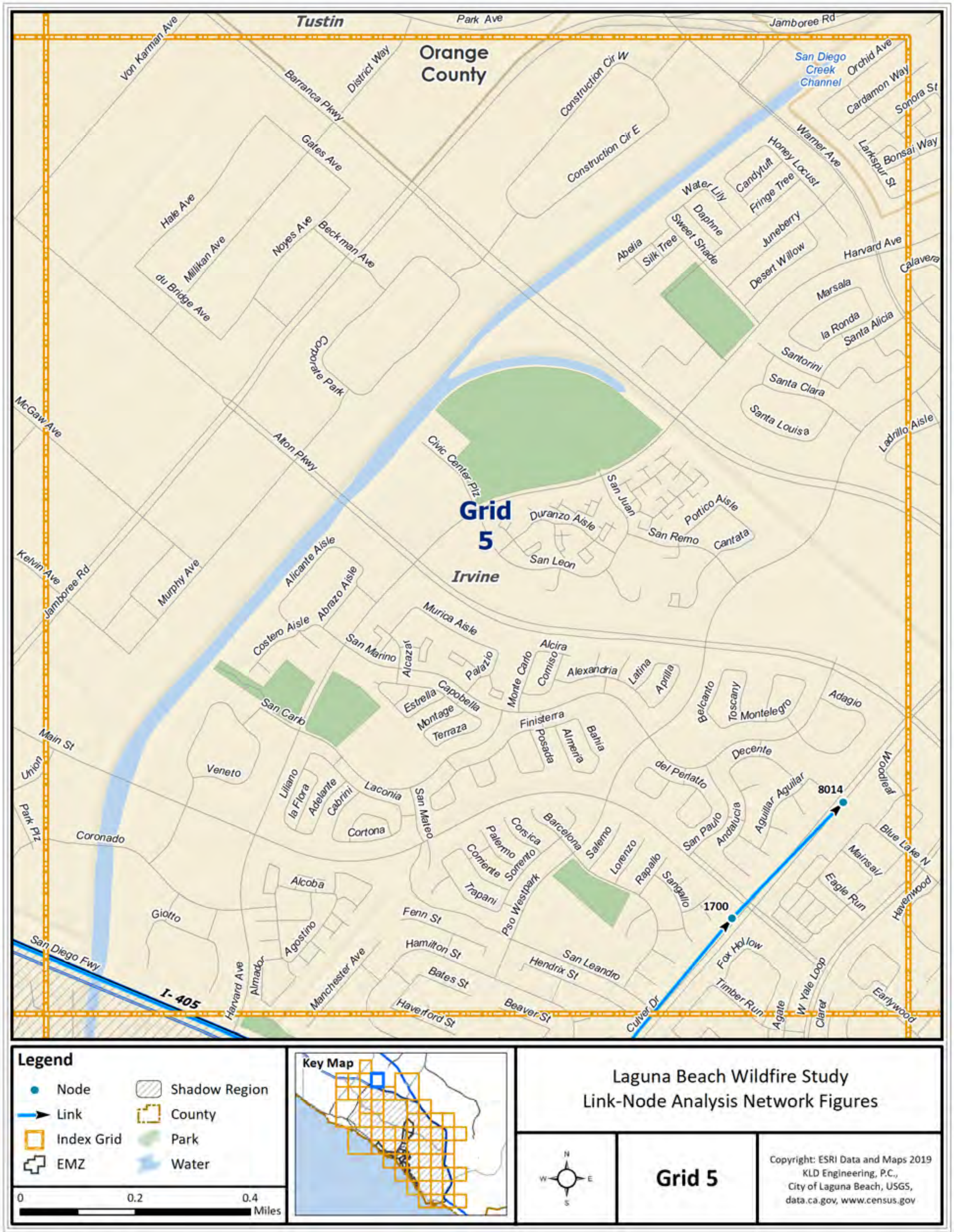


Figure H-6. Link-Node Analysis Network – Grid 5

Figure H-7. Link-Node Analysis Network – Grid 6

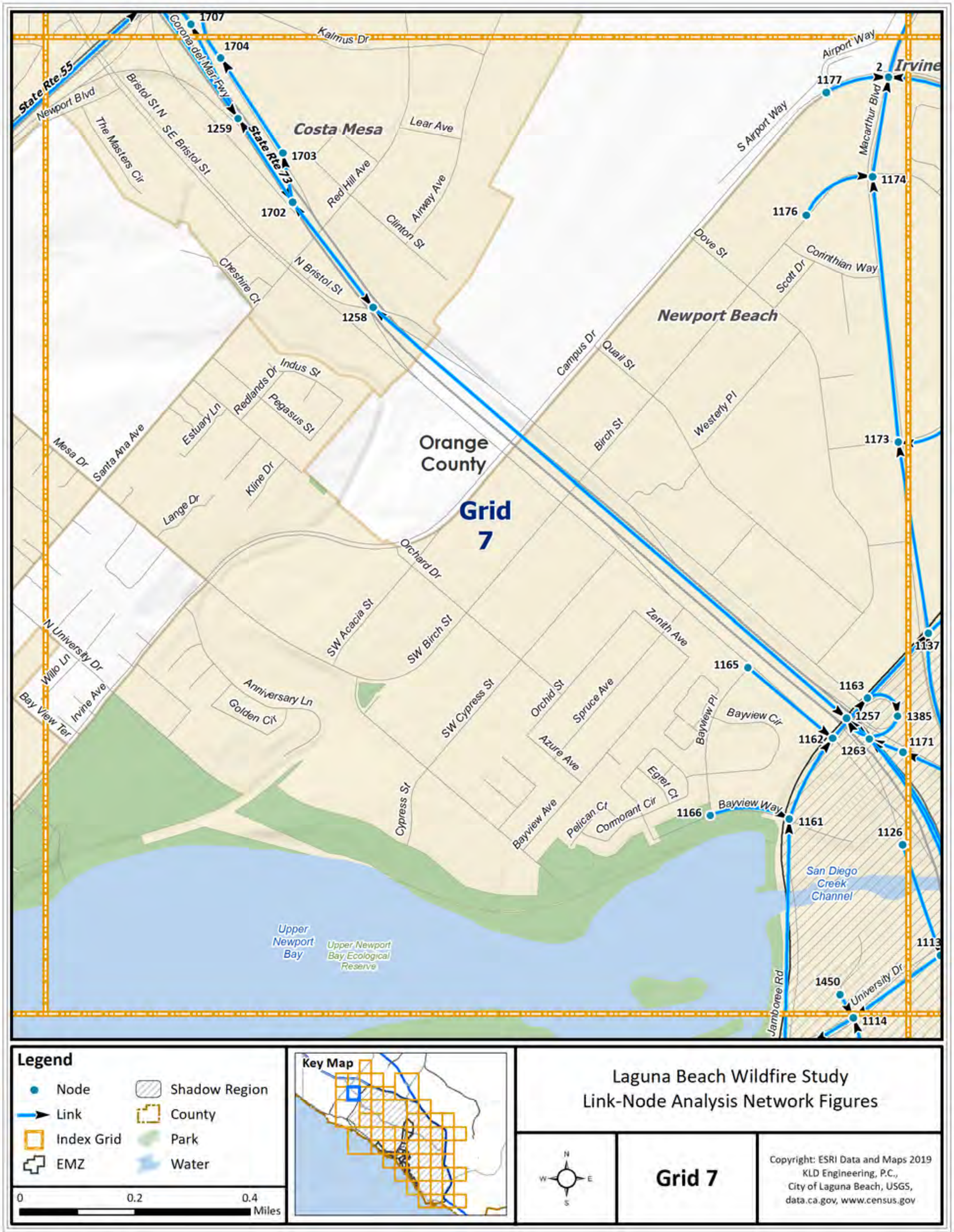


Figure H-8. Link-Node Analysis Network – Grid 7

Figure H-9. Link-Node Analysis Network – Grid 8

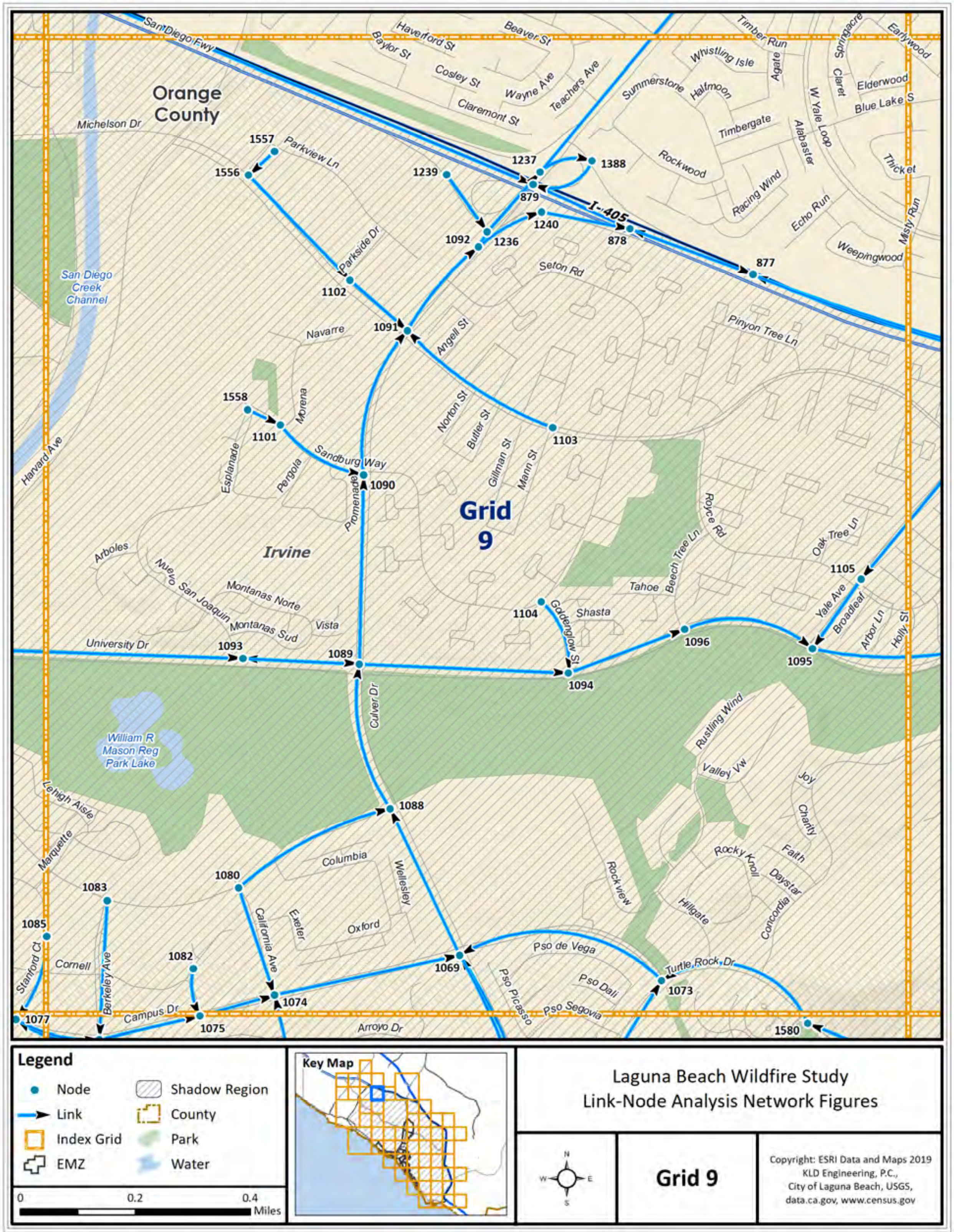


Figure H-10. Link-Node Analysis Network – Grid 9

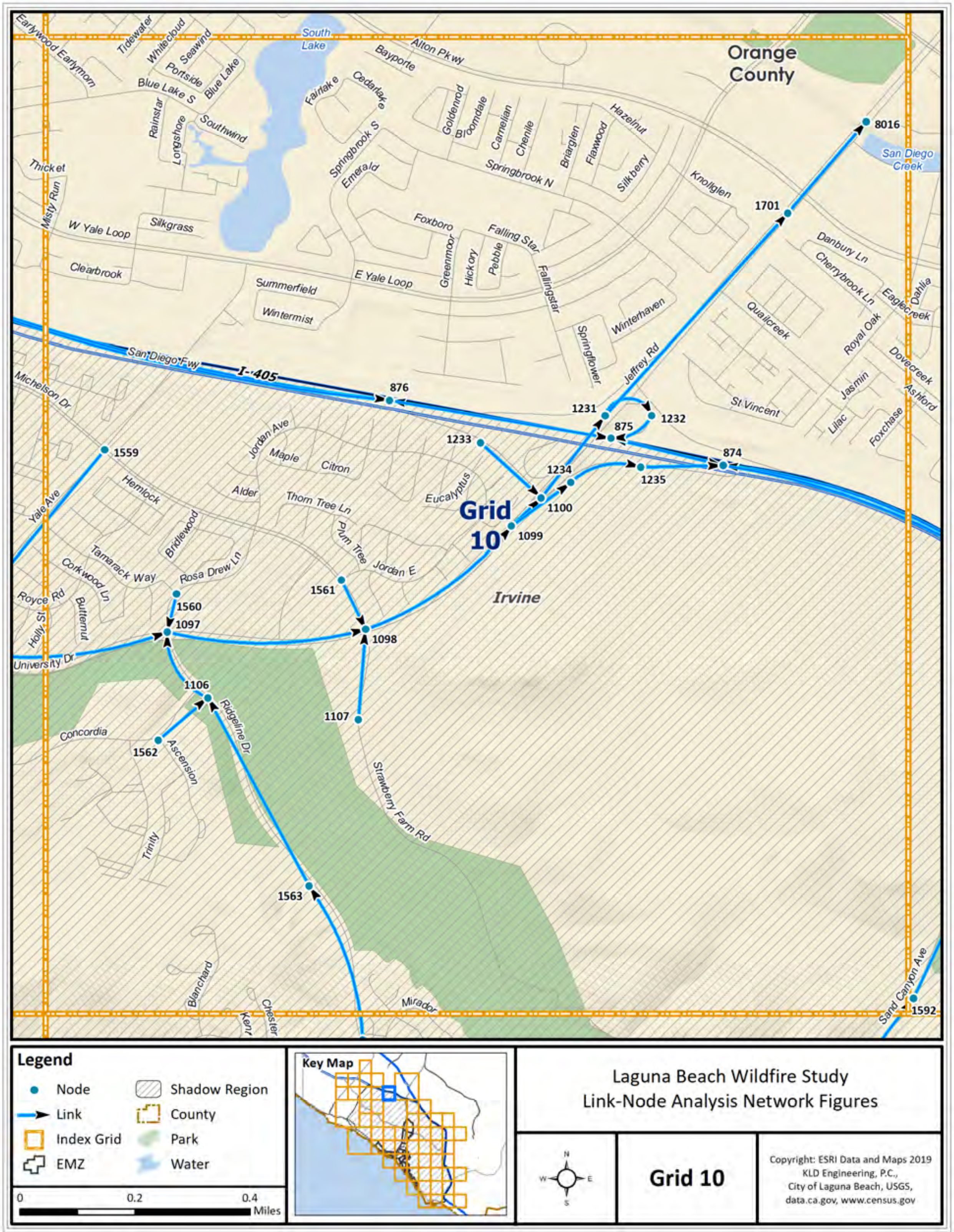


Figure H-11. Link-Node Analysis Network – Grid 10

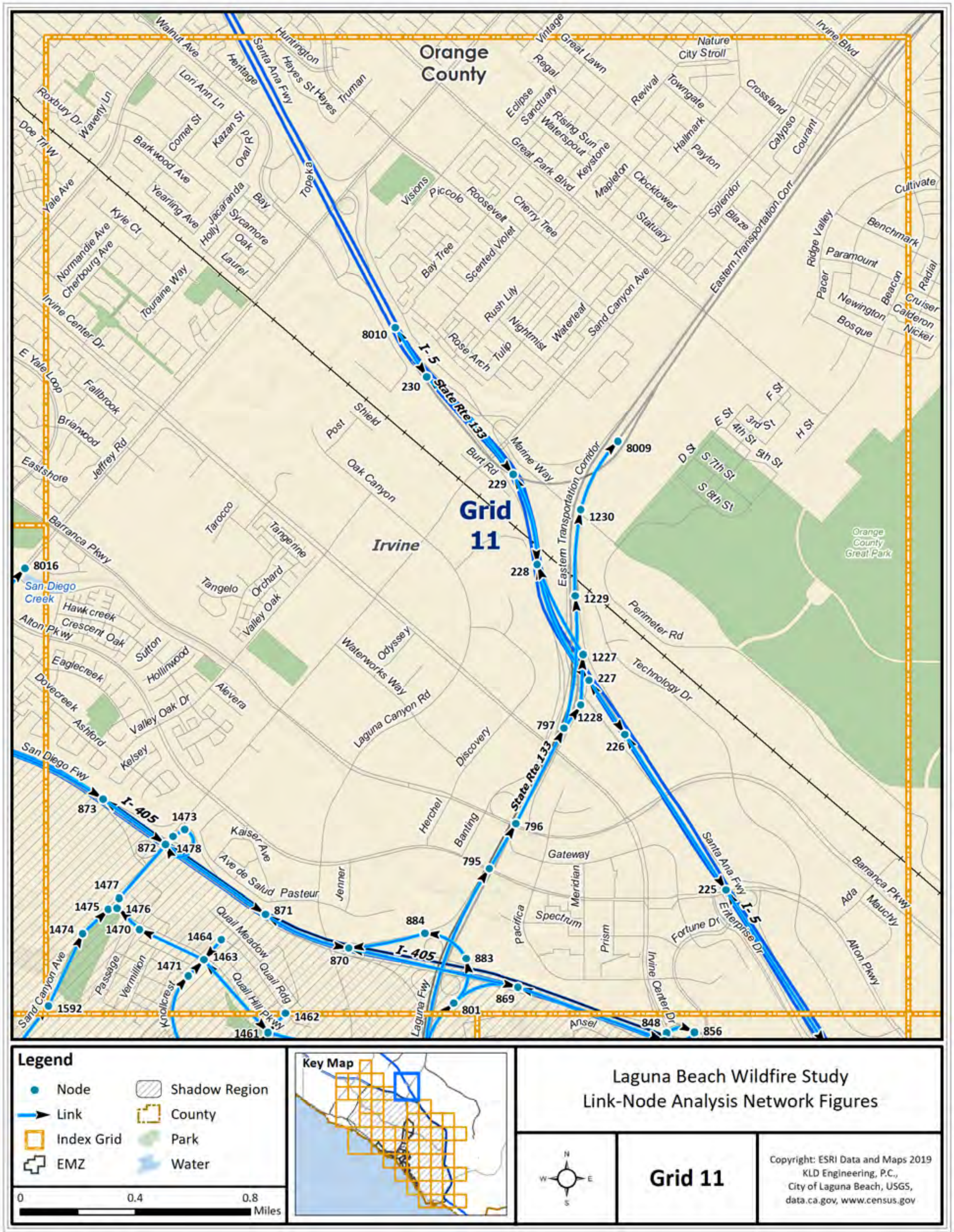


Figure H-12. Link-Node Analysis Network – Grid 11

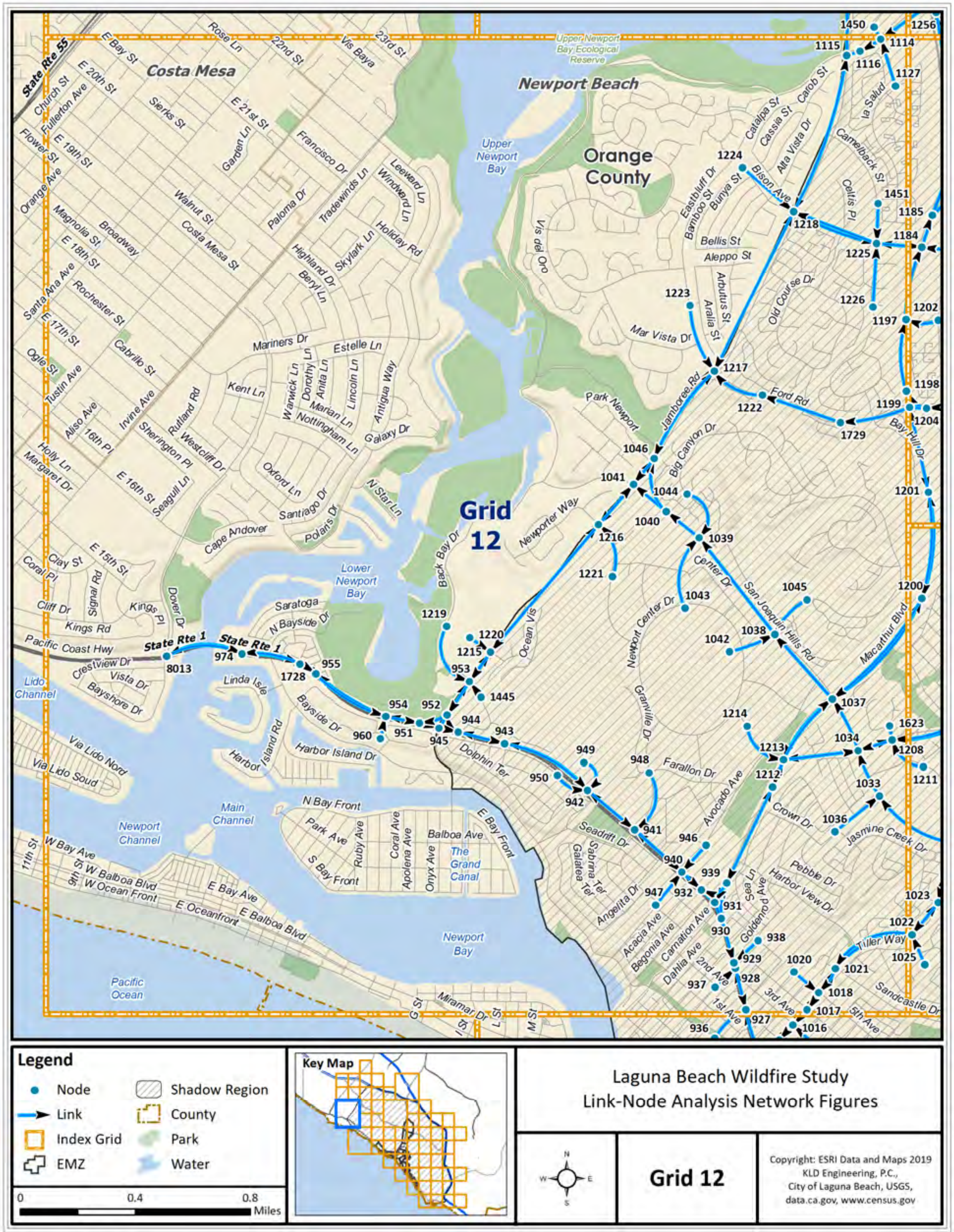


Figure H-13. Link-Node Analysis Network – Grid 12

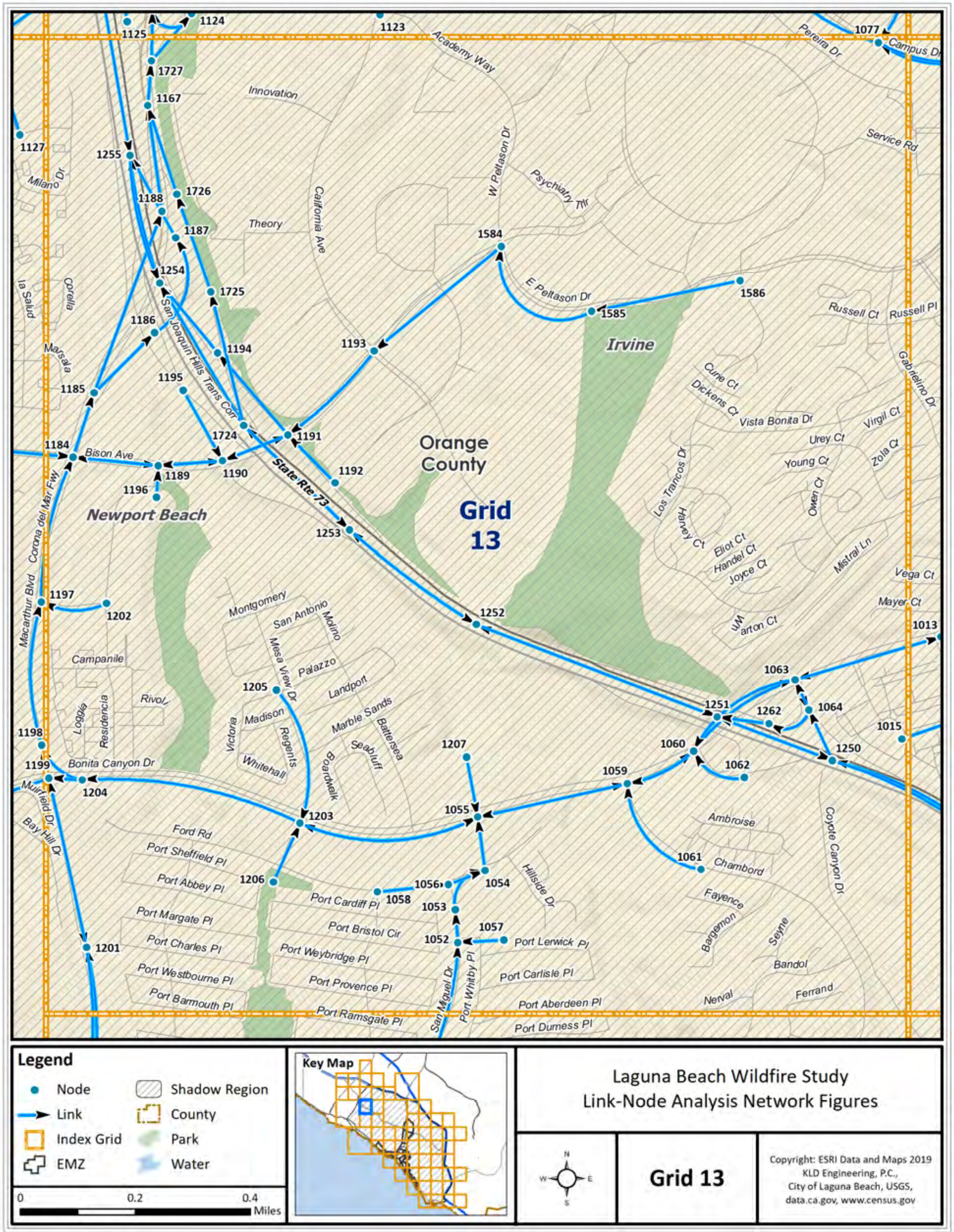


Figure H-14. Link-Node Analysis Network – Grid 13

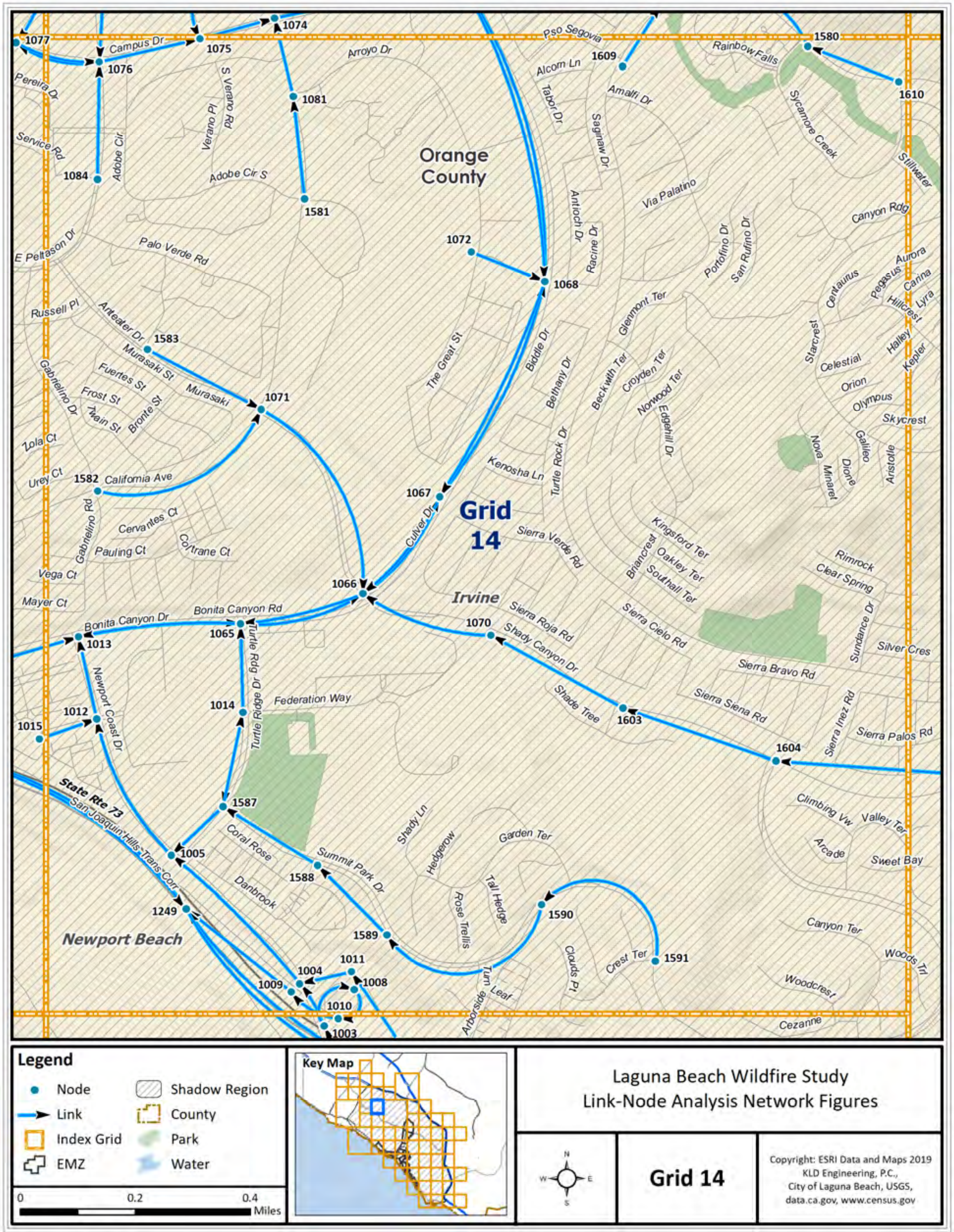


Figure H-15. Link-Node Analysis Network – Grid 14

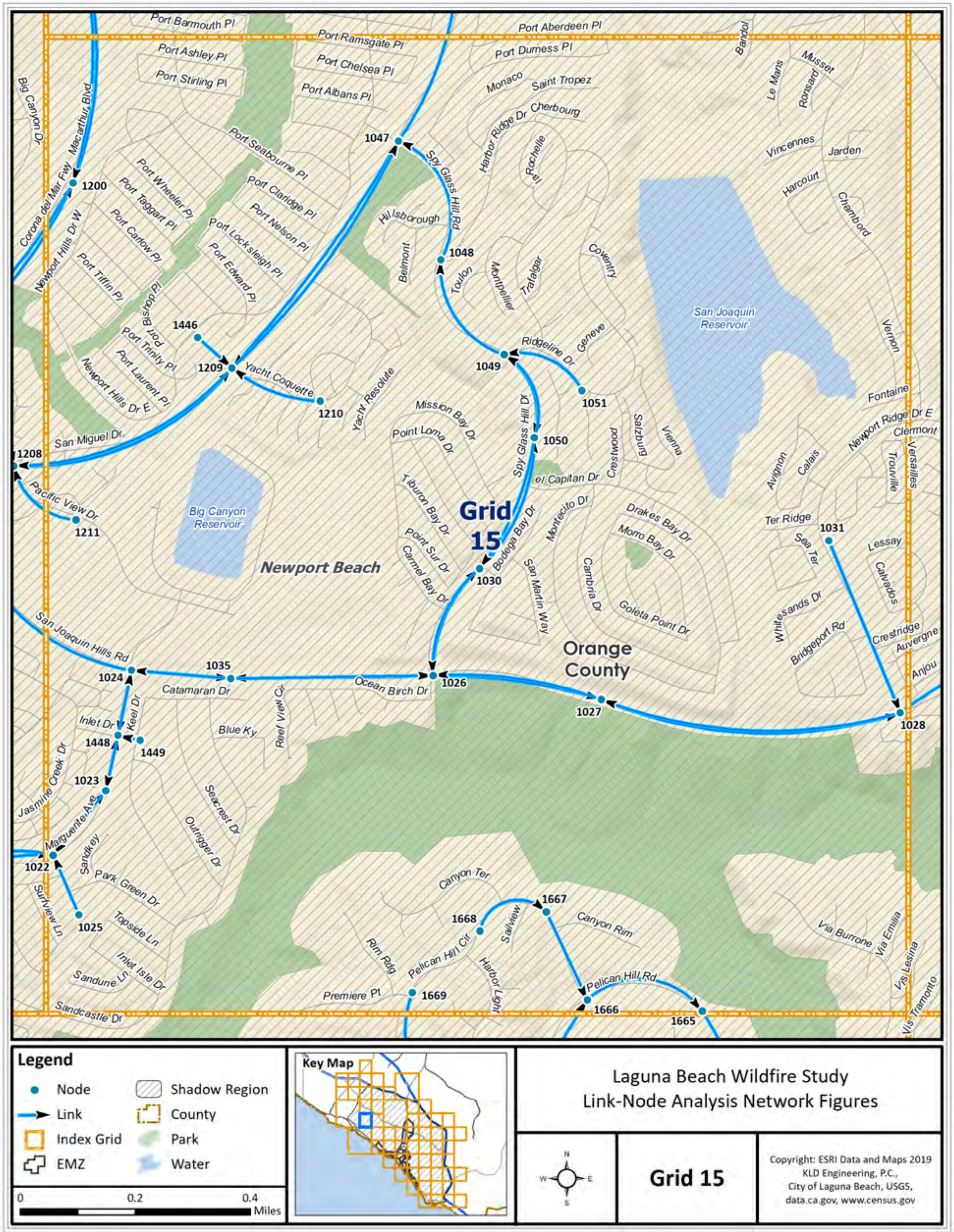


Figure H-16. Link-Node Analysis Network – Grid 15

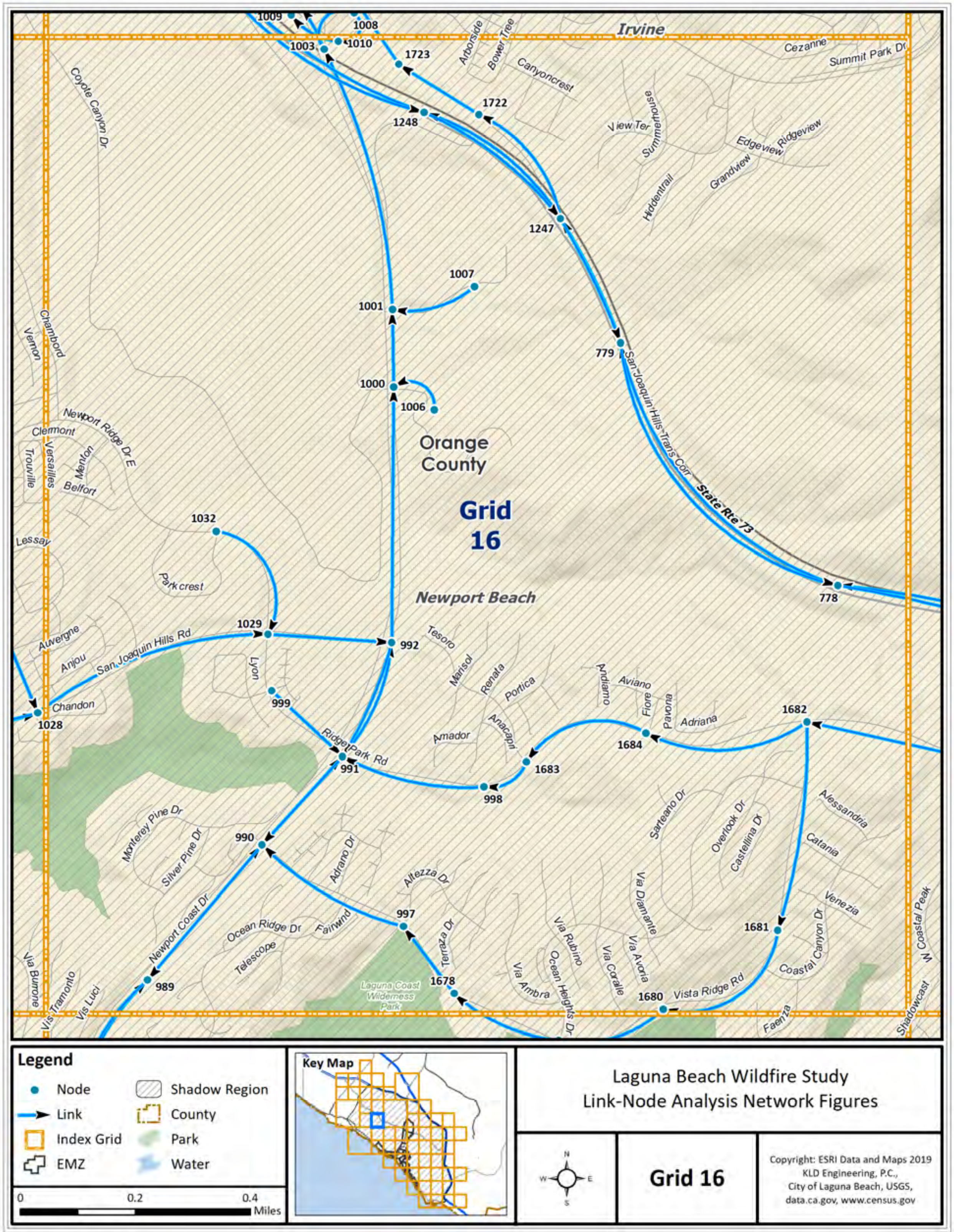


Figure H-17. Link-Node Analysis Network – Grid 16

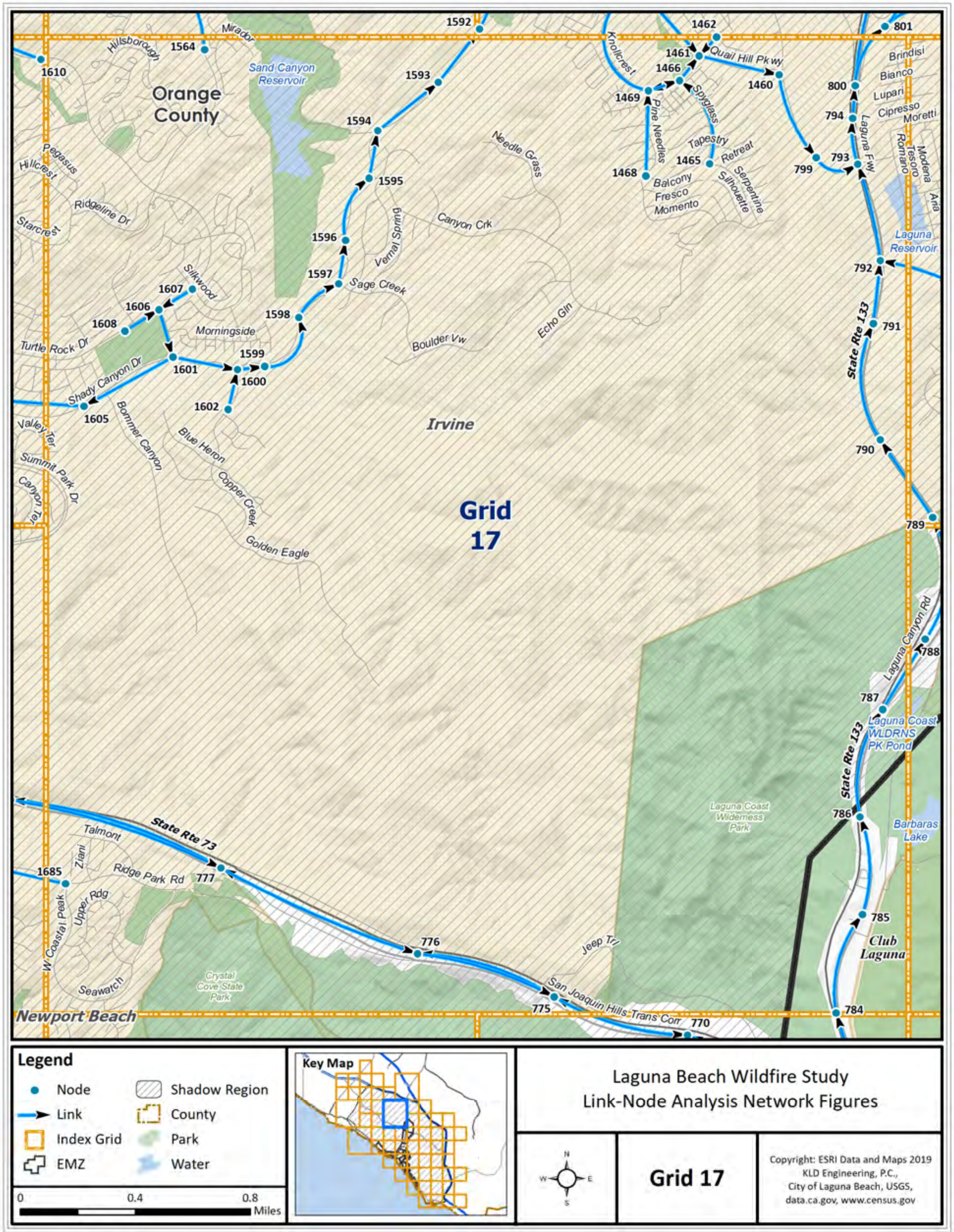


Figure H-18. Link-Node Analysis Network – Grid 17

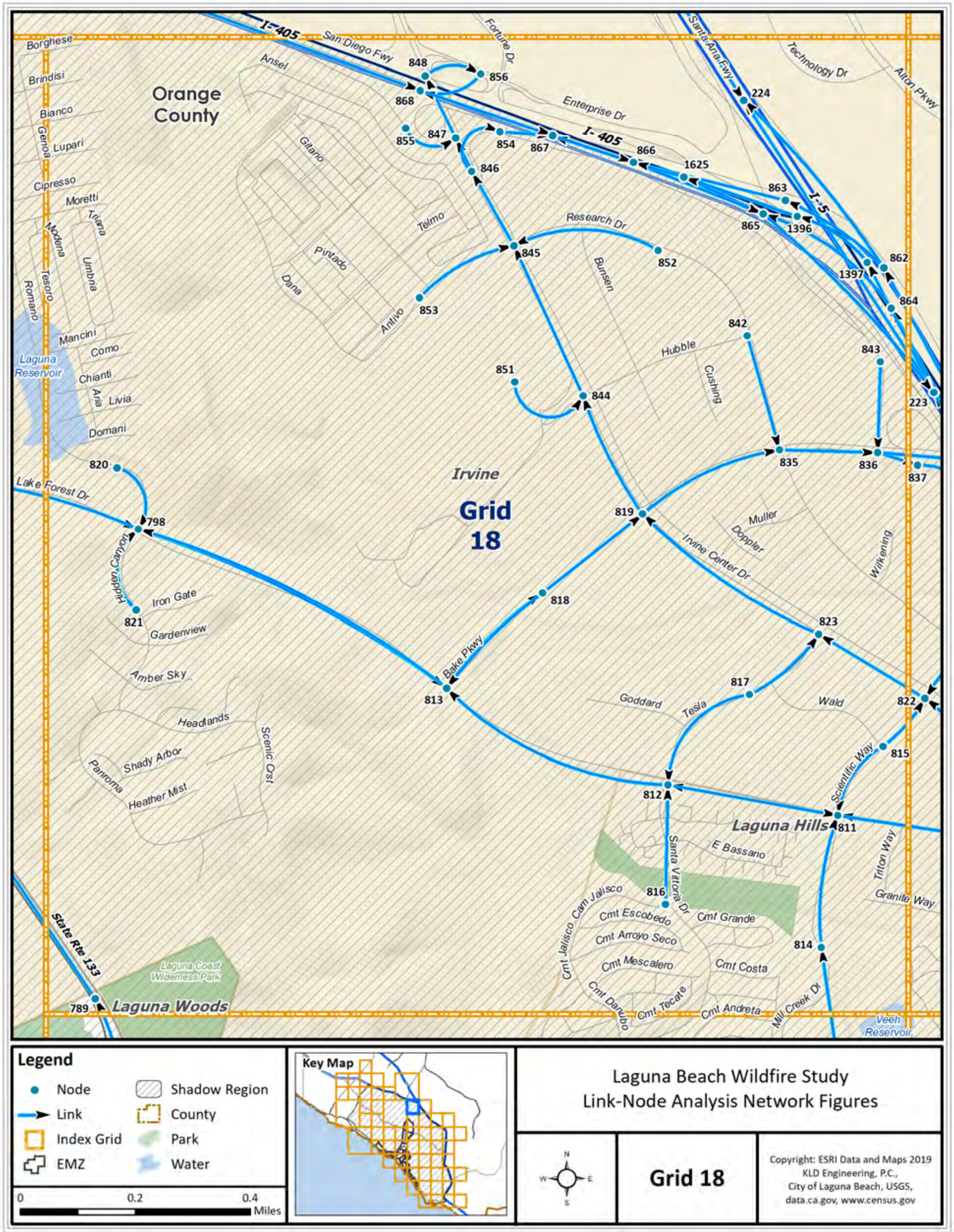


Figure H-19. Link-Node Analysis Network – Grid 18

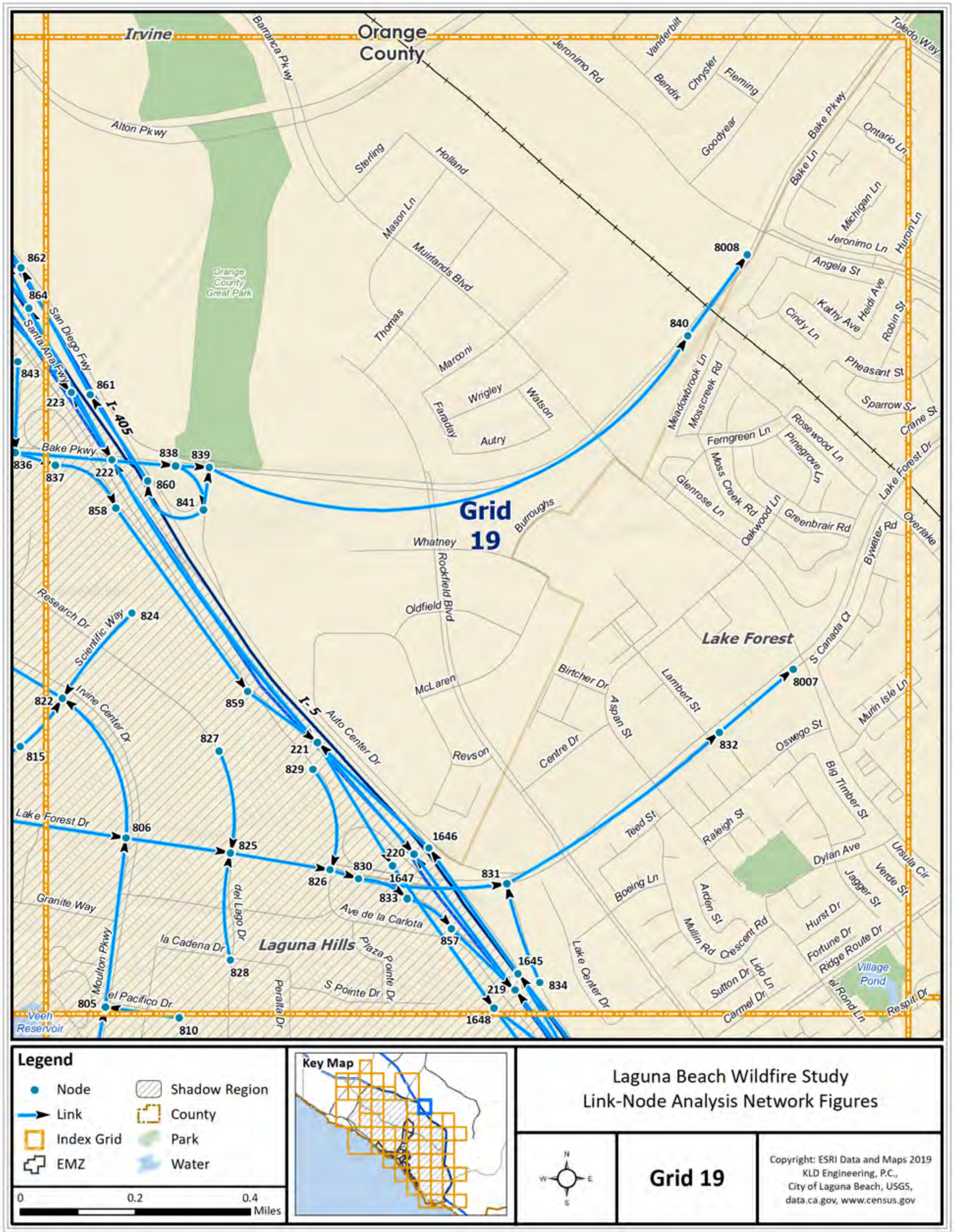


Figure H-20. Link-Node Analysis Network – Grid 19

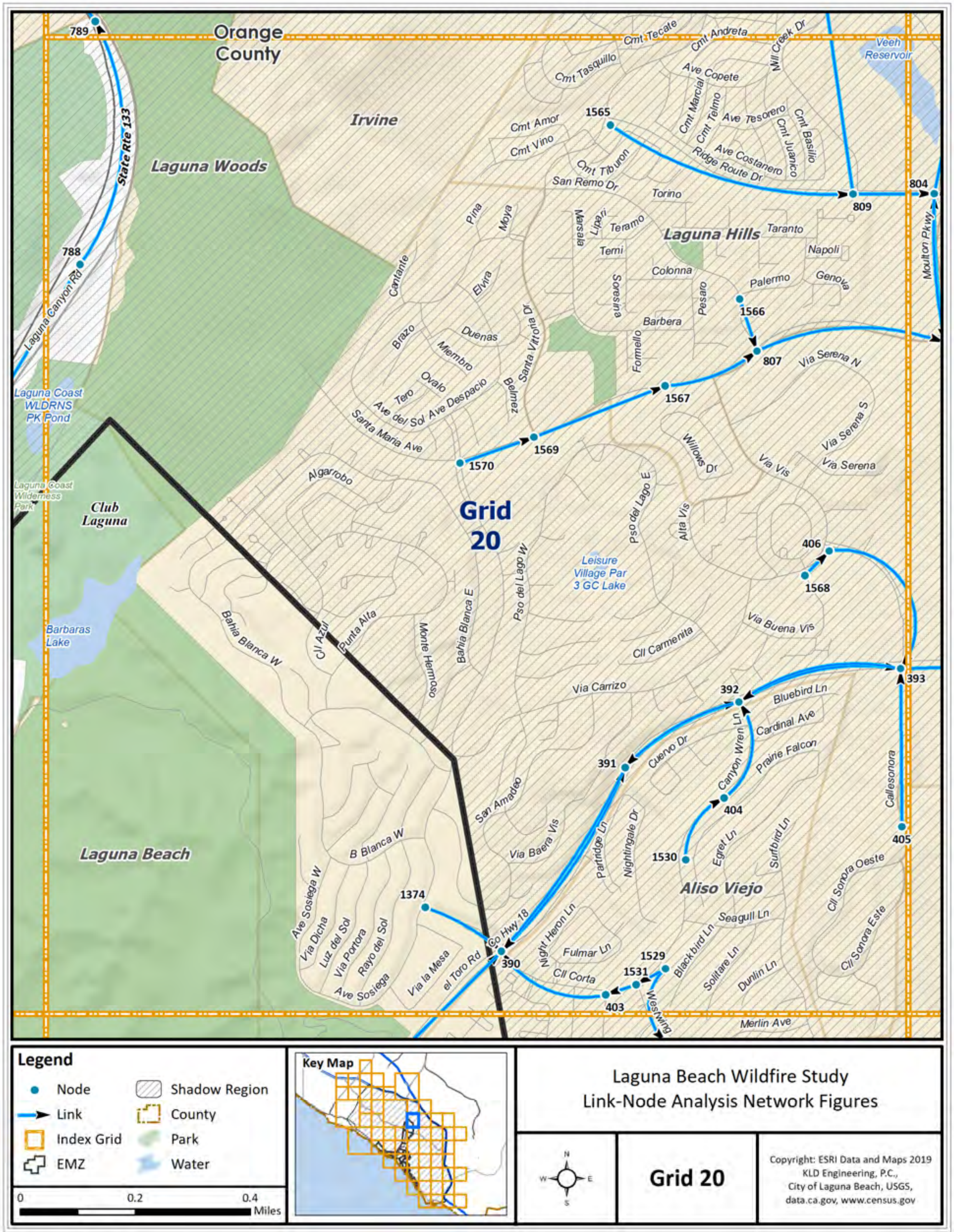


Figure H-21. Link-Node Analysis Network – Grid 20

Figure H-22. Link-Node Analysis Network – Grid 21

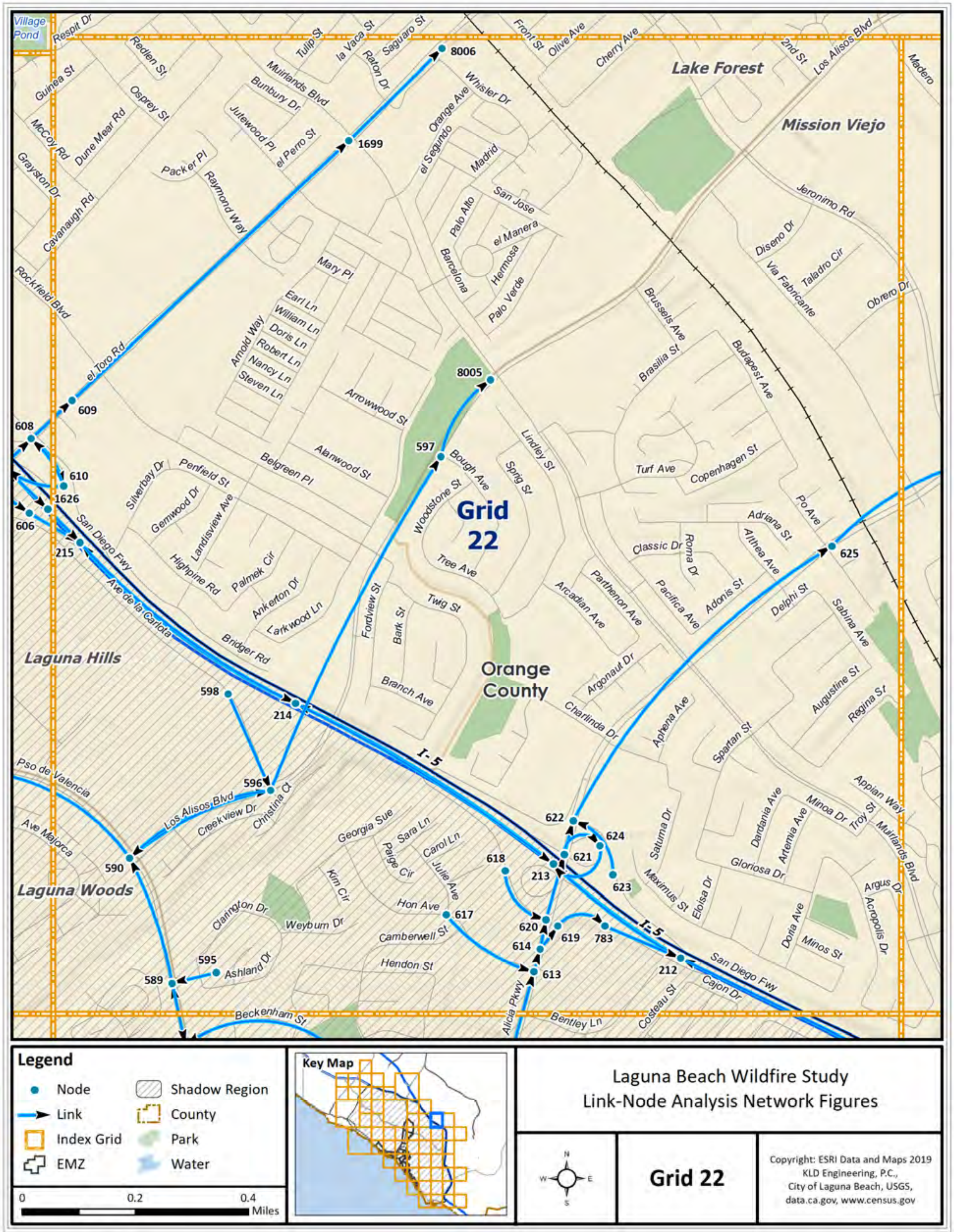


Figure H-23. Link-Node Analysis Network – Grid 22

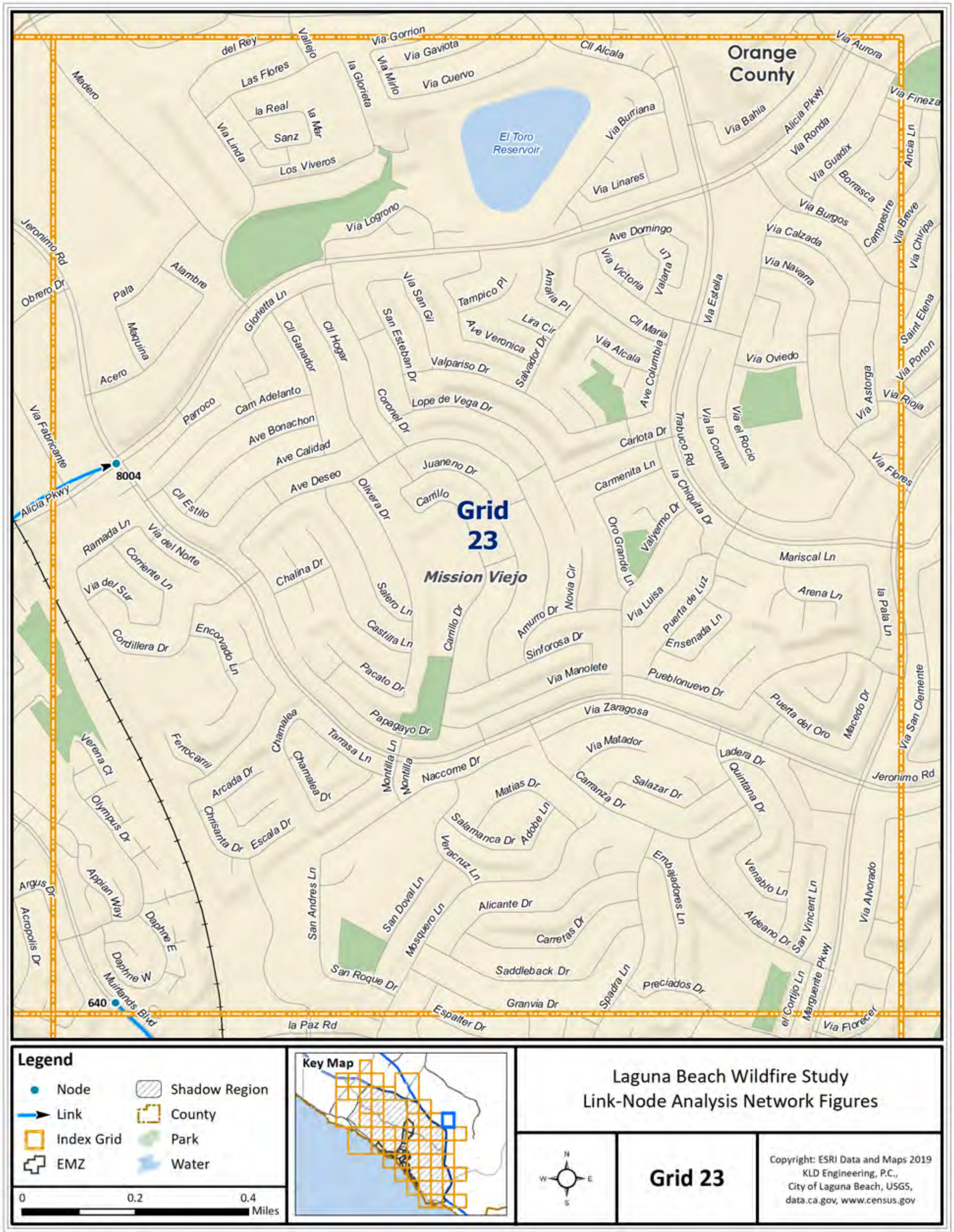


Figure H-24. Link-Node Analysis Network – Grid 23

Figure H-25. Link-Node Analysis Network – Grid 24

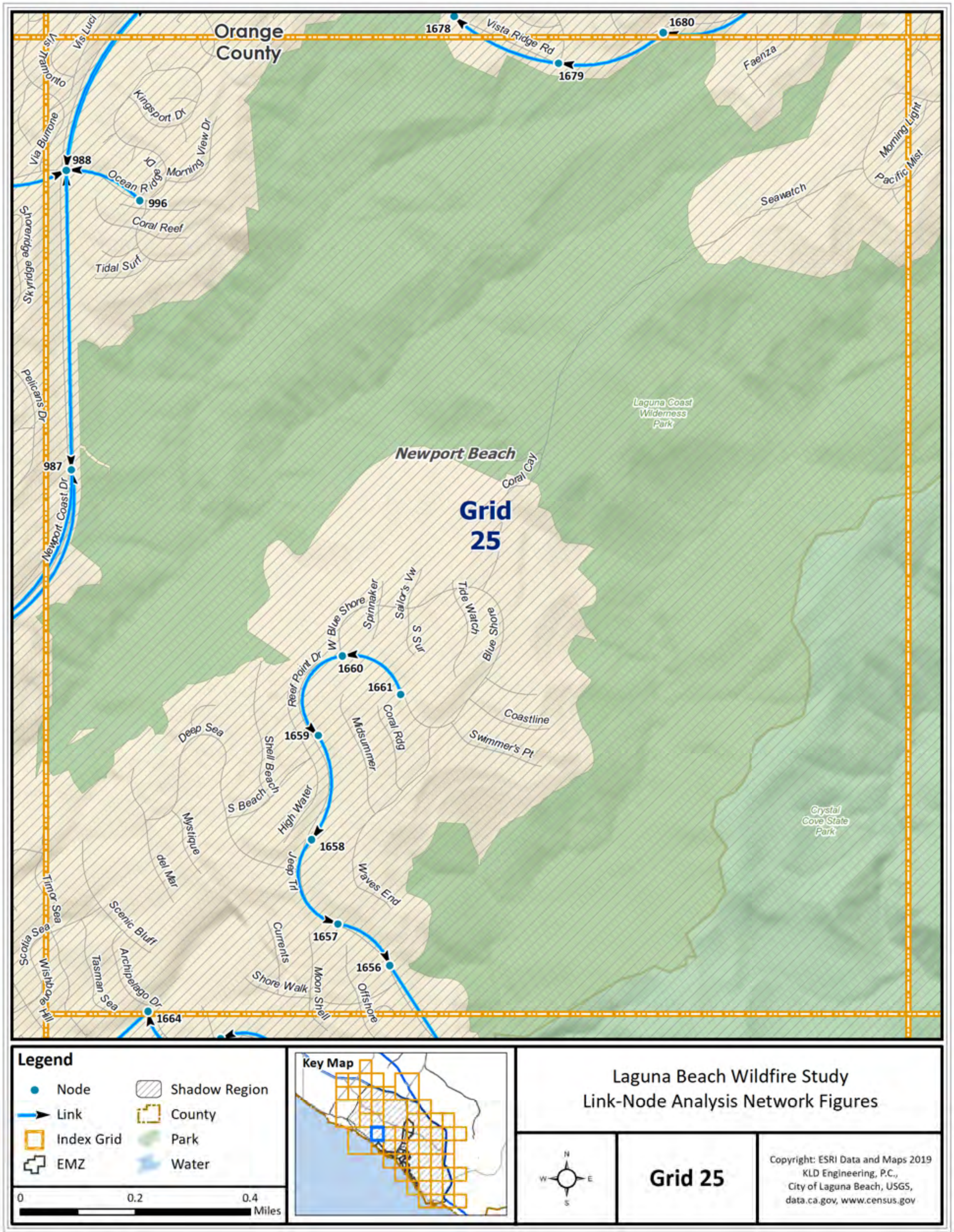


Figure H-26. Link-Node Analysis Network – Grid 25

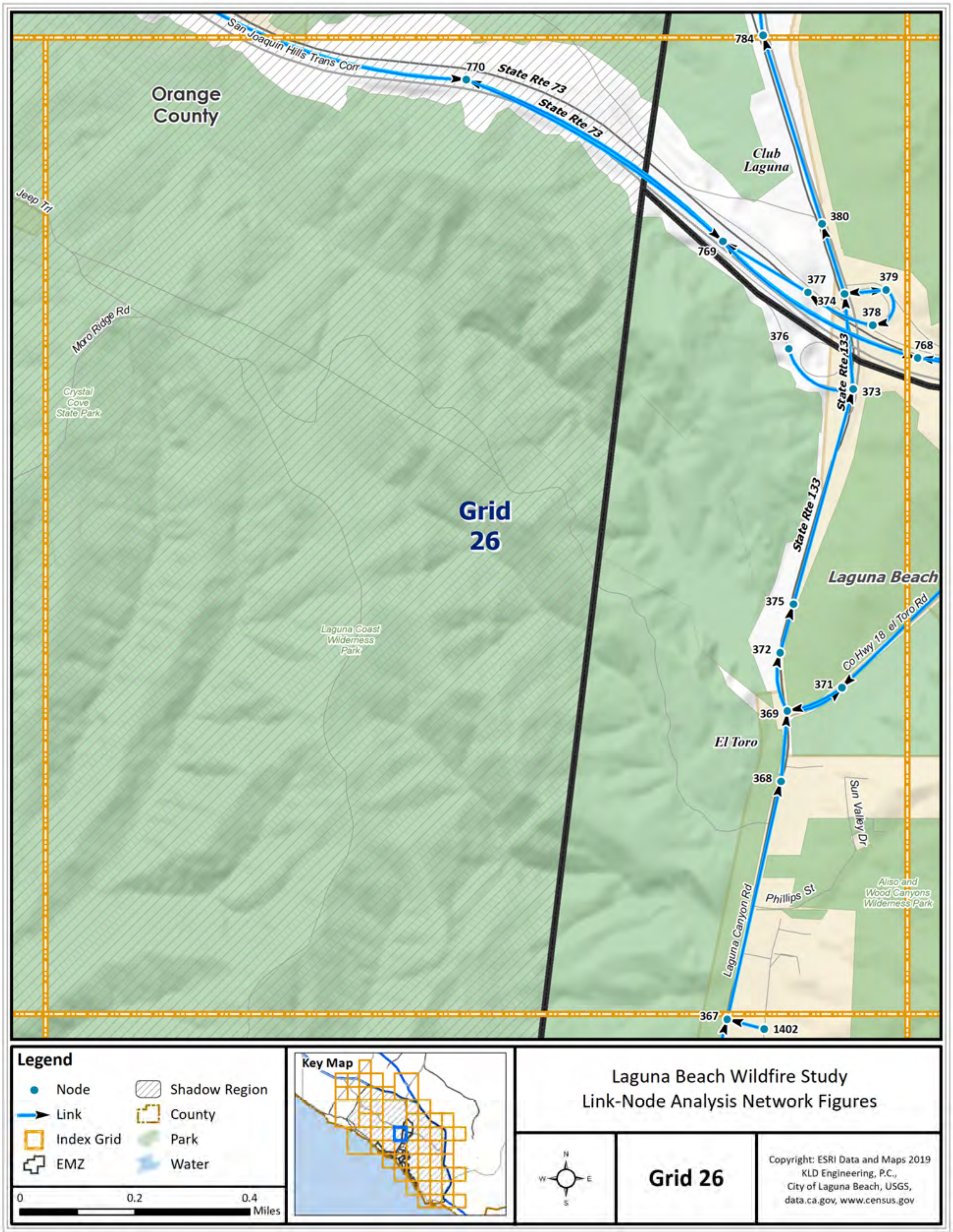


Figure H-27. Link-Node Analysis Network – Grid 26

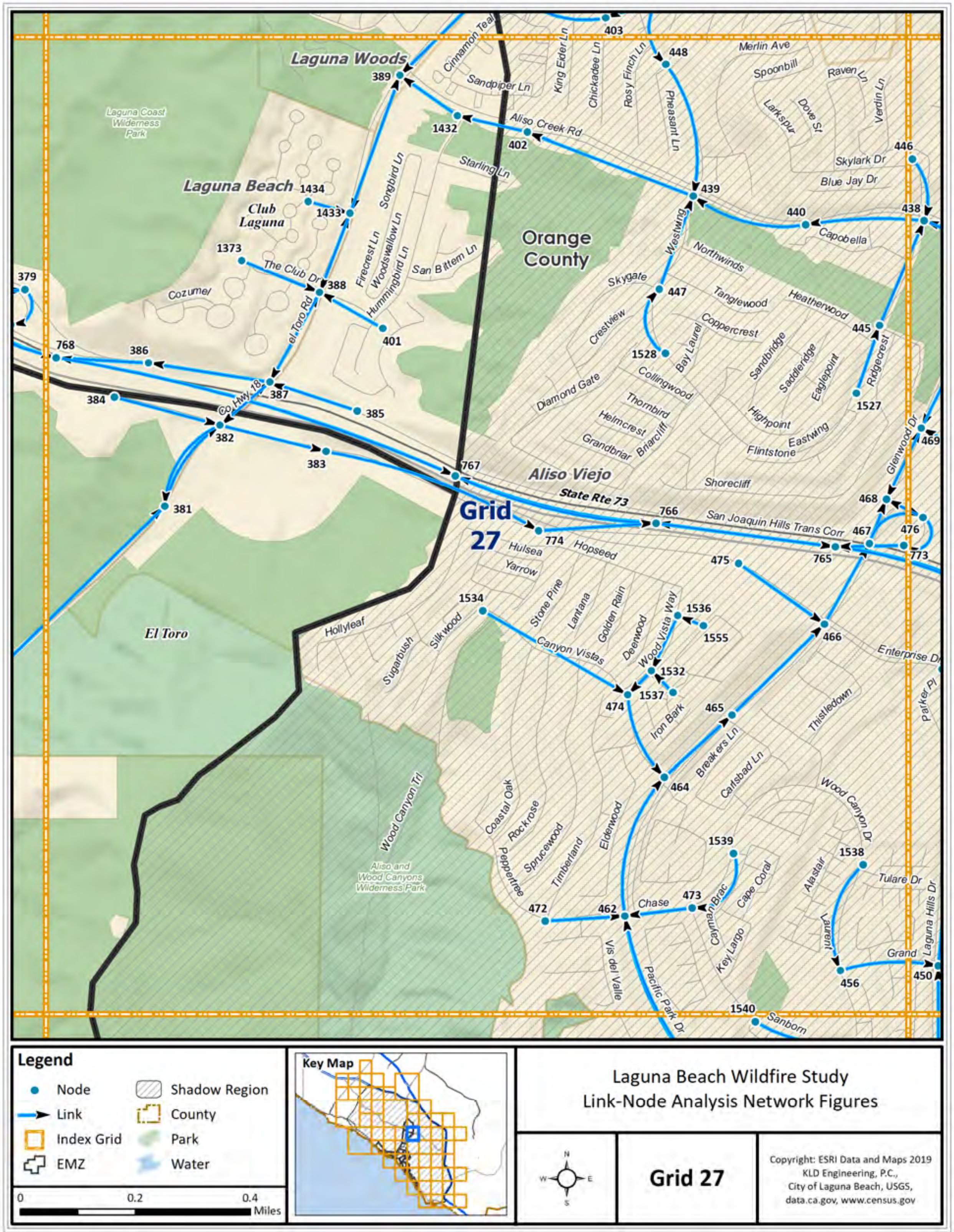


Figure H-28. Link-Node Analysis Network – Grid 27

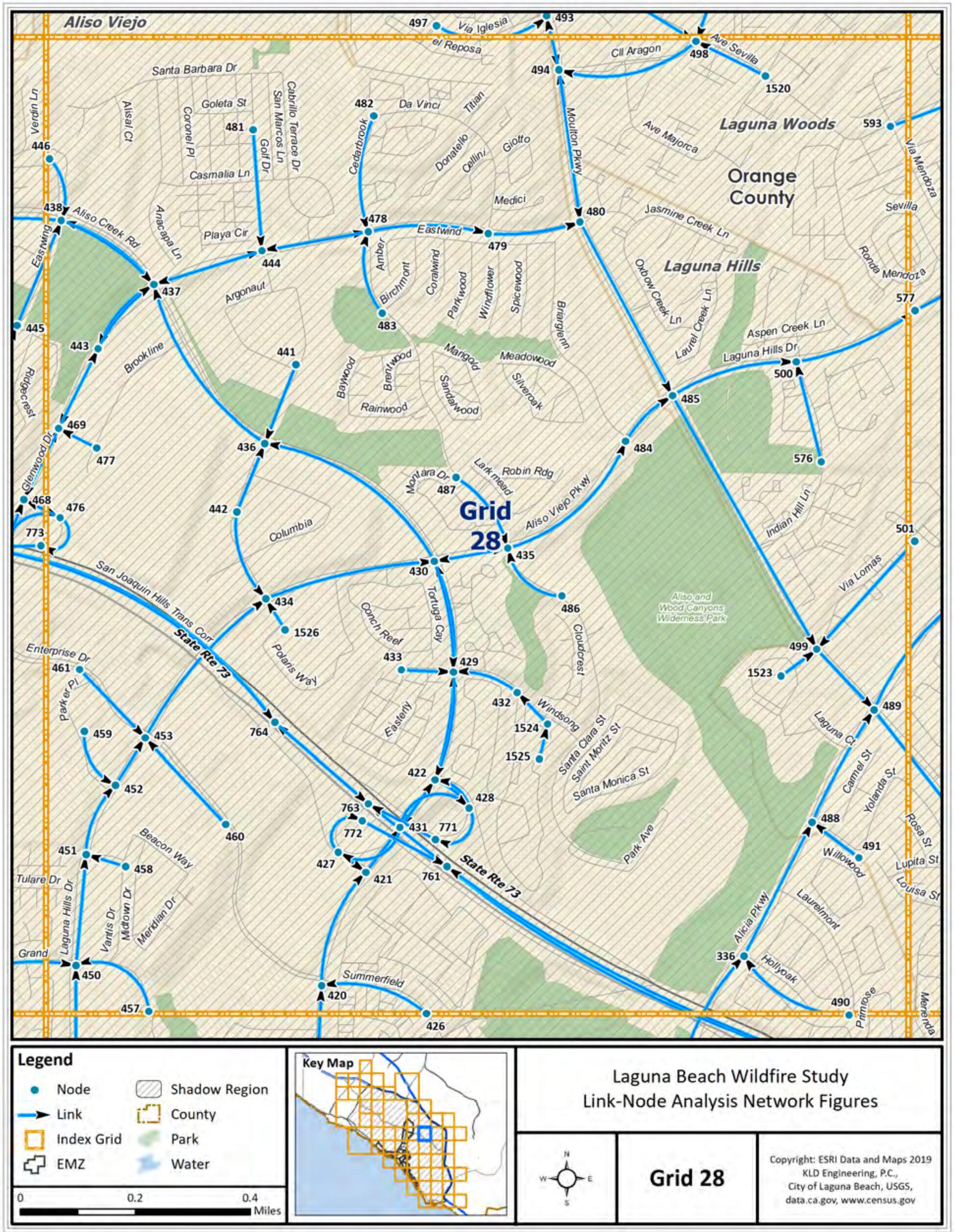


Figure H-29. Link-Node Analysis Network – Grid 28

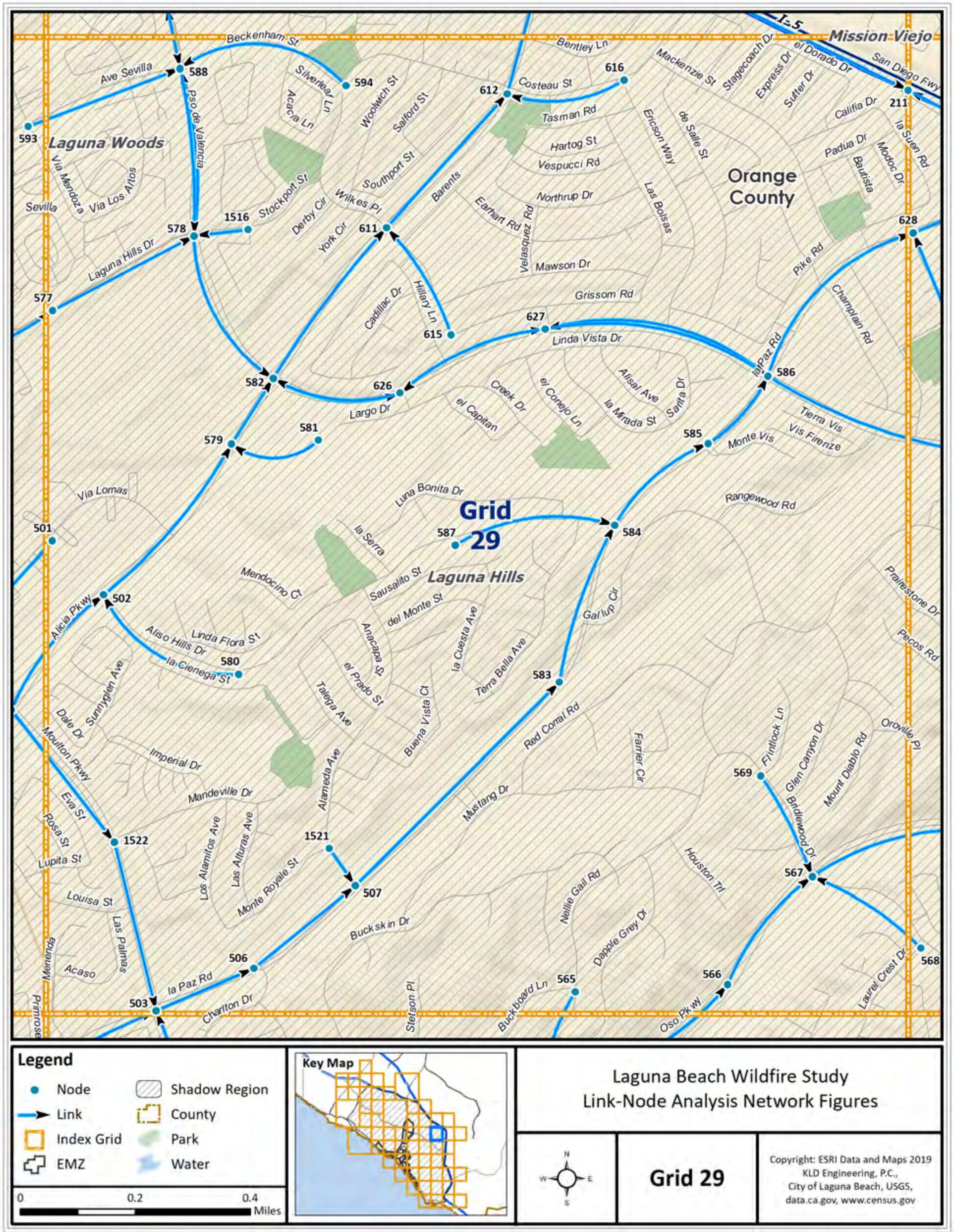


Figure H-30. Link-Node Analysis Network – Grid 29

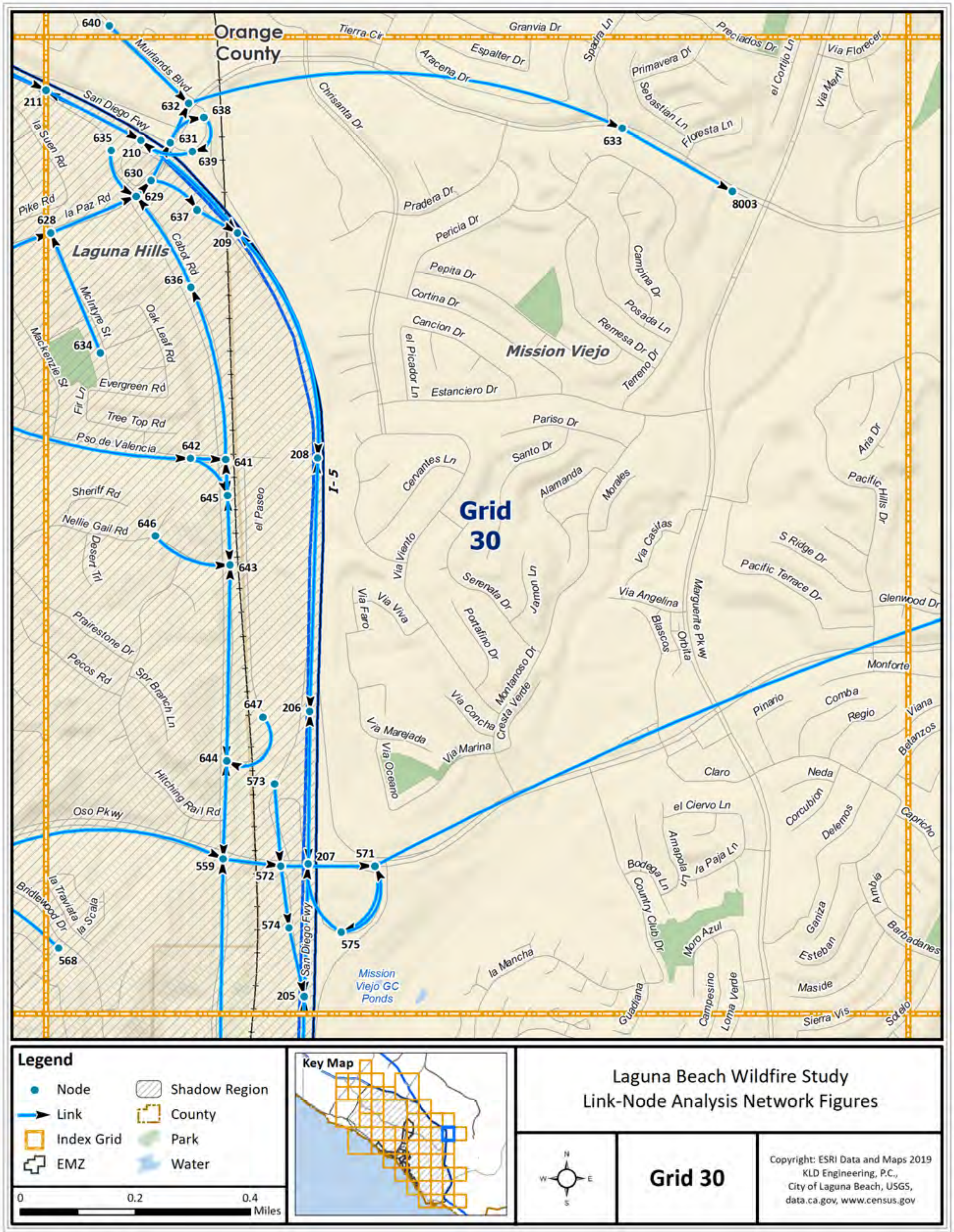


Figure H-31. Link-Node Analysis Network – Grid 30

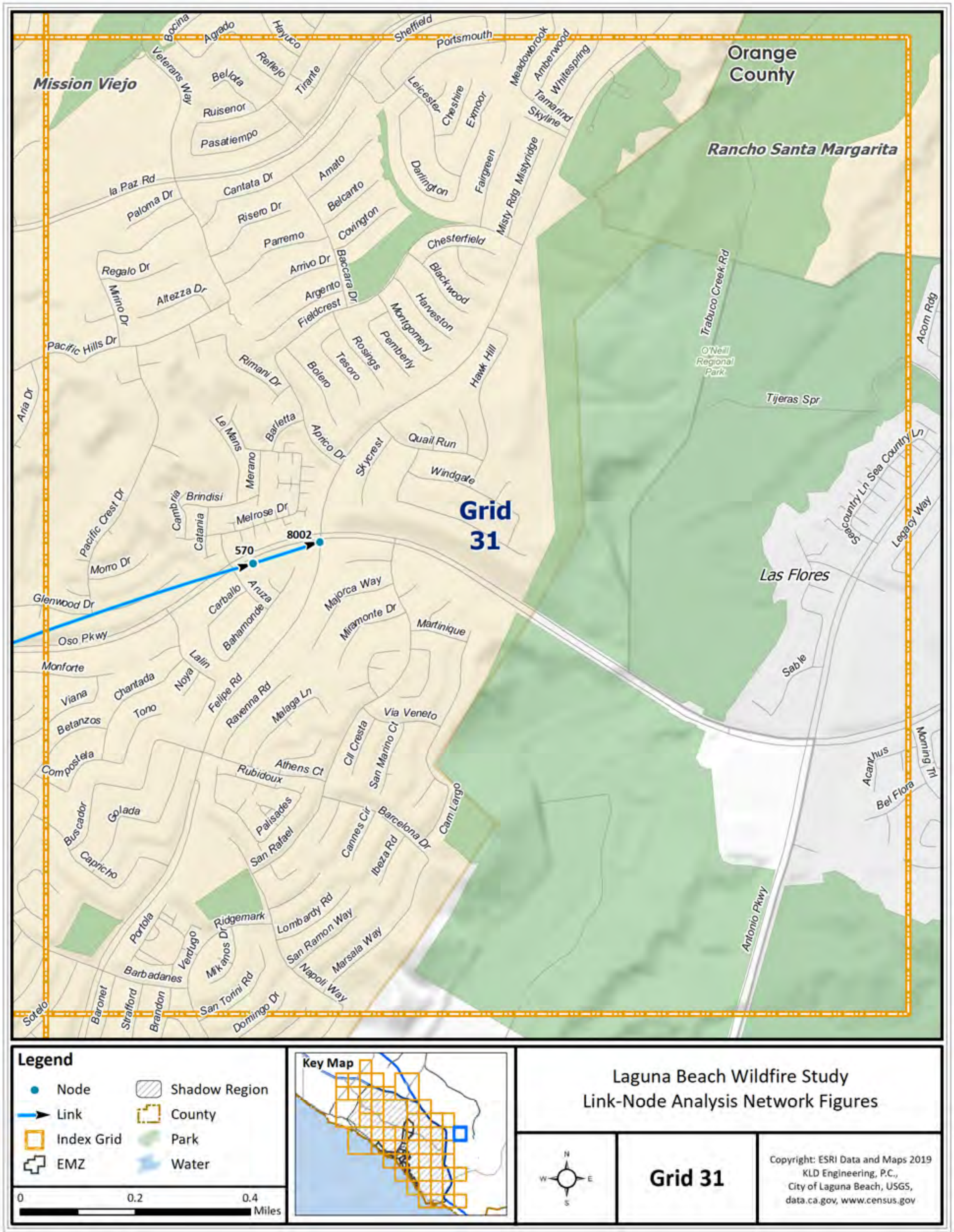


Figure H-32. Link-Node Analysis Network – Grid 31

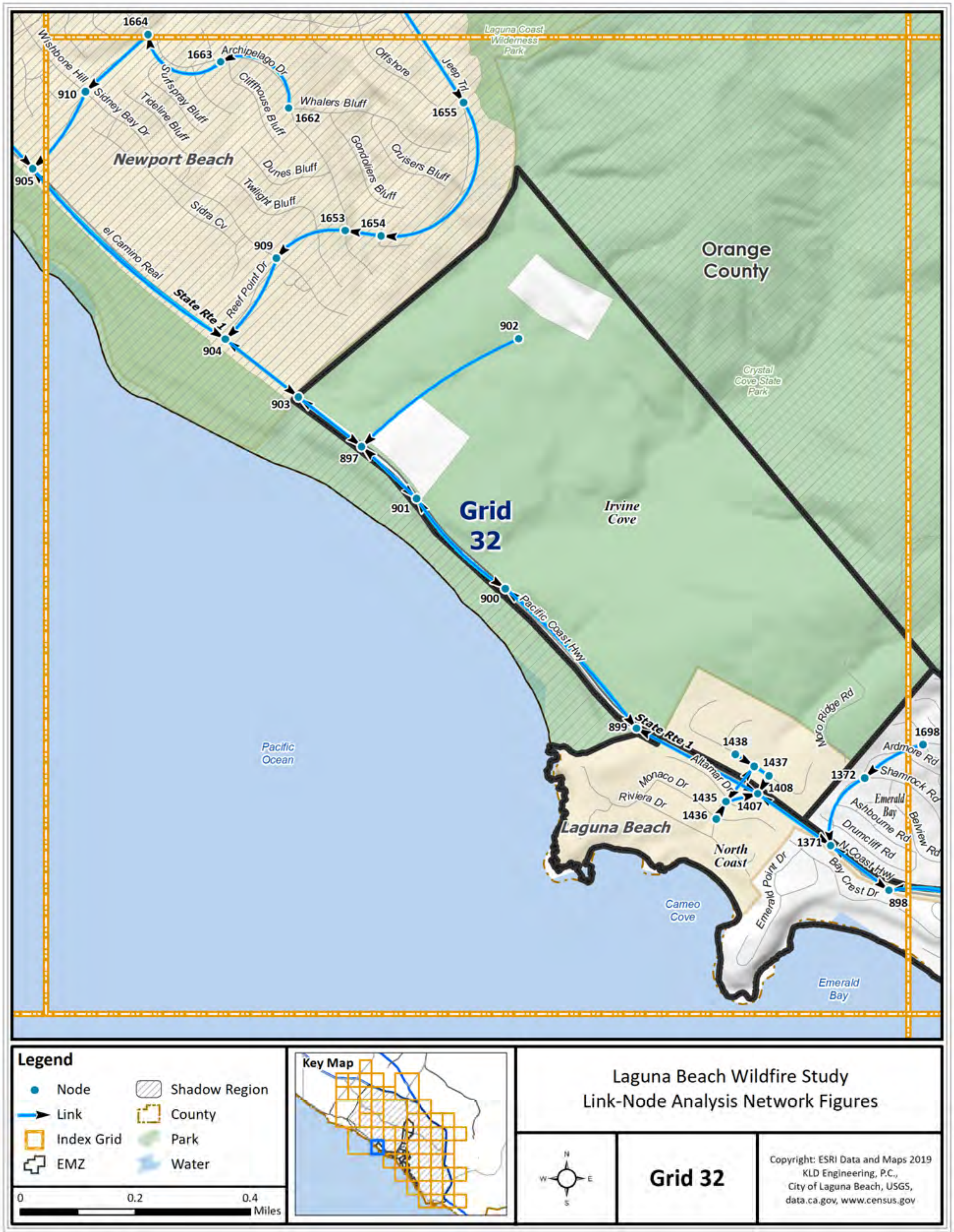


Figure H-33. Link-Node Analysis Network – Grid 32

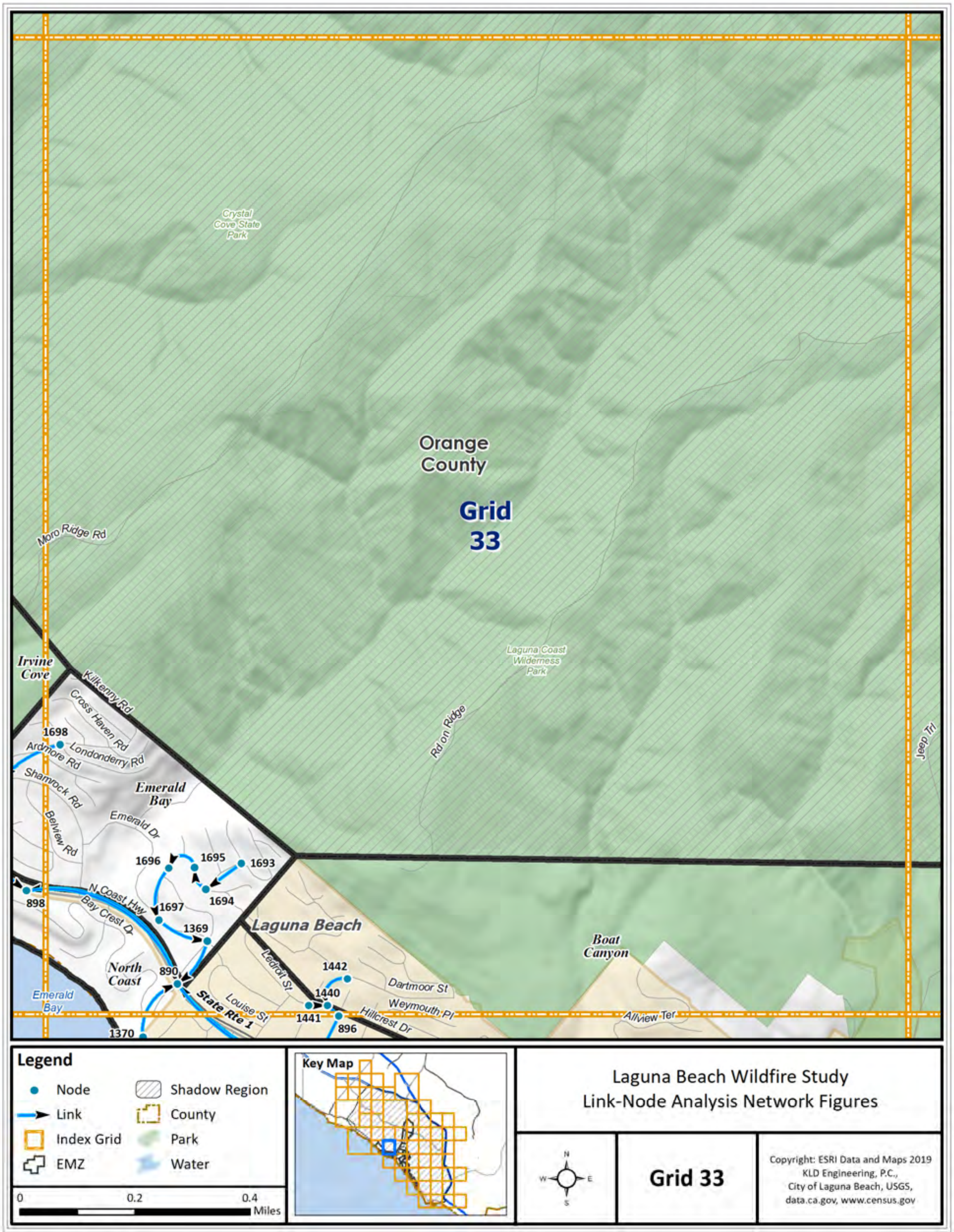


Figure H-34. Link-Node Analysis Network – Grid 33

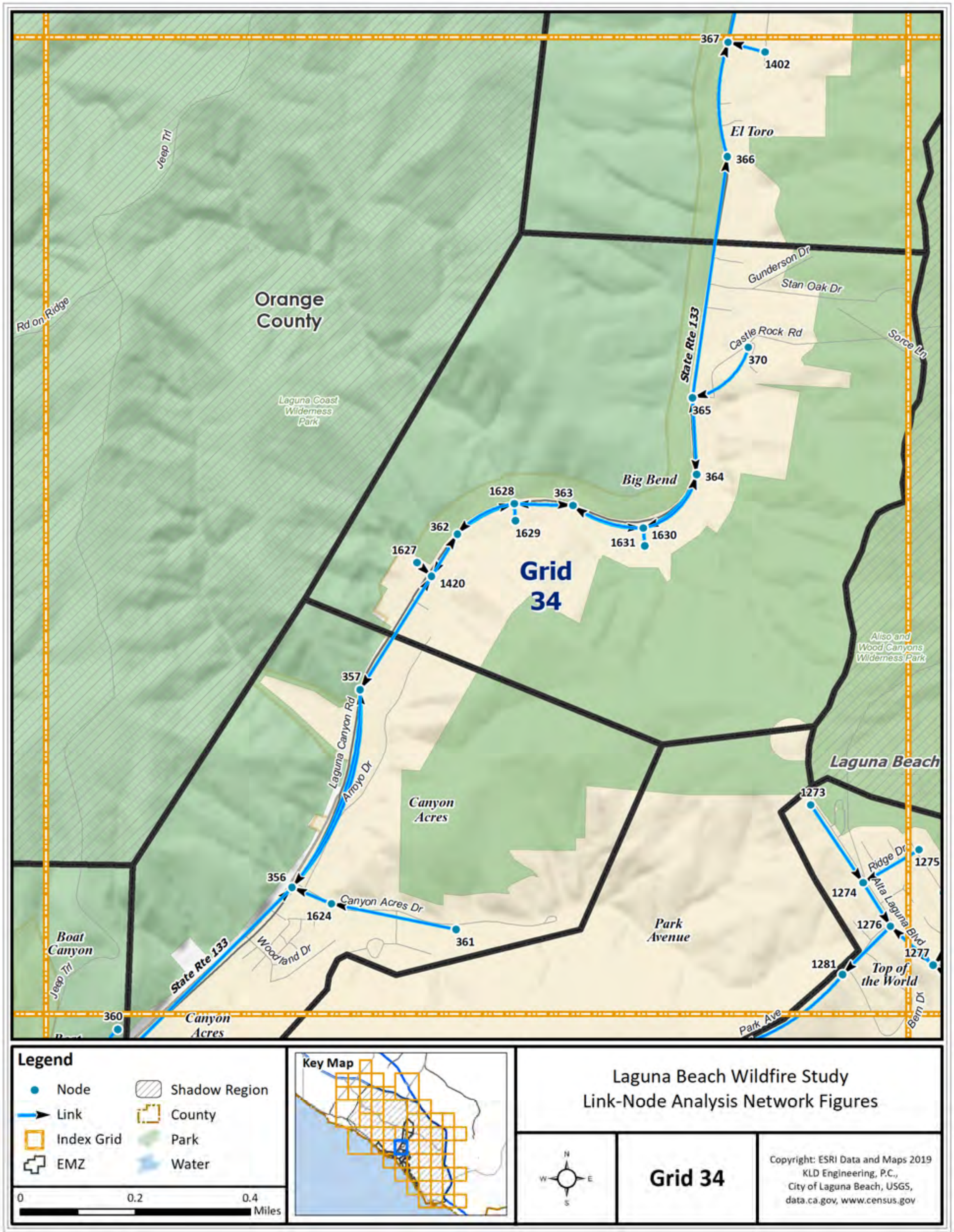


Figure H-35. Link-Node Analysis Network – Grid 34

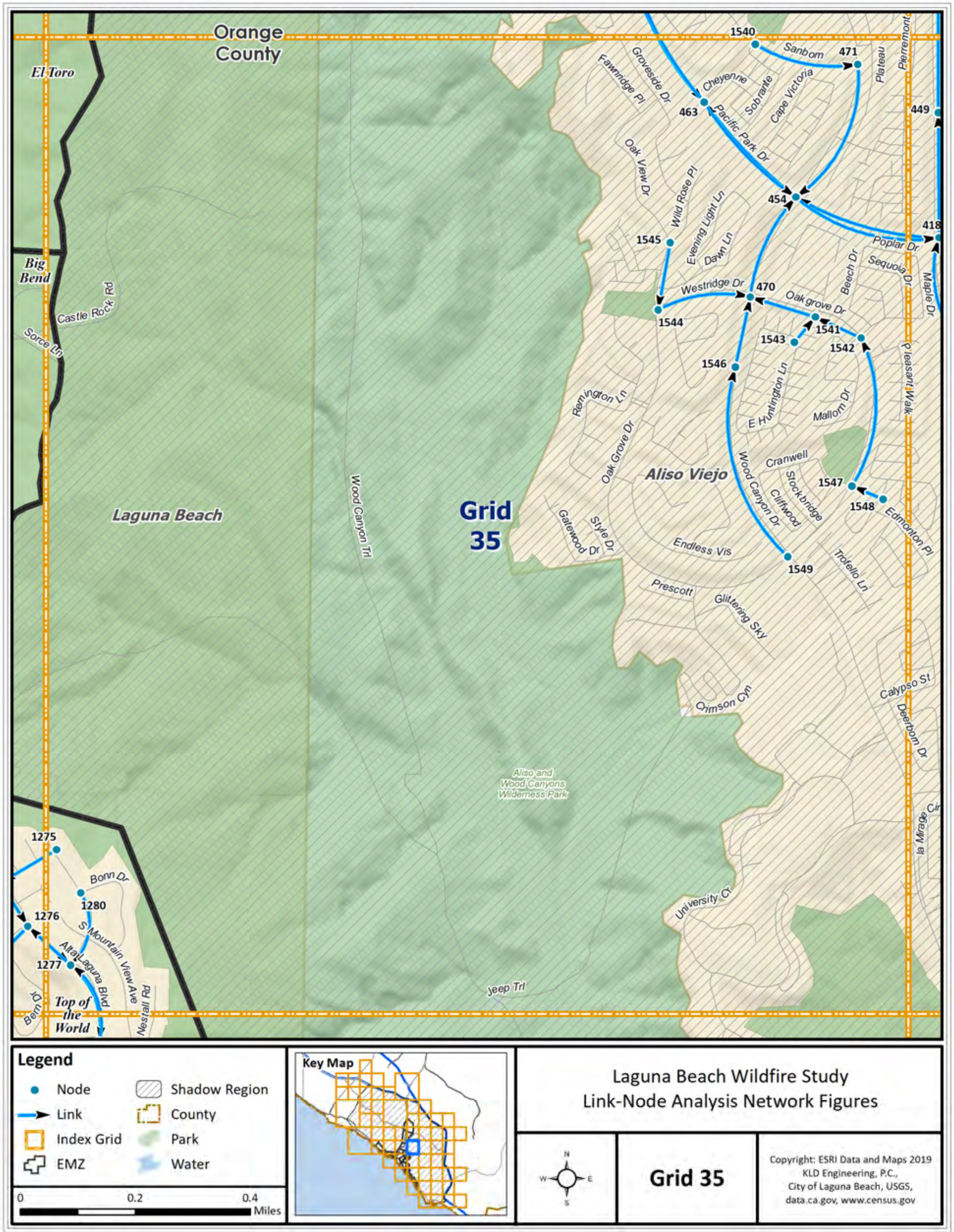


Figure H-36. Link-Node Analysis Network – Grid 35

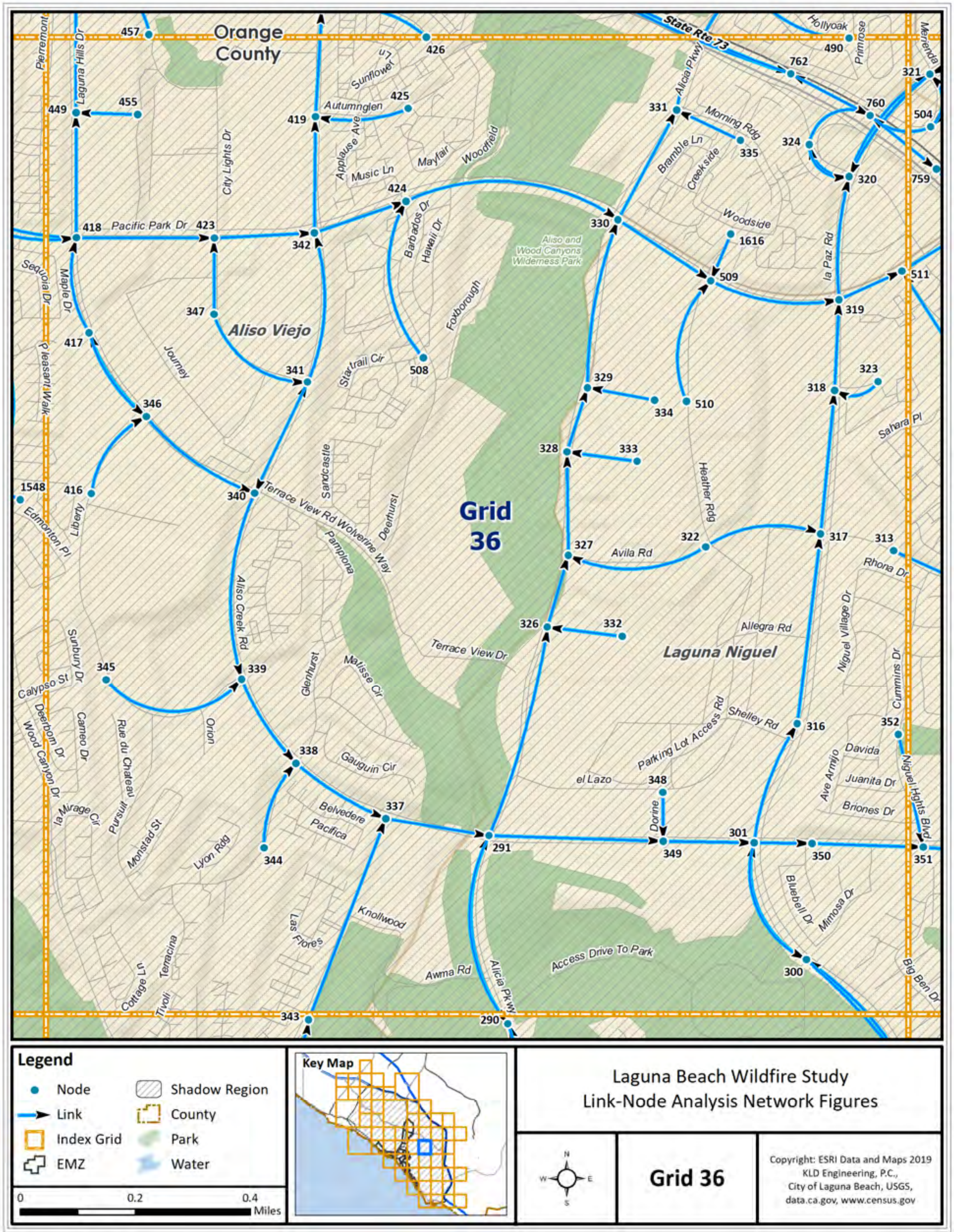


Figure H-37. Link-Node Analysis Network – Grid 36

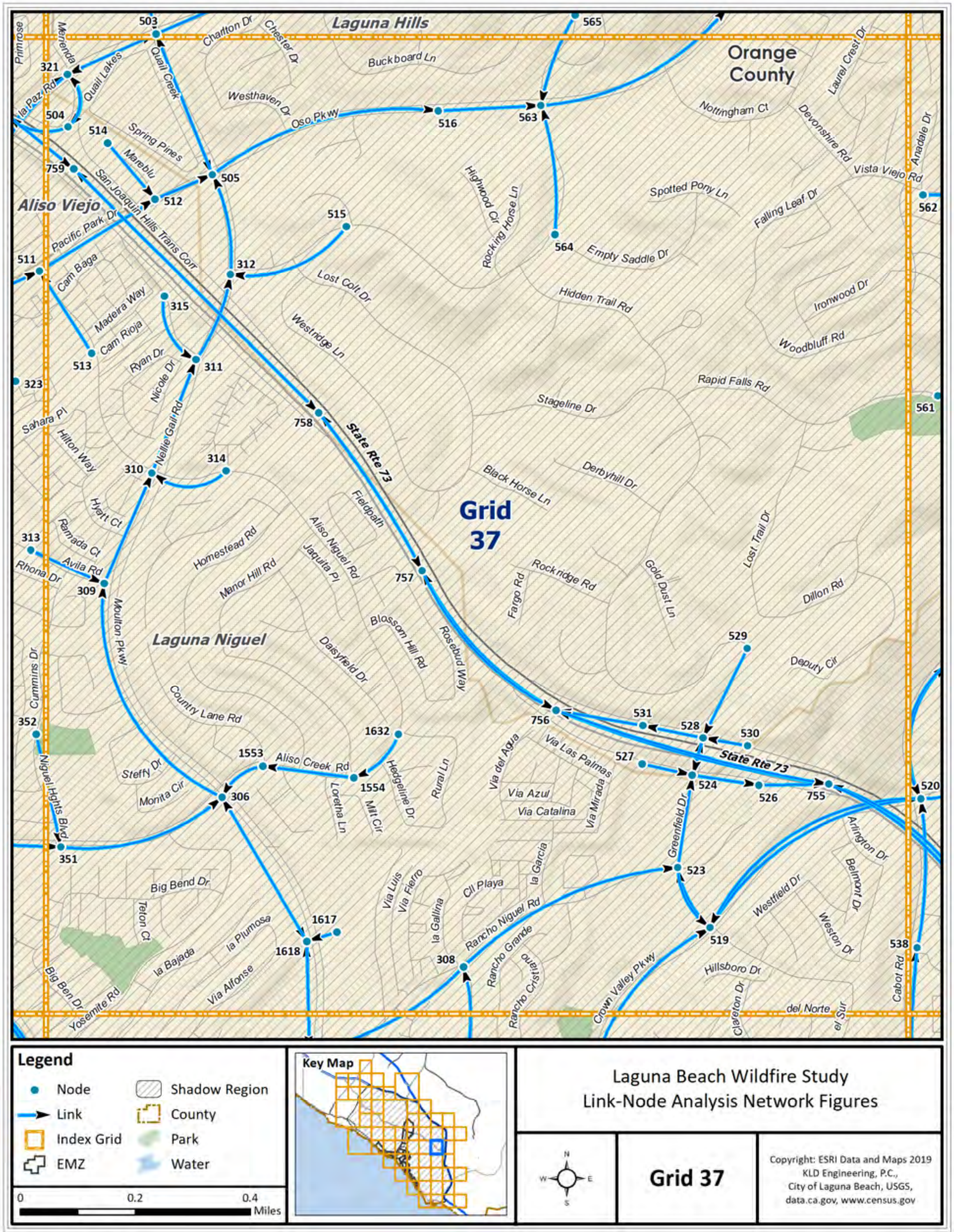


Figure H-38. Link-Node Analysis Network – Grid 37

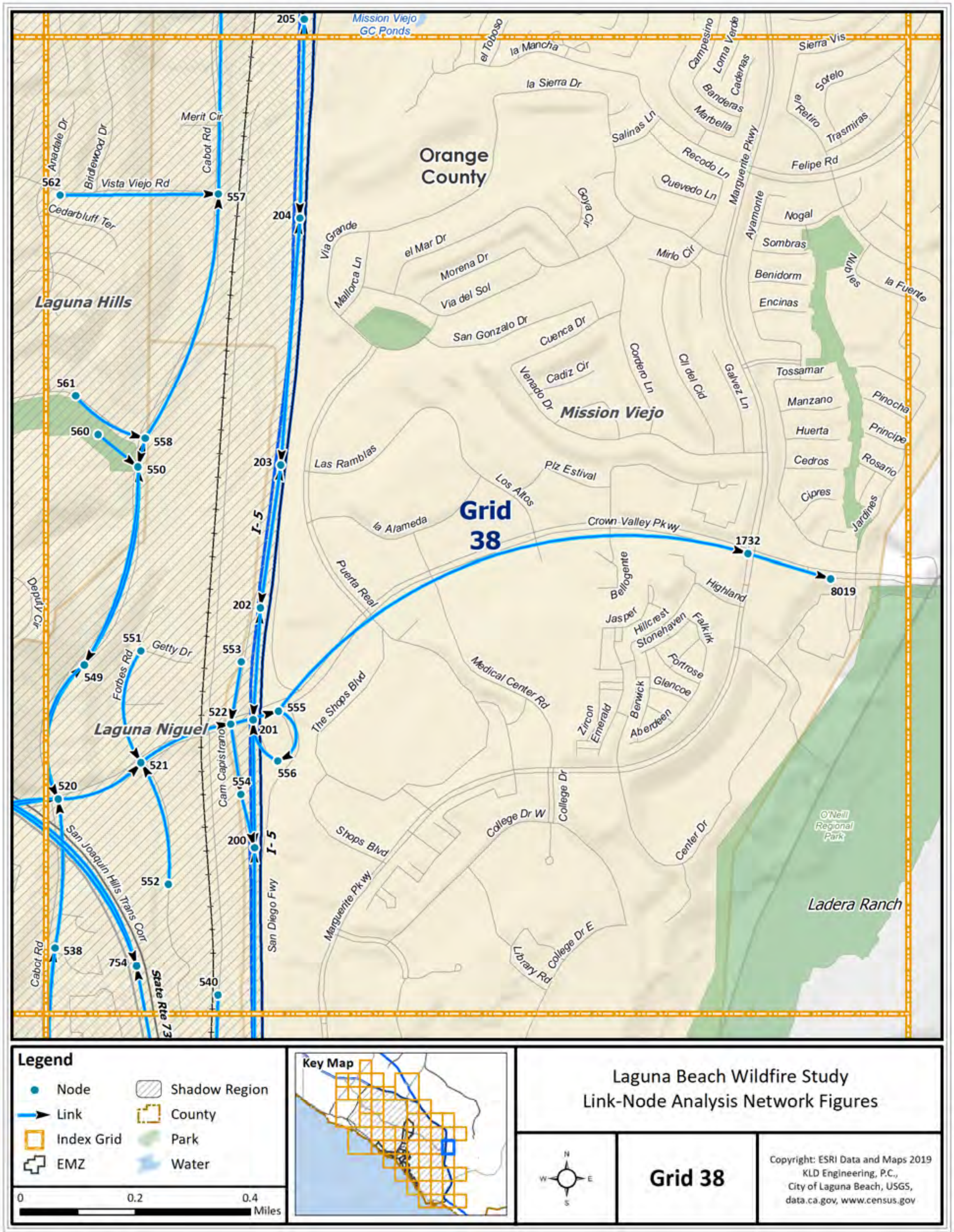


Figure H-39. Link-Node Analysis Network – Grid 38

Figure H-40. Link-Node Analysis Network – Grid 39

Figure H-41. Link-Node Analysis Network – Grid 40

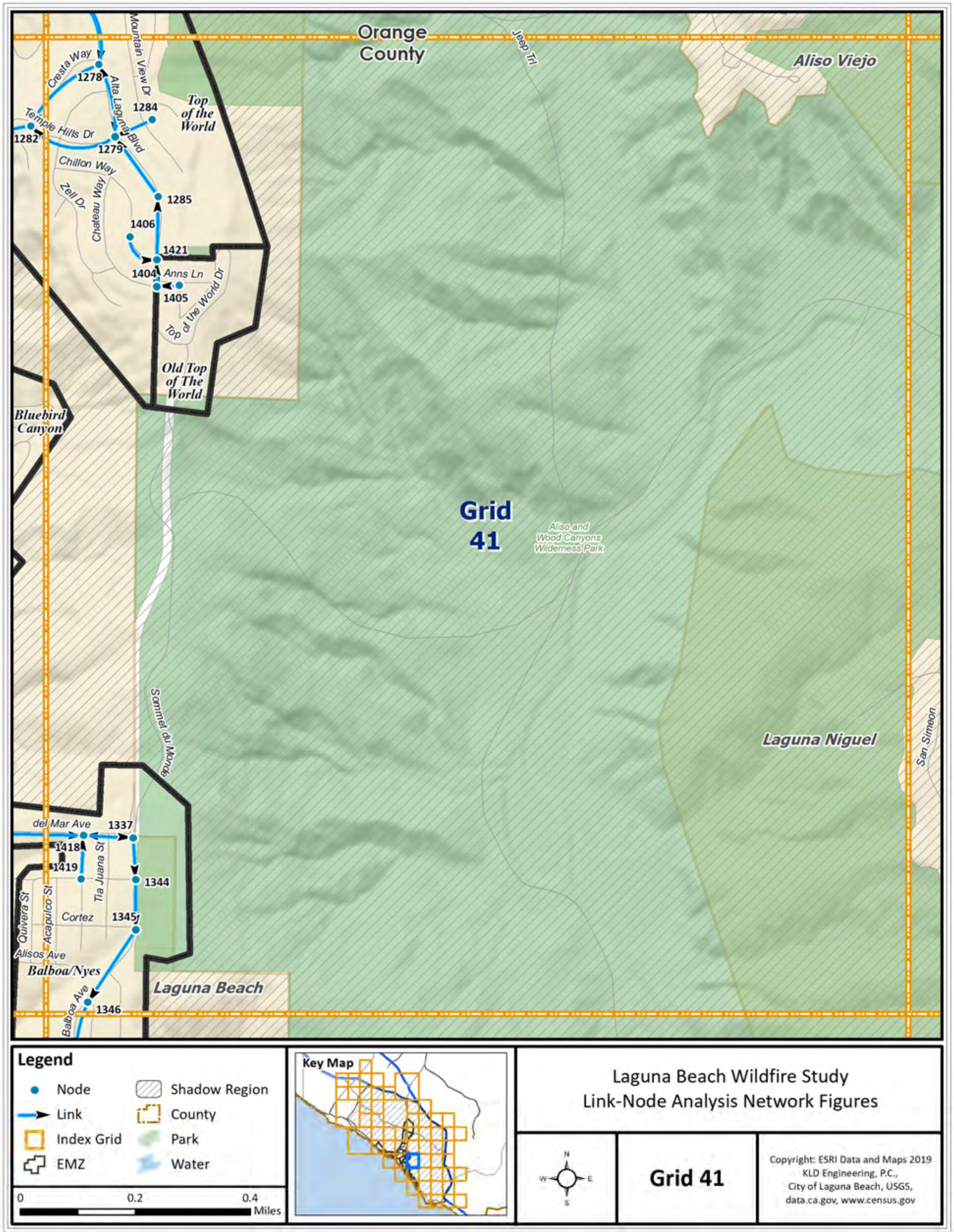


Figure H-42. Link-Node Analysis Network – Grid 41

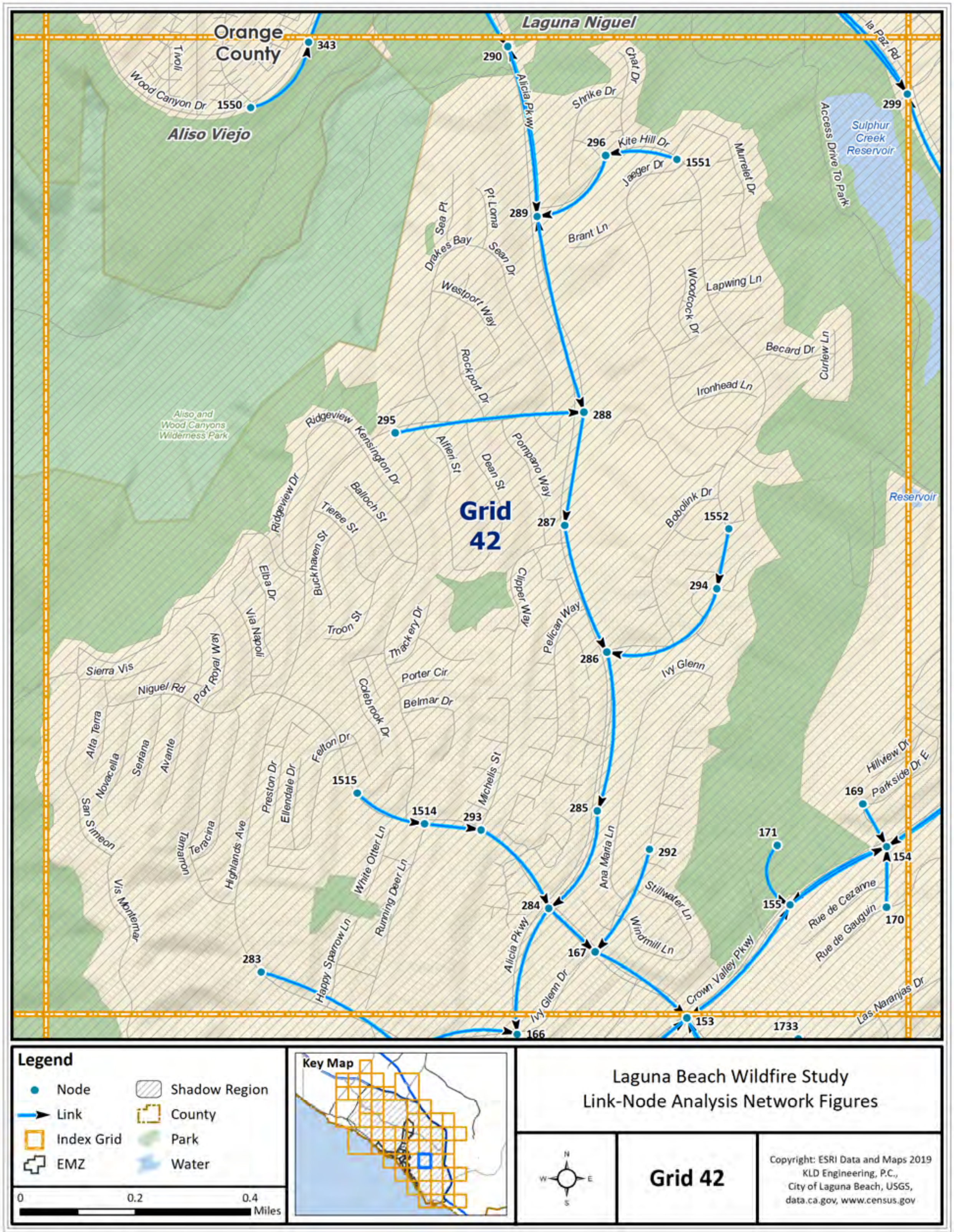


Figure H-43. Link-Node Analysis Network – Grid 42

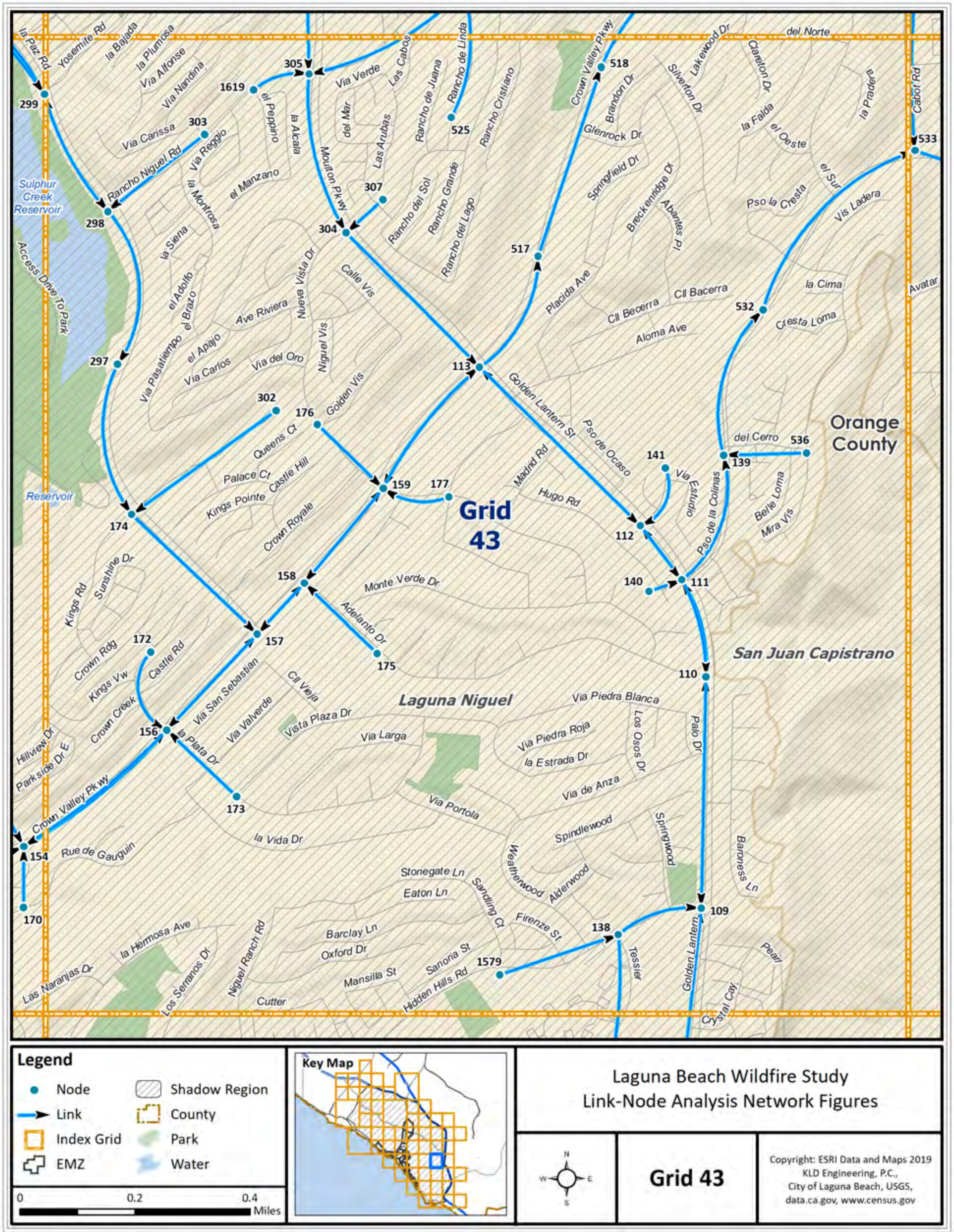


Figure H-44. Link-Node Analysis Network – Grid 43

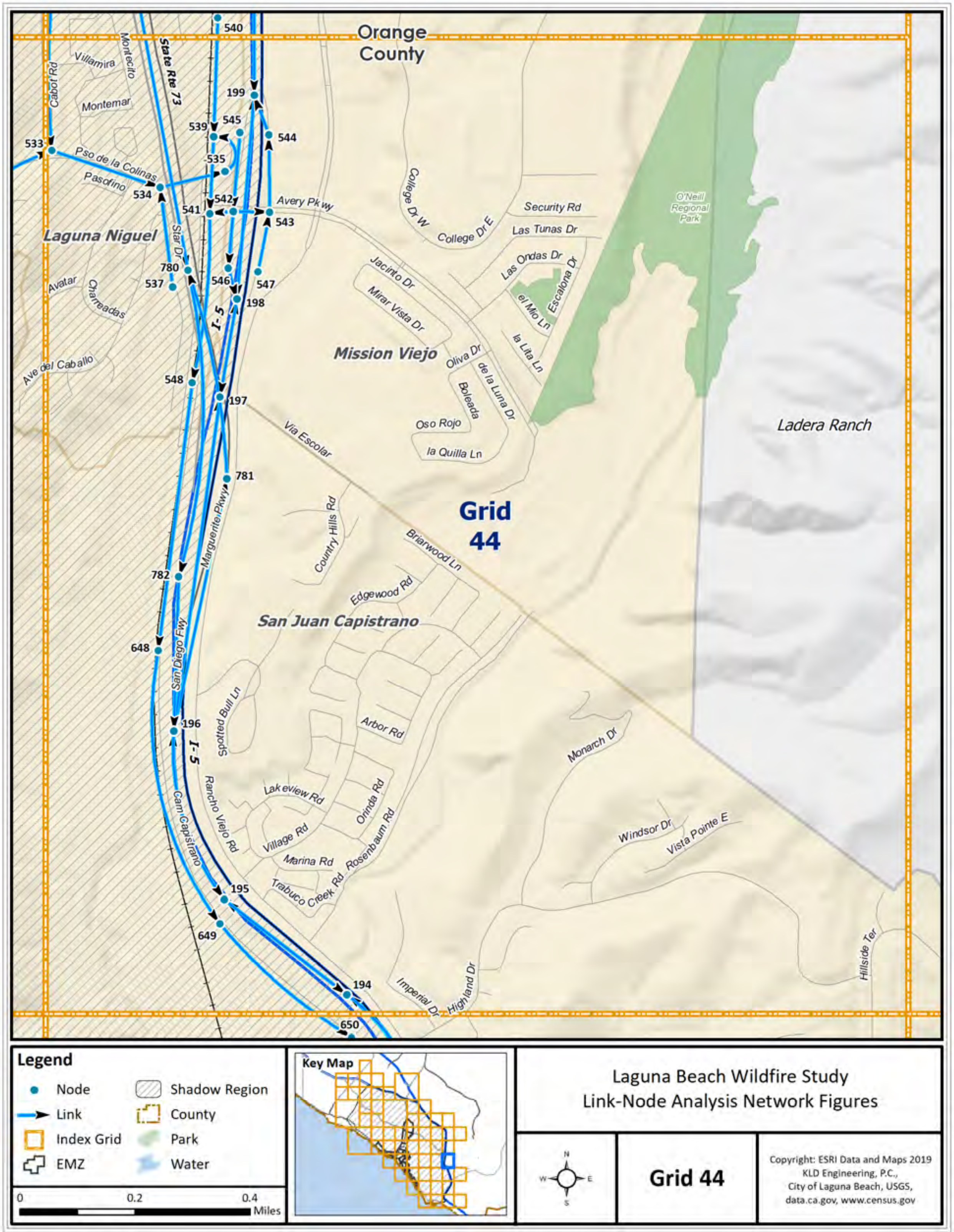


Figure H-45. Link-Node Analysis Network – Grid 44

Figure H-46. Link-Node Analysis Network – Grid 45

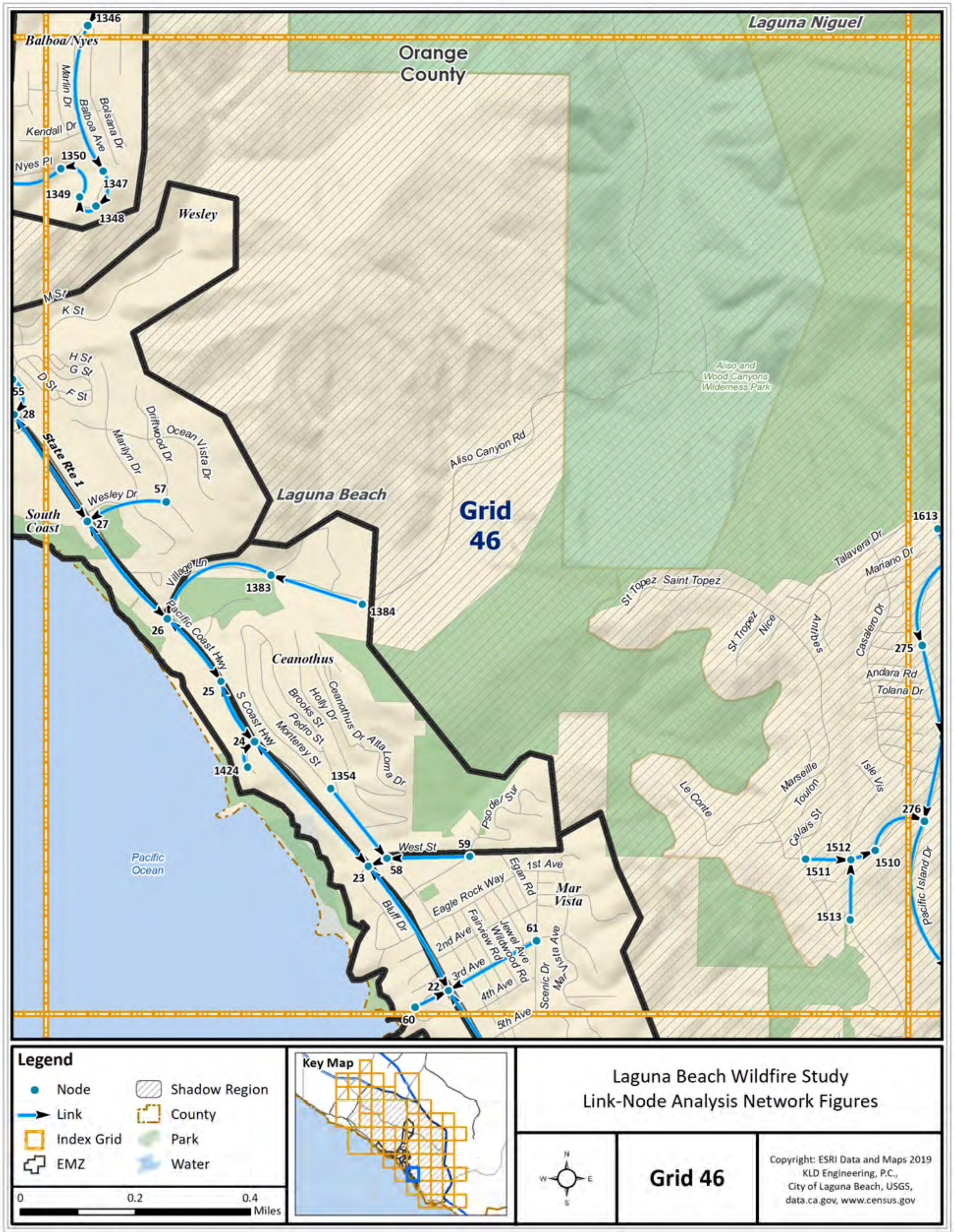


Figure H-47. Link-Node Analysis Network – Grid 46

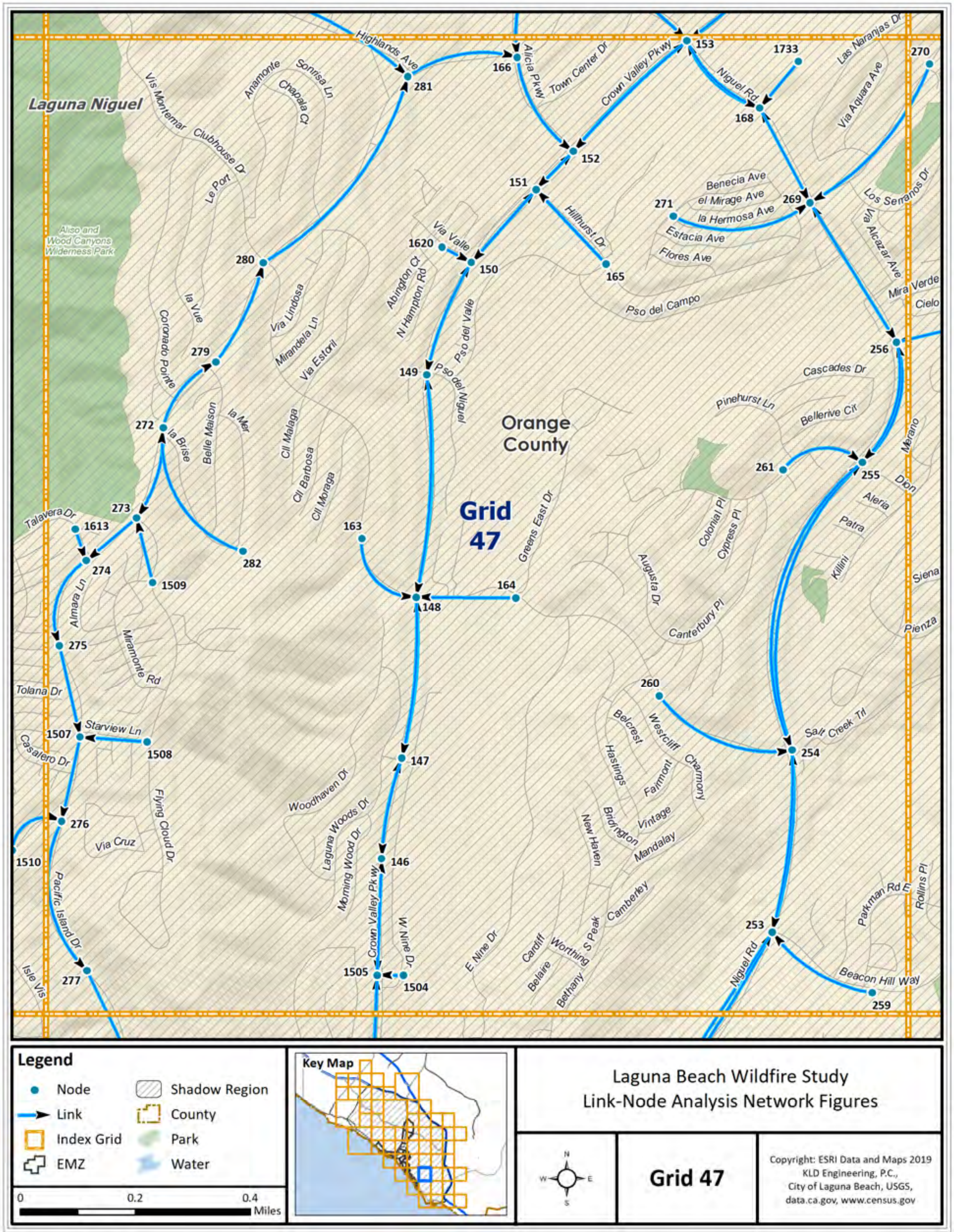


Figure H-48. Link-Node Analysis Network – Grid 47

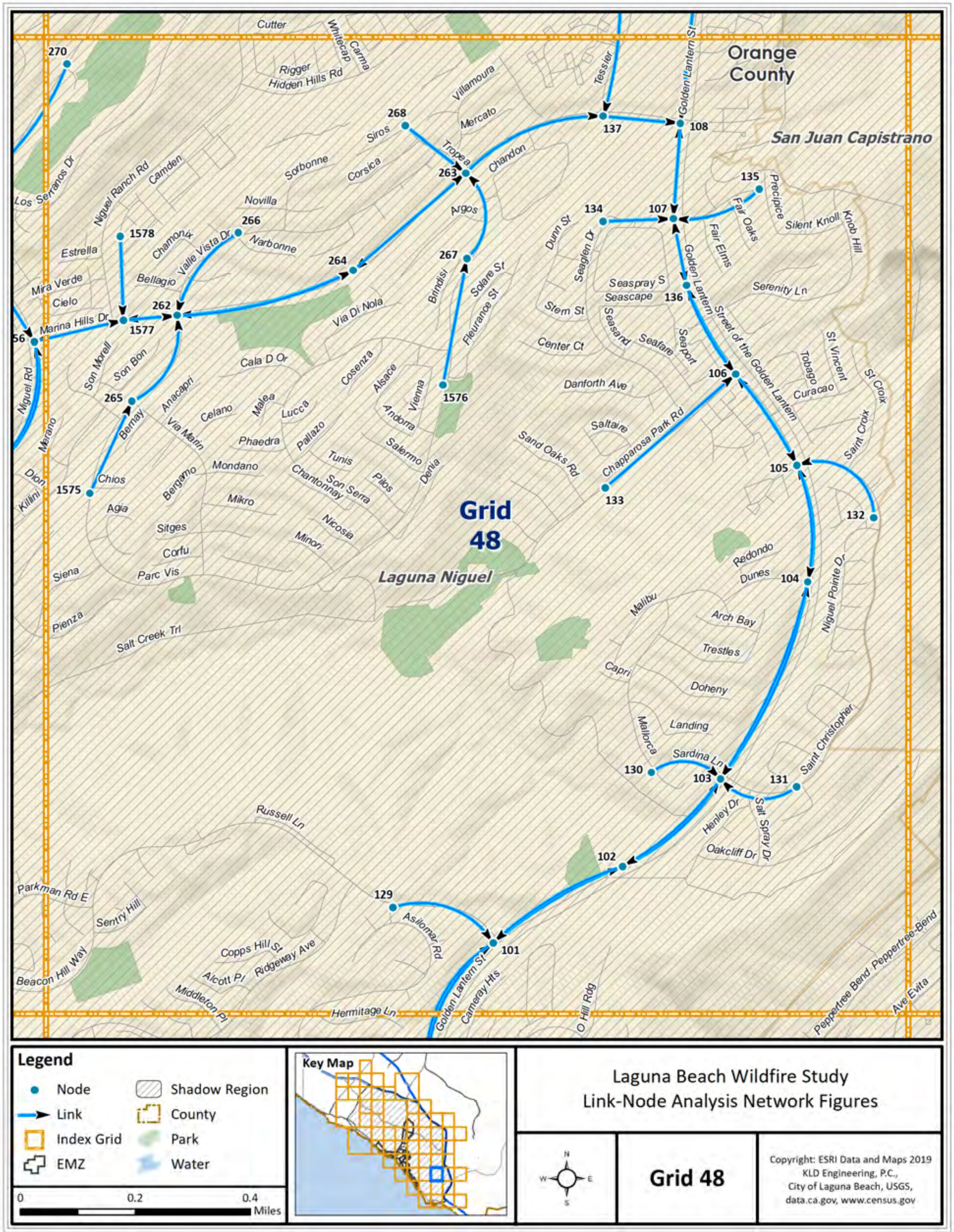


Figure H-49. Link-Node Analysis Network – Grid 48

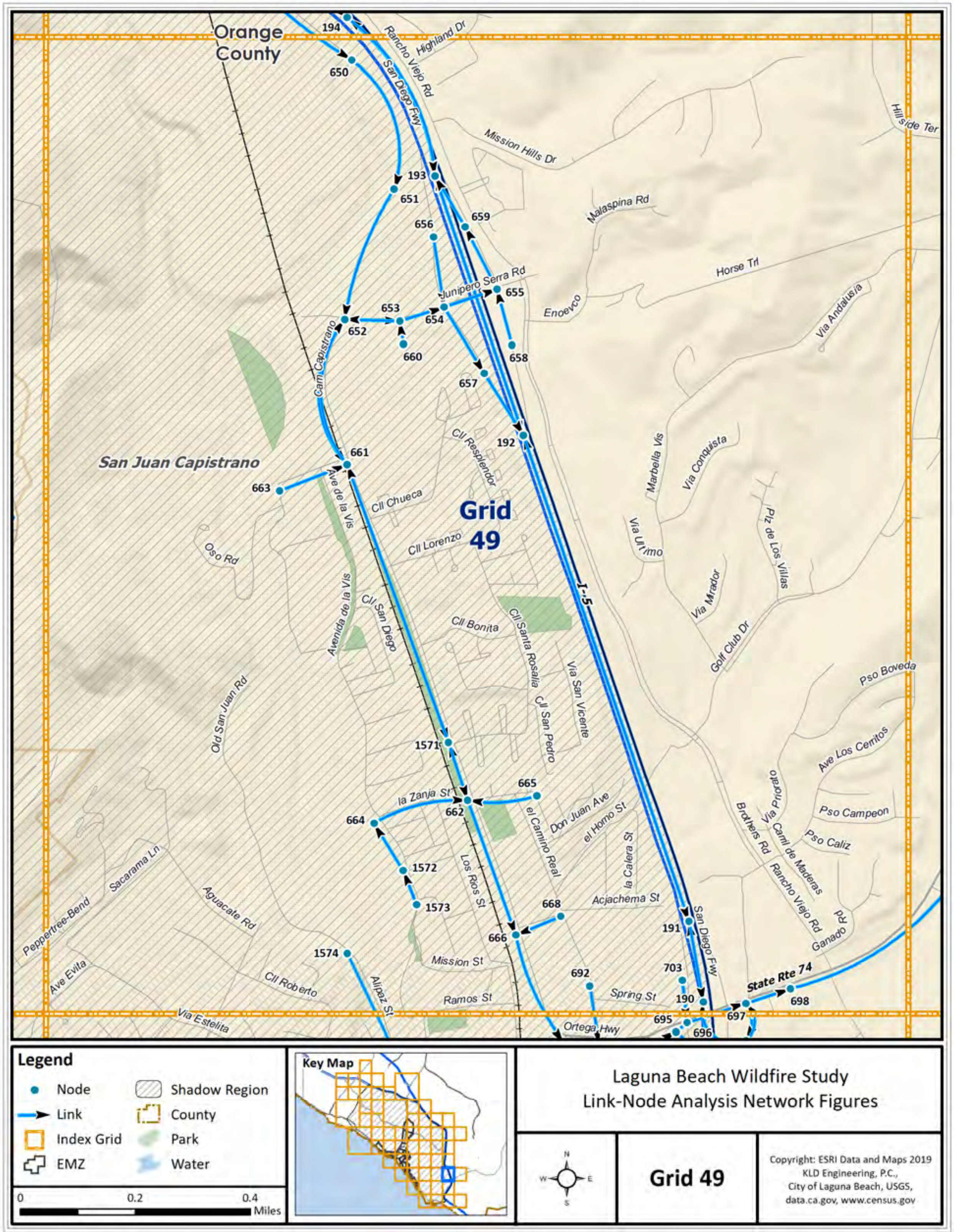


Figure H-50. Link-Node Analysis Network – Grid 49

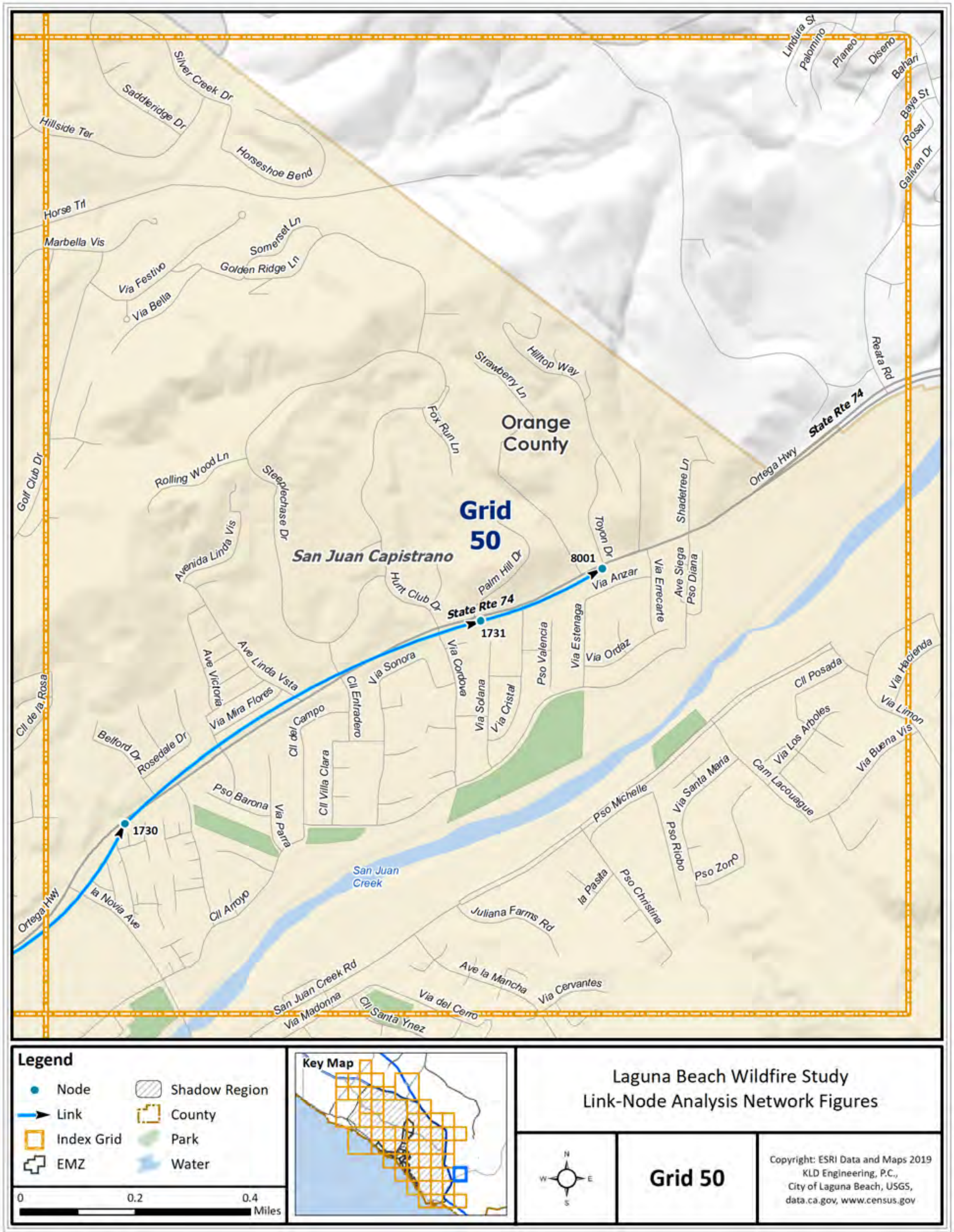


Figure H-51. Link-Node Analysis Network – Grid 50

Figure H-52. Link-Node Analysis Network – Grid 51

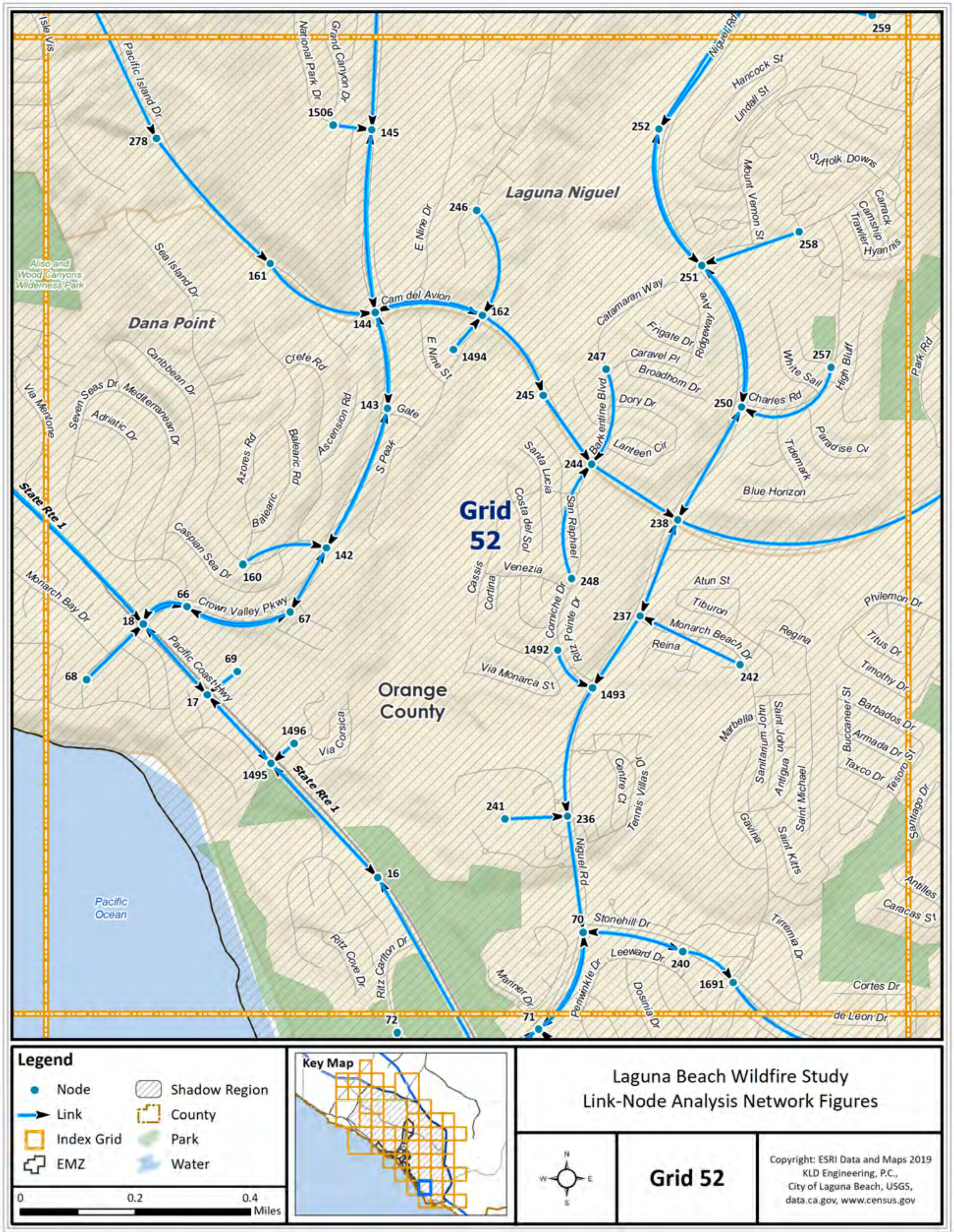


Figure H-53. Link-Node Analysis Network – Grid 52

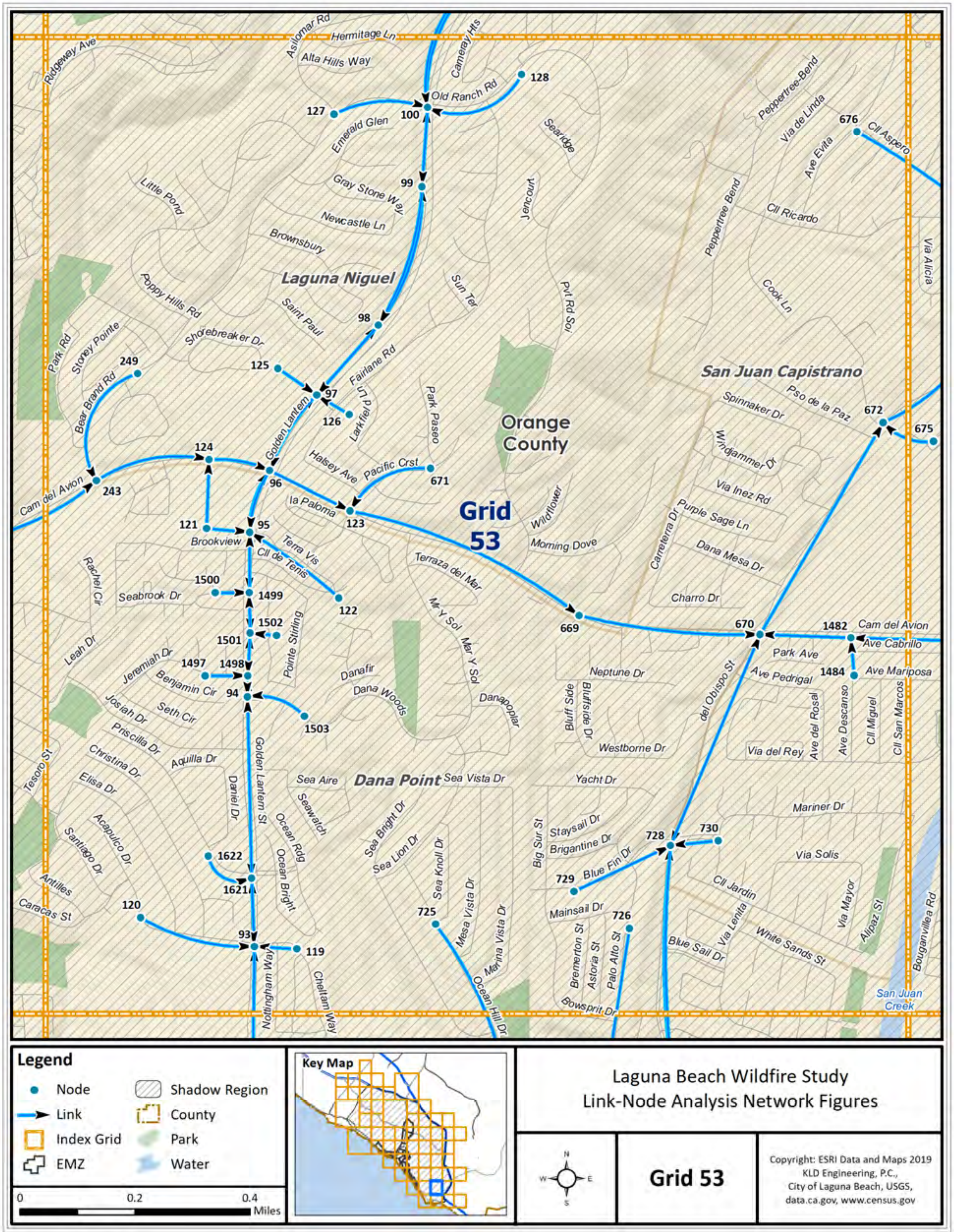


Figure H-54. Link-Node Analysis Network – Grid 53

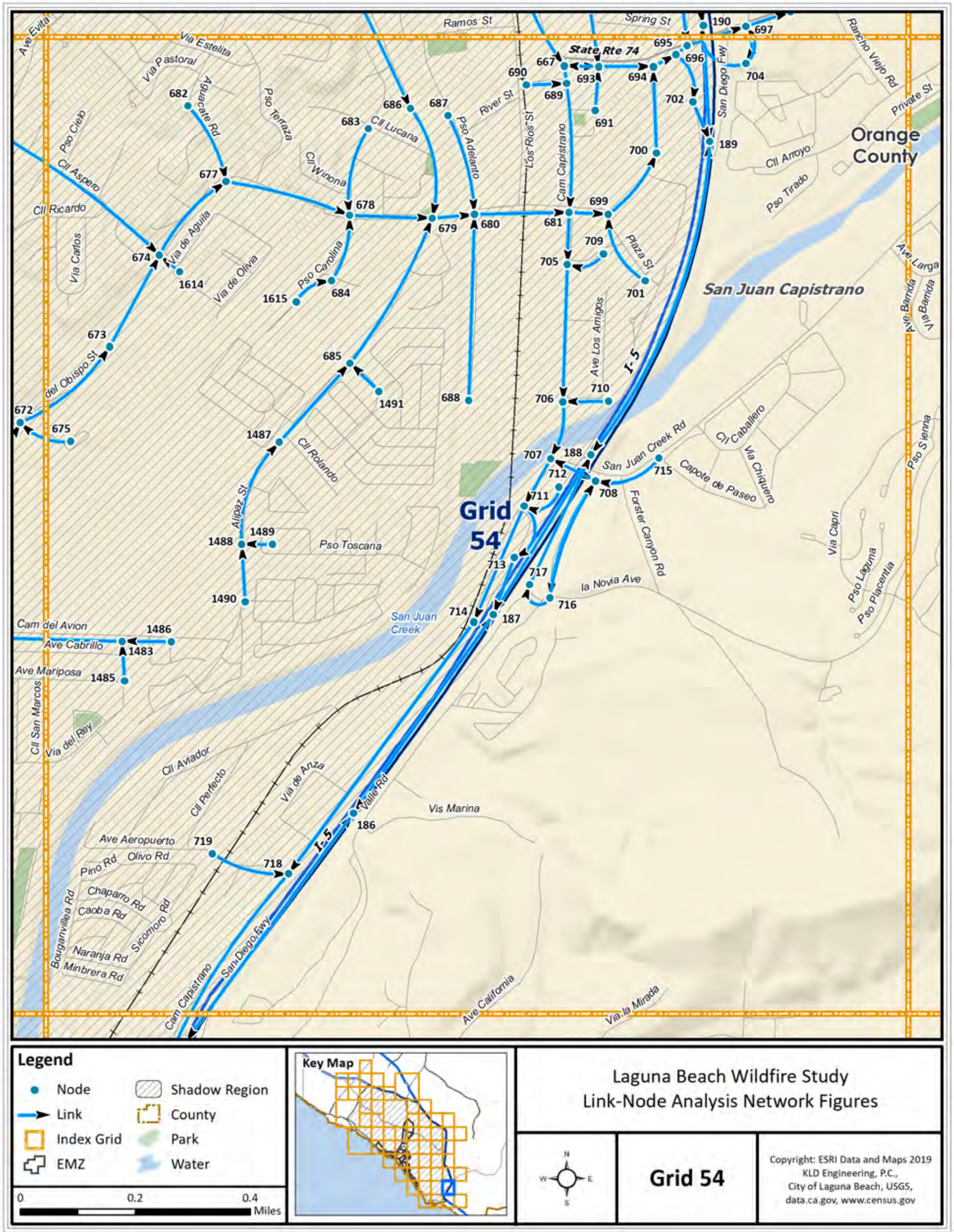


Figure H-55. Link-Node Analysis Network – Grid 54

Figure H-56. Link-Node Analysis Network – Grid 55

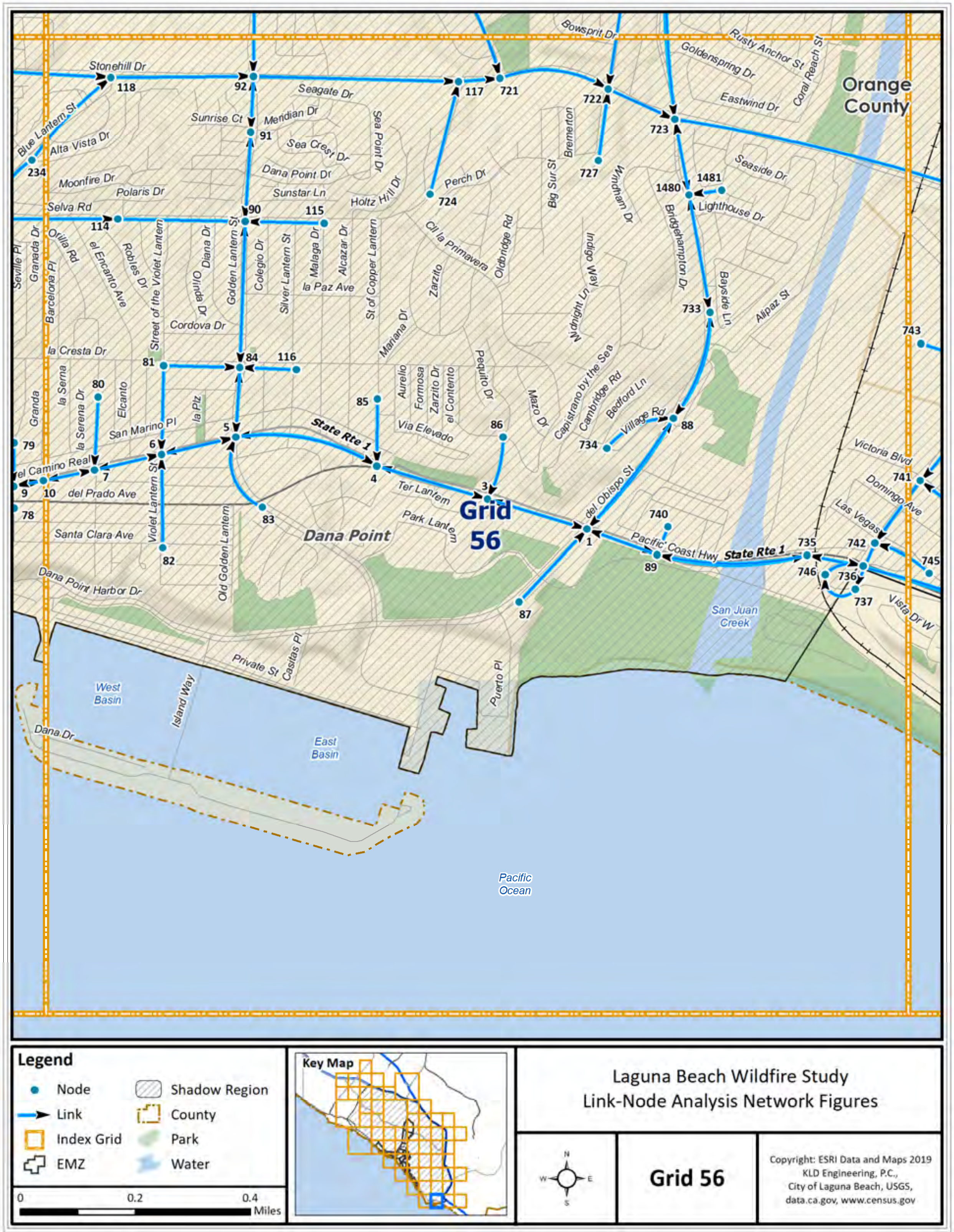


Figure H-57. Link-Node Analysis Network – Grid 56

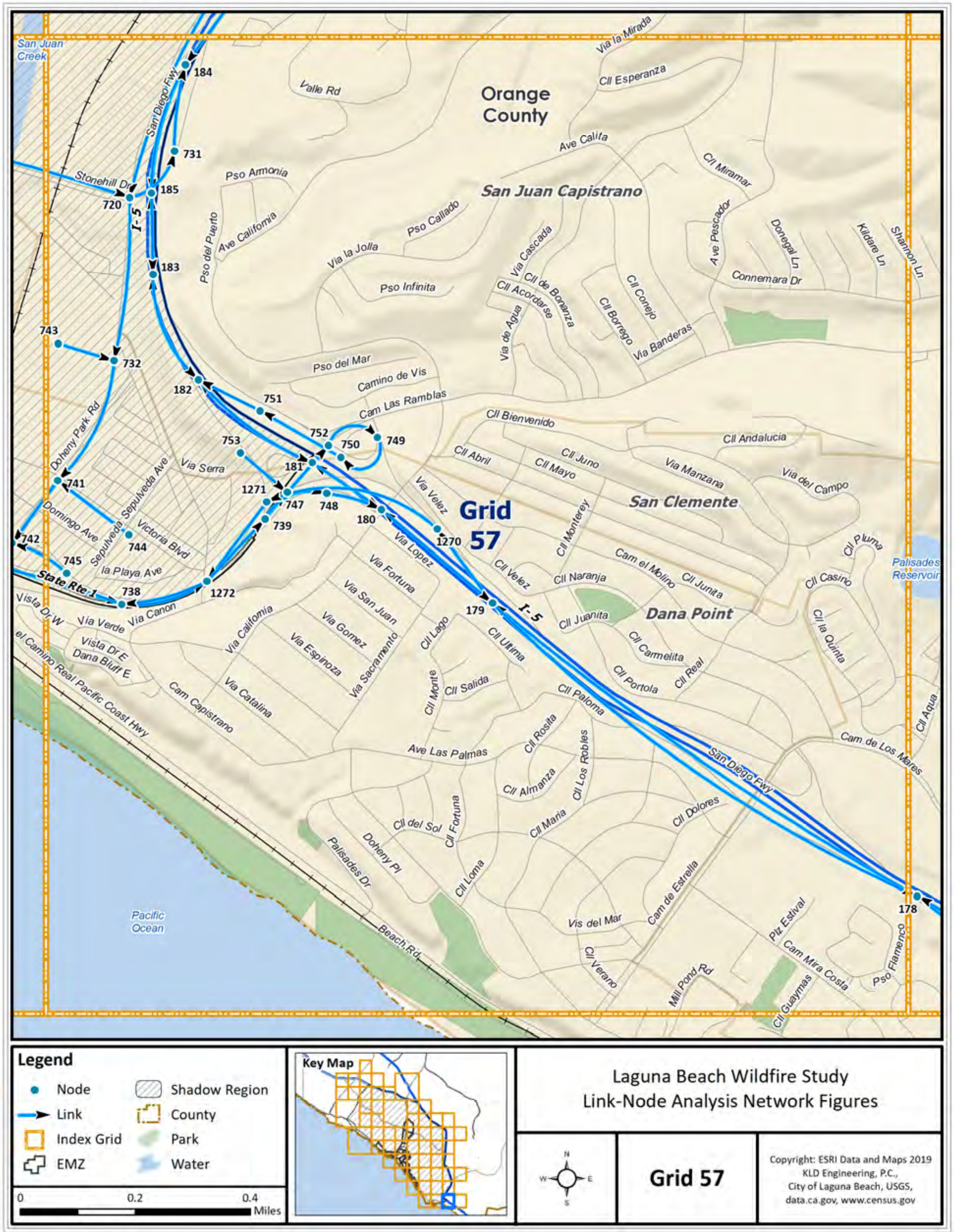


Figure H-58. Link-Node Analysis Network – Grid 57

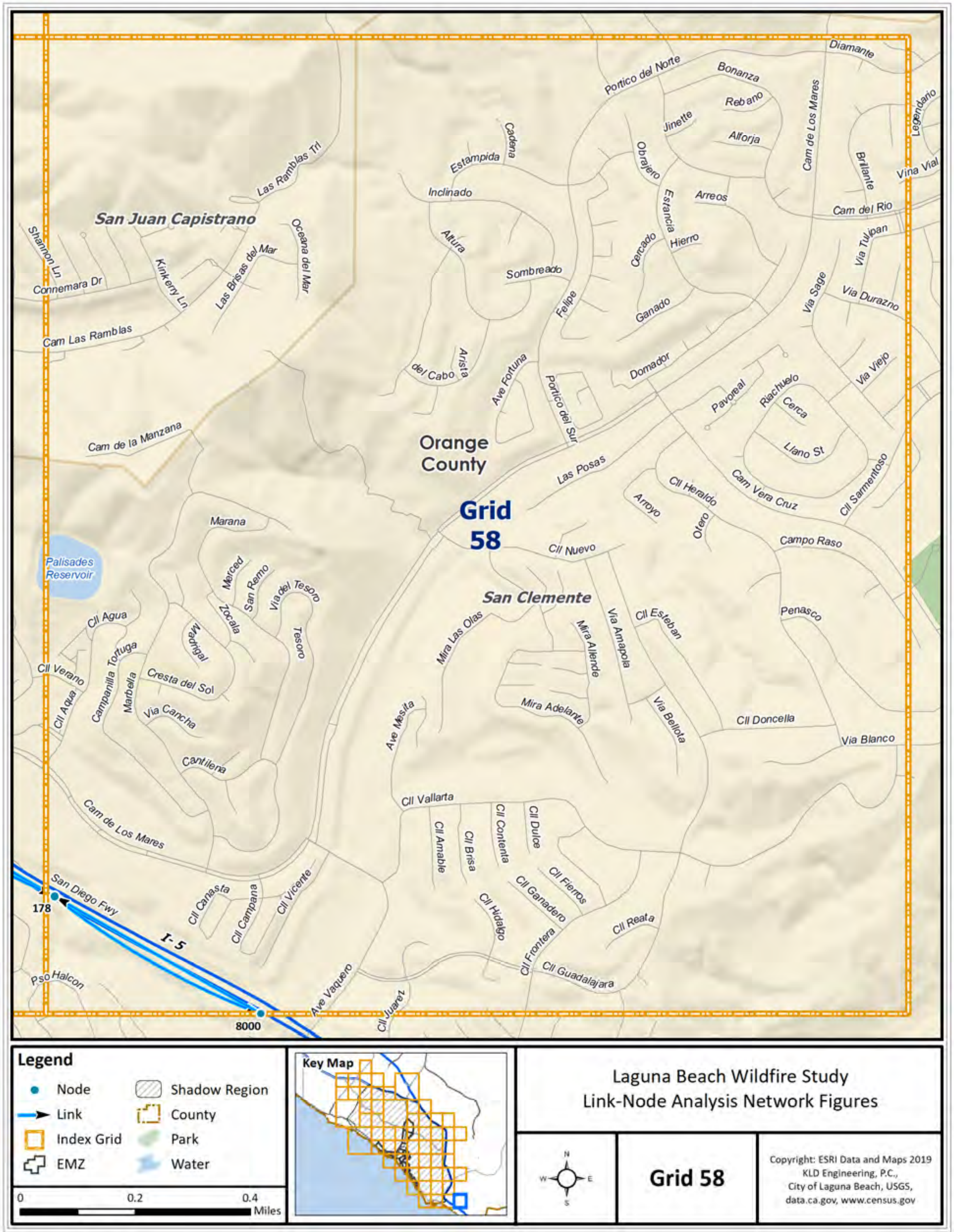


Figure H-59. Link-Node Analysis Network – Grid 58

APPENDIX J

Evacuation Sensitivity Studies

"What-if" Scenarios

J. EVACUATION SENSITIVITY STUDIES

This appendix presents the results of a series of sensitivity analyses, or "what-if" analyses. These analyses are designed to identify the sensitivity of the Evacuation Time Estimate (ETE) to changes in some base evacuation conditions.

J.1 Effect of Changes in Trip Generation Times

A sensitivity study was performed to determine whether changes in the estimated trip generation (mobilization) time influence the ETE for an evacuation of all EMZs (Region R28). Specifically, if the tail of the mobilization distribution were truncated (i.e., if those who responded most slowly to the evacuation order, could be persuaded to respond much more rapidly) or if the tail were elongated (i.e., spreading out the departure of evacuees to limit the demand during peak times), how would the ETE be affected? These "what if" scenarios were considered for a Summer, Midweek, Midday with normal conditions. Results are tabulated in Table J-1. Trip Generation times of 2 hours and 30 minutes, 4 hours and 30 minutes and 5 hours and 30 minutes were tested.

As seen shown in Table J-1, if evacuees mobilize in one less hour or take an additional hour, the 90th and 100th percentile ETE remains unchanged. As discussed in Section 7, congestion exists within the EMZs for approximately 4 hours and 30 minutes after the advisory to evacuate. As such, the ETE is not dictated by the trip generation time, but by the time needed to clear the congestion within the EMZ. Alternatively, when evacuees take an additional two hours to mobilize (well beyond when congestion clears), the ETE at the 100th percentile is dictated by the trip generation time (plus a 5-minute travel time to the EMZ boundary).

J.2 Effect of Changes in the Number of People in the Shadow Region Who Relocate

A sensitivity study was conducted to determine the effect on ETE due to changes in the percentage of people who decide to relocate from the Shadow Region beyond the ridge line, see Figure G-29. The case considered was Scenario 1, Region R28; a summer, midweek, midday, with normal conditions. The movement of people in the Shadow Region has the potential to impede vehicles evacuating from an Evacuation Region. Refer to Sections 3.2 and 7.1 for additional information on population within the Shadow Region. Shadow evacuation percentages of 25, 50, and 100 were tested.

Table J-2 presents the ETE for each of the cases considered. The results show that increasing the shadow population to 25 percent does not show a change at the 90th and the 100th percentile ETE. Increasing the shadow evacuation to 50%, increases the ETE by 10 minutes for the 90th percentile and 5 minutes for the 100th percentile – not a significant change. A full evacuation (100%) of the Shadow Region increases both the 90th and the 100th percentile ETE by 1 hour and 5 minutes – significant changes.

The Shadow Region includes the cities of Newport Beach to the north and the Laguna Niguel and Dana Point to the southeast of Laguna Beach, all densely populated areas. Therefore, any change in percentage of people that decide to voluntarily evacuate will affect the available capacity of the major evacuation routes leaving Laguna Beach. An increase in shadow evacuees will increase congestion, delay the egress of the EMZ evacuees, and prolong ETE.

J.3 Effect of Reducing the Evacuation Demand – One Vehicle per Household

The relationship between supply and demand is very important in computing evacuation time. Evacuation travel supply is the ability of the roadway network to serve the traffic demand (number of evacuating vehicles) during an emergency. In this context, when the demand exceeds the supply (available capacity), congestion occurs causing delay and prolonging the evacuation. The roadway capacity is often difficult to increase as its expensive and difficult to widen existing infrastructure or build additional roadways. Thus, it is good practice to attempt reduce the evacuating traffic demand such that demand does not exceed capacity. The demographic survey of the EMZs indicated residents would use approximately 1.64 vehicles per household during an evacuation (see Appendix F). A sensitivity study was conducted to determine the effect on ETE when the evacuating vehicles per household was reduced to one.

As seen in Table J-3, during the base case scenario, there are 17,571 evacuating residential vehicles inside the EMZ (see Table 3-4). When the number of evacuation vehicles per household is reduced to one, the number of evacuating residential vehicles is reduced to 10,705 – an approximately 40% reduction in traffic demand. The case considered was Scenario 1, Region R28; a summer, midweek, midday, with normal conditions and an evacuation of all EMZs. When the evacuee traffic demand is reduced by approximately 40%, the 90th percentile ETE is reduced by 1 hour and the 100th percentile ETE is reduced by 1 hour and 15 minutes. The 100th percentile ETE is now dictated by trip generation time (plus a 5-minute travel time to the EMZ boundary) and no longer is dictated by congestion. Efforts should be made to inform the general population that reducing the number of vehicles each household uses during an evacuation can greatly reduce the amount of time needed to evacuate the area.

J.4 Effect of Direction of Wildfire Approach

Depending on the origin and prevailing winds, a wildfire can block one or more egress routes out of the EMZs. Alternatively, emergency officials could decide to reserve egress routes for first responders and emergency vehicles and only use SR-1 northbound or southbound for evacuees. Four cases were run to simulate various roadway closure cases:

1. A scenario where SR-133 northbound is closed,
2. SR-133 northbound and SR-73 in both directions between SR-133 and I-405 are closed,
3. SR-133 northbound and SR-1 northbound are closed, and
4. SR-133 northbound and SR-1 southbound are closed.

These four cases were run for all scenarios for Regions R26 - R30, as shown in Table J-4 through Table J-11.

J.4.1 Closure of SR-133

Table J-4 and Table J-5 represent the 90th and 100th percentile ETE results when EMZ evacuees are unable to utilize SR-133 northbound. This case was run to represent a wildfire event that is in Laguna Coast Wilderness Park and evacuation to the north along SR-133 is not feasible. The road closure is located such that all evacuees south of SR-73 are forced to travel into downtown Laguna beach and then evacuate along SR-1 towards Dana Point or Newport Beach.

The 90th percentile ETE ranges between 2:25 (Hours:Minutes) and 4:40 for all scenarios for Regions R26 through R30. The 100th percentile ETE ranges between 3:35 (Hours:Minutes) and 5:20 for all scenarios for Regions R26 through R30.

When comparing the results of Table J-4 to Table 7-1, it can be seen that the 90th percentile ETE increases by as much as 55 minutes. When comparing Table J-5 and Table 7-2, the 100th percentile ETE increases by as much as 40 minutes. During the base case (summer midweek midday, normal conditions scenario of an evacuation of all EMZs) scenario, approximately 4,900 vehicles utilize SR-133 northbound to exit the EMZs. These vehicles are forced to reroute to SR-1, which is already oversaturated, when SR-133 is closed. As a result, congestion within the EMZ worsens, delays increase, and ETE increases.

J.4.2 Closure of SR-133 and SR-73

Table J-6 and Table J-7 represent the 90th and 100th percentile ETE results when EMZ evacuees are unable to utilize SR-133 northbound and SR-73 in both directions between SR-133 and Interstate 405 (I-405). This case was run to represent a wildfire event that is in Laguna Coast Wilderness Park and evacuation to the north along SR-133 and along SR-73 (in either direction) is not feasible. The road closure is located such that all evacuees south of SR-73 are forced to travel into downtown Laguna beach and then evacuate along SR-1 towards Dana Point or Newport Beach. For this case, it was assumed that the ramps that lead to SR-73 between SR-133 and I-405 are closed.

The 90th percentile ETE ranges between 2:35 (Hours:Minutes) and 4:50 for all scenarios for Regions R26 through R30. The 100th percentile ETE ranges between 3:35 (Hours:Minutes) and 5:45 for all scenarios for Regions R26 through R30.

When comparing the results of Table J-6 to Table 7-1 and Table J-7 and Table 7-2, it can be seen that the 90th and 100th percentile ETE increase by as much as 1 hour and 20 minutes each. During the base case (summer midweek midday, normal conditions scenario of an evacuation of all EMZs) scenario, approximately 4,900 vehicles utilize SR-133 northbound to exit the EMZs. These vehicles are forced to reroute to SR-1, which is already oversaturated, when SR-133 is closed. In addition, over 9,000 vehicles utilize SR-73 westbound and over 3,000 vehicles utilize SR-73 eastbound. These vehicles are forced to reroute to I-405 or SR-1 to reach the same destination. As a result, congestion within the study area worsens, delays increase, and ETE increases.

J.4.3 Closure of SR-133 and SR-1 Northbound

Table J-8 and Table J-9 represent the 90th and 100th percentile ETE results when EMZ are forced to evacuate southbound toward Dana Point along SR-1 southbound. This case was run to represent a wildfire event that is near Laguna Coast Wilderness Park and Crystal Cove State Park and evacuation to the north along SR-1 and SR-133 is not feasible. The road closure is located such that all evacuees within the Laguna Beach EMZs are forced to evacuate along SR-1 southbound toward Dana Point.

The 90th percentile ETE ranges between 3:40 (Hours:Minutes) and 7:05 for all scenarios for Regions R26 through R30. The 100th percentile ETE ranges between 4:30 (Hours:Minutes) and 8:20 for all scenarios for Regions R26 through R30.

When comparing the results of Table J-8 to Table 7-1, it can be seen that the 90th percentile ETE increases by as much as 3 hours and 25 minutes. When comparing Table J-9 and Table 7-2, the 100th percentile ETE increases by as much as 4 hours. During the base case (summer midweek midday, normal conditions scenario of an evacuation of all EMZs) scenario, approximately 4,900 vehicles utilize SR-133 northbound and over 12,000 vehicles utilize SR-1 northbound to exit the EMZs. These vehicles are forced to reroute to SR-1 southbound. SR-1 southbound is overwhelmed, and congestion and queuing worsen. As a result, ETE significantly increases.

J.4.4 Closure of SR-133 and SR-1 Southbound

Table J-10 and Table J-11 represent the 90th and 100th percentile ETE results when EMZ are forced to evacuate northbound toward Newport Beach along SR-1 northbound. This case was run to represent a wildfire event that is near Aliso and Wood Canyon Wilderness Park and evacuation to the south along SR-1 and north along SR-133 is not feasible. The road closure is located such that all evacuees within the Laguna Beach EMZs are forced to evacuate along SR-1 northbound toward Newport Beach.

The 90th percentile ETE ranges between 3:45 (Hours:Minutes) and 6:50 for all scenarios for Regions R26 through R30. The 100th percentile ETE ranges between 4:30 (Hours:Minutes) and 8:00 for all scenarios for Regions R26 through R30.

When comparing the results of Table J-10 to Table 7-1, it can be seen that the 90th percentile ETE increases by as much as 3 hours and 25 minutes. When comparing Table J-11 and Table 7-2, the 100th percentile ETE increases by as much as 3 hours and 45 minutes. During the base case (summer midweek midday, normal conditions scenario of an evacuation of all EMZs) scenario, approximately 4,900 vehicles utilize SR-133 northbound and about 12,000 vehicles utilize SR-1 southbound to exit the EMZs. These vehicles are forced to reroute to SR-1 northbound. SR-1 northbound is overwhelmed, and congestion and queuing worsen. As a result, ETE significantly increases.

J.4.5 Patterns of Traffic Congestion during Closures

Figure J-1 through Figure J-7 show the patterns of congestion for the closure cases discussed above and the base case at each hour into the evacuation up to 7 hours after the advisory to evacuate.

At 1 hour into the evacuation, as shown in Figure J-1, all cases show peak congestion in the EMZs. Congestion along SR-1 is severe in all cases. Congestion along I-405 is worst in the case wherein parts of SR-73 are closed as these vehicles utilize I-405 to get to their destination. Congestion along SR-73 is worse in all cases (except the case wherein parts of it are closed) when compared to the base case. This is because vehicles in the Shadow Region choose to evacuate via SR-73 instead of SR-1 since parts SR-1 are closed or SR-1 is so congested (in the SR-133 only closure case).

When comparing the patterns of congestion at 2 hours into the evacuation for all closure cases, in Figure J-2, the north-eastern portion of the city (Top of the World, Old Top of the World, Temple Hills, and Bluebird Canyon) is more congested than in the base case. Congestion along I-405 is worst in the SR-133 and SR-73 closure case. Congestion along SR-1 outside of the EMZs is worst in the case wherein SR-133 and SR-73 are closed, as well.

At 3 hours into the evacuation, as shown in Figure J-3, congestion remains in the southern portion of the shadow region in all cases. Severe congestion persists in most of the city for the cases wherein SR-1 is closed either northbound or southbound. Congestion patterns in the case wherein SR-133 is closed with and without a closure along SR-73 are similar.

Figure J-4 shows the patterns of congestion at 4 hours after the advisory to evacuate. At this time, the congestion that remains in the case wherein SR-133 is closed with and without a closure along SR-73 is mainly along SR-1. The congestion along SR-1 in these cases is worse than in the base case at this time. The cases wherein SR-1 is closed northbound or southbound are still heavily congested within the EMZ.

When comparing the patterns of congestion at 5 hours into the evacuation for all closure cases, in Figure J-5, the base case is clear of congestion. The case wherein only SR-133 is closed is nearly clear of congestion. Congestion remains along SR-1 in the case wherein SR-133 and SR-73 are closed. All though lessened since the previous hour, the cases wherein SR-1 is closed northbound or southbound are still congested within the EMZ.

At 6 hours into the evacuation, as shown in Figure J-6, the cases wherein SR-133 with and without a closure along SR-73 are clear of congestion within the EMZs. Some congestion remains along SR-1 northbound north of the EMZs in the case wherein SR-133 and SR-73 are closed. Congestion remains along SR-1 in the direction that is open in the SR-1 closure cases.

Figure J-7 shows the patterns of congestion at 7 hours after the advisory to evacuate. All cases, except the case wherein SR-133 and SR-1 northbound, are closed are clear of congestion at this time. This congestion clears an hour and 20 minutes later.

J.5 Effect of Using Contraflow

Contraflow is a form of reversible traffic operation in which one or more travel lanes of a divided highway are used for the movement of traffic in the opposing direction[1]. It is an effective way of temporarily increasing the available capacity of a roadway, if planned for and executed effectively, without the monetary cost of widening a roadway or building a new one. For this sensitivity study, three cases of contraflow were analyzed:

- Contraflow of a single lane on SR-1 southbound from SR-133 to Reef Point Drive - since contraflow of both southbound lanes would be difficult to implement and would not permit emergency vehicles from entering the area along SR-1 southbound, only a single lane was contraflowed. For this case, the network included 3 lanes along SR-1 northbound and one lane on SR-1 southbound from SR-133 to Reef Point Drive.
- Contraflow of a single lane on SR-1 northbound from SR-133 to Crown Valley Parkway[2] - since contraflow of both southbound lanes would be difficult to implement and would not permit emergency vehicles from entering the area along SR-1 northbound, only a single lane was contraflowed. For this case, the network included 3 lanes along SR-1 southbound and one lane on SR-1 northbound from SR-133 to Crown Valley Parkway.
- Contraflow of the center turning lane along SR-133 from Canyon Acres Drive to El Toro Road, since contraflow of both the southbound and center turning lanes would be difficult to implement and would not permit emergency vehicles from entering the area along SR-133 southbound. For this case, the network included 2 lanes along SR-133 northbound and one lane on SR-133 southbound for this stretch of roadway.

For these cases, it was assumed the contraflow was in place at the start of the evacuation. ETE were calculated for Scenario 1, Region R28, R29 and R30; a summer, midweek, midday, with normal conditions and an evacuation of all EMZs. The results were compared to Section 7.

As shown in Table J-12, if contraflow is implemented for an evacuation along SR-1 north, the 90th percentile ETE is reduced by at most 10 minutes and the 100th percentile ETE is reduced by at most 15 minutes. If contraflow is implemented for an evacuation along SR-1 south, the 90th percentile ETE is reduced by at most 20 minutes. There is no impact on the 100th percentile ETE. If contraflow is implemented for an evacuation along SR-133 north, the 90th and 100th percentile ETE are reduced by at most 5 minutes and 15 minutes, respectively. The additional lanes that are used to contraflow traffic, increases the capacity of these roadways by about one third. As a result, evacuees reach safety more quickly.

Care should be given to when and how a contraflow plan is implemented. Depending on the roadway configuration, implementing contraflow can inhibit first responders and/or emergency vehicles trying to reach the area of risk or residents returning from work to unite with their families to evacuate. Implementing contraflow is dangerous – potential for head-on collisions –

[1] A Policy on Geometric Design of Highways and Streets, 5th Edition., American Association of State Highway and Transportation Officials, Washington, D.C. (2001)

[2] Please note for this case, external traffic traveling northbound on SR-1 were given the ability to utilize I-5 as the single lane servicing northbound traffic on SR-1 is not sufficient to process these vehicles and service the evacuating traffic demand.

and resource intensive – requires extensive equipment and personnel to block all roadways that could potentially turn into oncoming traffic. Despite the fact that the ETE decreases when contraflow is implemented, the ETE benefit does not outweigh the danger and effort required to implement it. Implementing contraflow would only be worth the risk if the ETE decreases by hours, not minutes.

J.6 Effect of Additional Housing Units Along SR-1

The City requested an additional sensitivity study be performed to determine whether adding an additional 400 housing units along SR-1 in the City of Laguna Beach would have an impact on ETE. The presence of additional housing units in the city will increase the number of permanent residents, and thereby increase the number of vehicles, evacuating along SR-1. As described earlier, evacuation travel supply is the ability of a roadway network to serve the traffic demand (number of evacuating vehicles) during an emergency. The results from the demographic survey indicate that, on average, households would use 1.64 vehicles to evacuate. Therefore, the addition of 400 housing units along SR-1 will increase the evacuating vehicle demand by 656 vehicles (400 x 1.64 vehicles). The exact location of the units was not provided, but it was indicated the housing units would be generally located near the coastal highway. It was assumed that fifty percent of the housing units would be built north of SR-133 along SR-1, and that fifty percent of the housing units would be built south of SR-133 along SR-1. This case was studied for Regions R26 through R30 for all scenarios.

The 90th percentile ETE ranges between 2:05 (Hours:Minutes) and 3:55 for all scenarios for Regions R26 through R30. The 100th percentile ETE ranges between 3:35 (Hours:Minutes) and 5:30 for all scenarios for Regions R26 through R30.

When comparing the results of Table J-13 to Table 7-1, it can be seen that the 90th percentile ETE increases by as much as 25 minutes. When comparing Table J-14 and Table 7-2, the 100th percentile ETE increases by as much as 40 minutes – a significant change. The greatest increases in ETE are experience during weekend scenarios. During weekends, transient activity is high and many transient facilities are located along SR-1. During these scenarios SR-1 is already overwhelmed and highly congested. The additional 656 vehicles exacerbate the congestion along SR-1. As a result, delays increase and ETE increases.

Table J-1. Evacuation Time Estimates for Trip Generation Sensitivity Study

Trip Generation Time (Minutes)	Evacuation Time Estimates for All EMZs	
	90th Percentile	100th Percentile
2 Hours and 30 Minutes	3:45	4:50
3 Hours and 30 Minutes (Base)	3:45	4:50
4 Hours and 30 Minutes	3:45	4:50
5 Hours and 30 Minutes	3:45	5:35

Table J-2. Evacuation Time Estimates for Shadow Sensitivity Study

Percent Shadow Evacuation Beyond the Ridge Line	Evacuating Shadow Vehicles[3] Beyond the Ridge Line	Evacuation Time Estimate for All EMZs	
		90th Percentile	100th Percentile
14 (Base)	29,624	3:45	4:50
25	52,900	3:45	4:50
50	105,800	3:55	4:55
100	211,601	4:50	5:55

Table J-3. Evacuation Time Estimates for Reduction in Demand

Case	Evacuating Resident Vehicles	Evacuation Time Estimates for All EMZs	
		90th Percentile	100th Percentile
One Vehicle per HH	10,705	2:45	3:30
Base Case	17,571	3:45	4:50

[3] The Evacuating Shadow Vehicles, in Table J-2, represent the residents and employees who will spontaneously decide to relocate during the evacuation. The basis, for the base values shown, is a 14% relocation of shadow residents along with a proportional percentage of shadow employees. See Section 6 for further discussion.

Table J-4. 90th Percentile ETE – SR-133 Closure

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Midday		Evening	Midday		Midday	Evening
Region	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	3:25	3:15	2:35	3:10	3:35	2:50	2:25
R27 - South and Central Laguna	3:50	3:40	2:55	3:35	4:10	3:10	2:50
R28 – All EMZs + 100% of Shadow Region along Ridge Line	4:30	4:15	3:35	4:15	4:40	3:45	3:15
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	4:25	4:15	3:30	4:10	4:35	3:45	3:15
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	4:20	4:10	3:30	4:05	4:35	3:40	3:15

Table J-5. 100th Percentile ETE – SR-133 Closure

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Midday		Evening	Midday		Midday	Evening
Region	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	4:05	4:05	3:35	3:50	4:10	3:35	3:35
R27 - South and Central Laguna	4:30	4:15	3:35	4:20	5:00	4:10	3:35
R28 – All EMZs + 100% of Shadow Region along Ridge Line	5:10	4:55	4:10	4:55	5:20	4:20	3:55
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	5:00	4:55	4:10	4:45	5:15	4:20	3:55
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	5:00	4:55	4:10	4:50	5:10	4:20	3:50

Table J-6. 90th Percentile ETE – SR-133 and SR-73 Closure

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Midday		Evening	Midday		Midday	Evening
Region	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	3:30	3:45	2:35	3:35	3:35	3:10	2:35
R27 - South and Central Laguna	3:50	3:35	2:55	3:45	3:55	3:15	2:40
R28 – All EMZs + 100% of Shadow Region along Ridge Line	4:50	4:15	3:55	4:35	4:35	3:45	3:40
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	4:45	4:30	3:35	4:35	4:40	3:45	3:15
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	4:20	4:05	3:30	4:05	4:30	4:00	3:20

Table J-7. 100th Percentile ETE – SR-133 and SR-73 Closure

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Midday		Evening	Midday		Midday	Evening
Region	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	4:35	4:45	3:35	4:35	4:50	4:15	3:35
R27 - South and Central Laguna	4:55	4:35	3:35	4:45	5:00	4:10	3:35
R28 – All EMZs + 100% of Shadow Region along Ridge Line	5:45	5:25	4:45	5:30	5:40	4:45	4:30
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	5:40	5:25	4:30	5:25	5:40	4:45	3:50
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	5:10	4:50	4:20	5:00	5:10	4:45	4:00

Table J-8. 90th Percentile ETE – SR-133 and SR-1 Northbound

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	4:45	4:30	4:15	4:25	4:55	3:40	3:45
R27 - South and Central Laguna	5:35	5:15	4:55	5:10	5:45	4:25	4:30
R28 – All EMZs + 100% of Shadow Region along Ridge Line	6:50	6:30	6:10	6:20	7:05	5:30	5:40
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	6:50	6:30	6:10	6:20	7:05	5:35	5:40
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	6:50	6:30	6:10	6:20	7:05	5:30	5:40

Table J-9. 100th Percentile ETE – SR-133 and SR-1 Northbound

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	6:20	6:15	5:40	5:25	5:55	4:30	4:40
R27 - South and Central Laguna	7:35	7:30	6:40	6:30	7:05	5:15	5:25
R28 – All EMZs + 100% of Shadow Region along Ridge Line	8:20	8:05	7:30	7:30	8:05	6:20	6:35
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	8:20	8:05	7:30	7:30	8:05	6:20	6:35
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	8:20	8:05	7:30	7:30	8:05	6:20	6:35

Table J-10. 90th Percentile ETE – SR-133 and SR-1 Southbound

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	5:10	4:45	4:55	5:00	5:00	3:45	4:05
R27 - South and Central Laguna	5:15	4:15	4:00	4:40	5:20	4:00	4:00
R28 – All EMZs + 100% of Shadow Region along Ridge Line	6:50	6:15	6:15	6:05	6:05	4:35	5:05
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	6:25	6:45	6:05	5:55	5:55	4:45	4:50
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	6:45	6:10	5:30	5:55	5:55	5:15	4:35

Table J-11. 100th Percentile ETE – SR-133 and SR-1 Southbound

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	6:15	5:50	5:55	6:05	6:10	4:30	5:00
R27 - South and Central Laguna	6:20	5:20	4:50	5:35	6:15	4:40	4:45
R28 – All EMZs + 100% of Shadow Region along Ridge Line	8:00	7:20	7:25	7:10	7:10	5:25	5:55
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	7:50	7:45	7:00	7:00	7:00	5:35	5:40
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	8:00	7:10	6:25	6:55	6:55	6:10	5:25

Table J-12. Evacuation Time Estimates for Scenario 1 – Contraflow Sensitivity Study

Contraflowed Roadway	90th Percentile ETE	100th Percentile
Region R28 – All EMZs + 100% of Shadow Region along Ridge Line		
Base Case	3:45	4:50
SR-1 NB	3:35	4:35
SR-1 SB	3:25	4:50
SR-133 NB	3:45	4:35
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only		
Base Case	3:30	4:20
SR-1 NB	3:30	4:20
SR-1 SB	3:10	4:20
SR-133 NB	3:25	4:15
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only		
Base Case	3:35	4:50
SR-1 NB	3:35	4:35
SR-1 SB	3:25	4:50
SR-133 NB	3:35	4:40

Table J-13. 90th Percentile ETE – Additional Housing Units

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	3:00	2:45	2:10	2:45	2:50	2:25	2:05
R27 - South and Central Laguna	3:15	3:10	2:45	3:10	3:30	2:55	2:30
R28 – All EMZs + 100% of Shadow Region along Ridge Line	3:55	3:40	3:05	3:25	3:50	3:20	2:55
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	3:35	3:35	3:05	3:25	3:40	3:20	2:40
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	3:35	3:30	3:00	3:20	3:45	3:05	2:45

Table J-14. 100th Percentile ETE – Additional Housing Units

	Summer		Summer	Fall		Fall	
	Midweek	Weekend	Midweek Weekend	Midweek		Weekend	Midweek Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Region	Midday		Evening	Midday		Midday	Evening
	Normal Conditions	Normal Conditions	Normal Conditions	Normal Conditions	Reduced Roadway Capacity	Normal Conditions	Normal Conditions
R26 - North and Central Laguna	3:55	3:40	3:35	3:45	3:35	3:35	3:35
R27 - South and Central Laguna	4:30	4:35	3:35	4:20	5:00	4:10	3:35
R28 – All EMZs + 100% of Shadow Region along Ridge Line	5:00	4:50	3:55	4:45	5:30	4:30	3:40
R29 - All EMZs + 100% of Shadow Region along Ridge Line to the North Only	4:20	4:45	3:45	4:55	5:15	4:15	3:35
R30 - All EMZs + 100% of Shadow Region along Ridge Line to the South Only	4:50	5:00	3:40	4:40	5:20	4:10	3:45

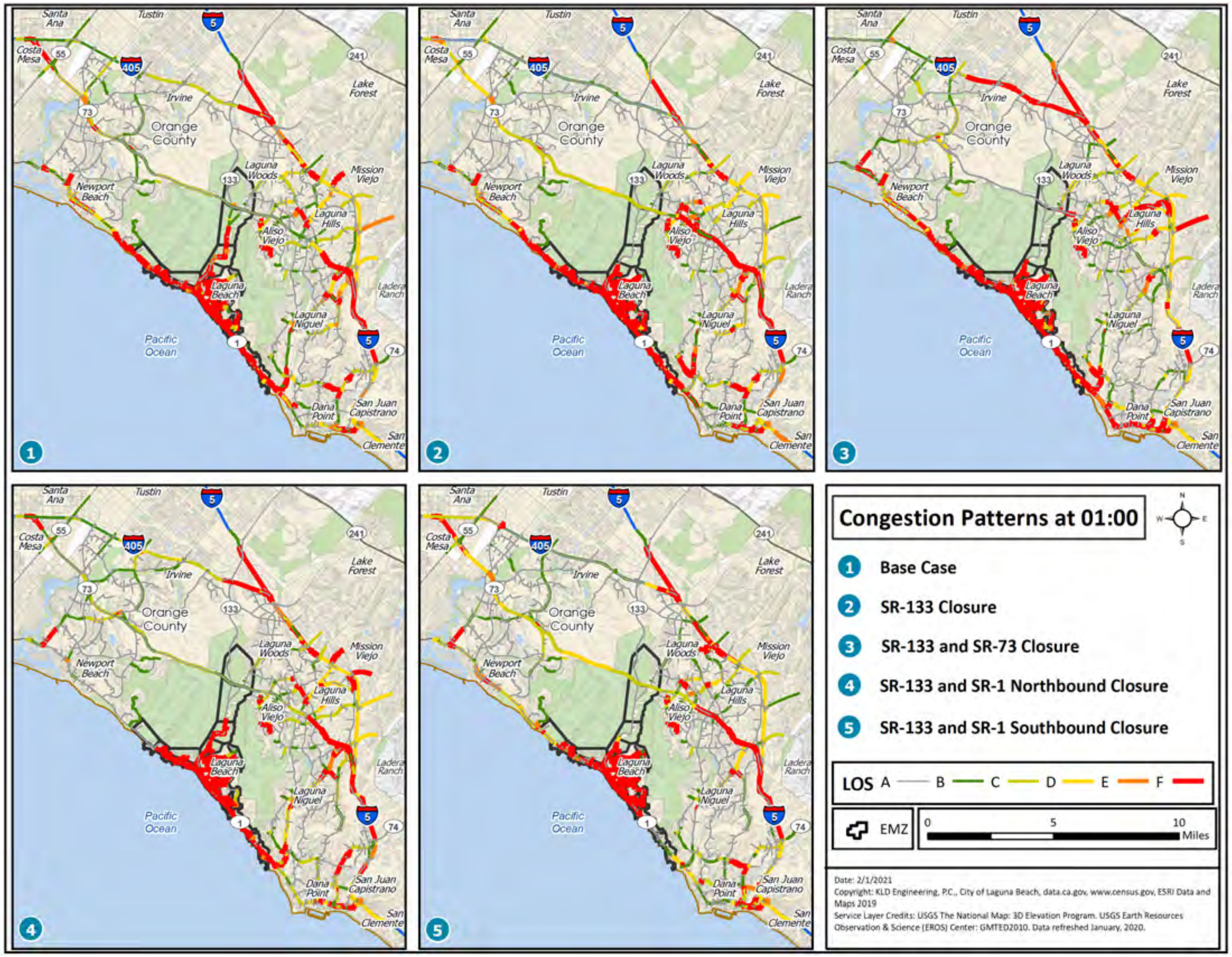


Figure J-1. Road Closure Congestion Patterns at 1 Hour after the Advisory to Evacuate

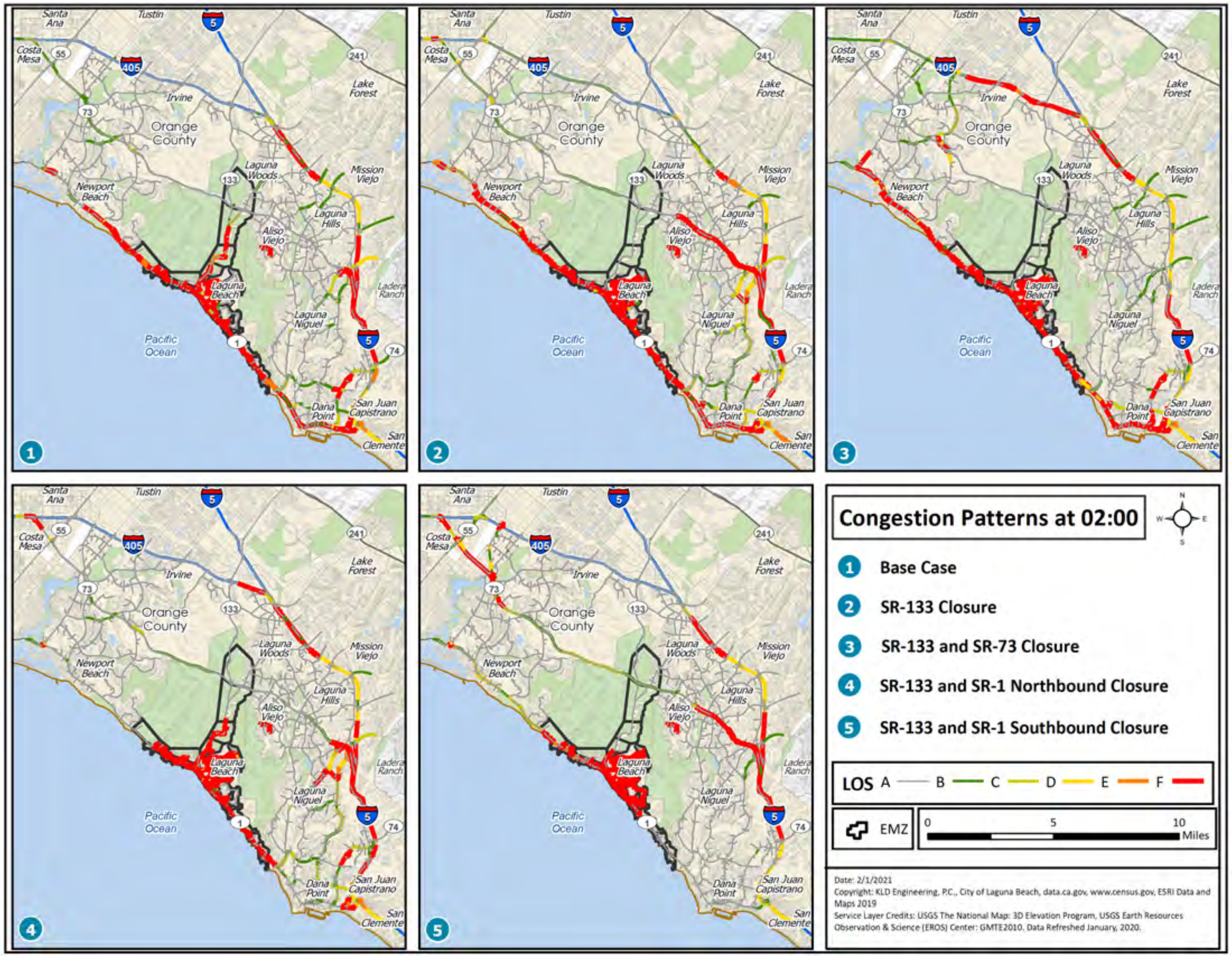


Figure J-2. Road Closure Congestion Patterns at 2 Hours after the Advisory to Evacuate

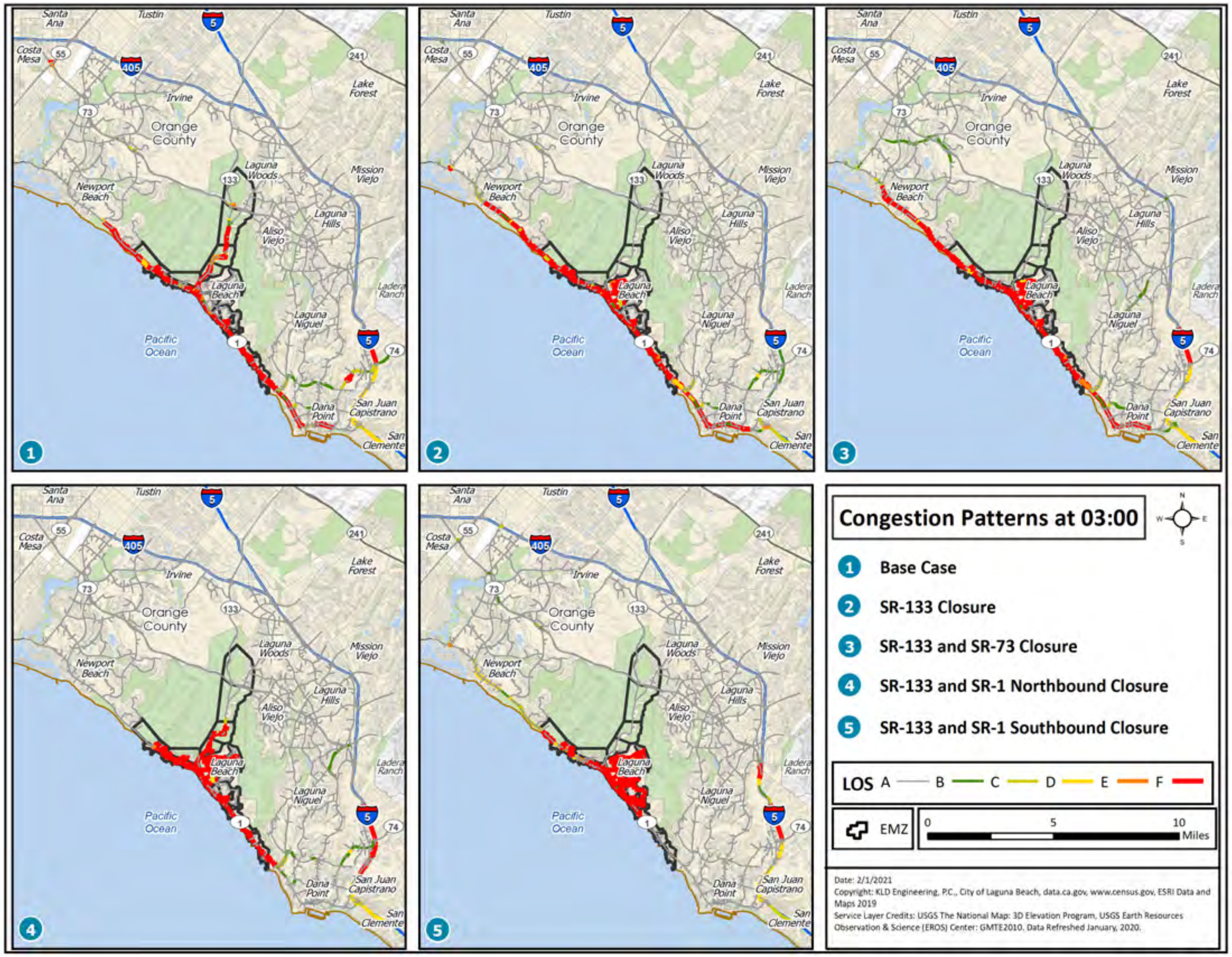


Figure J-3. Road Closure Congestion Patterns at 3 Hours after the Advisory to Evacuate

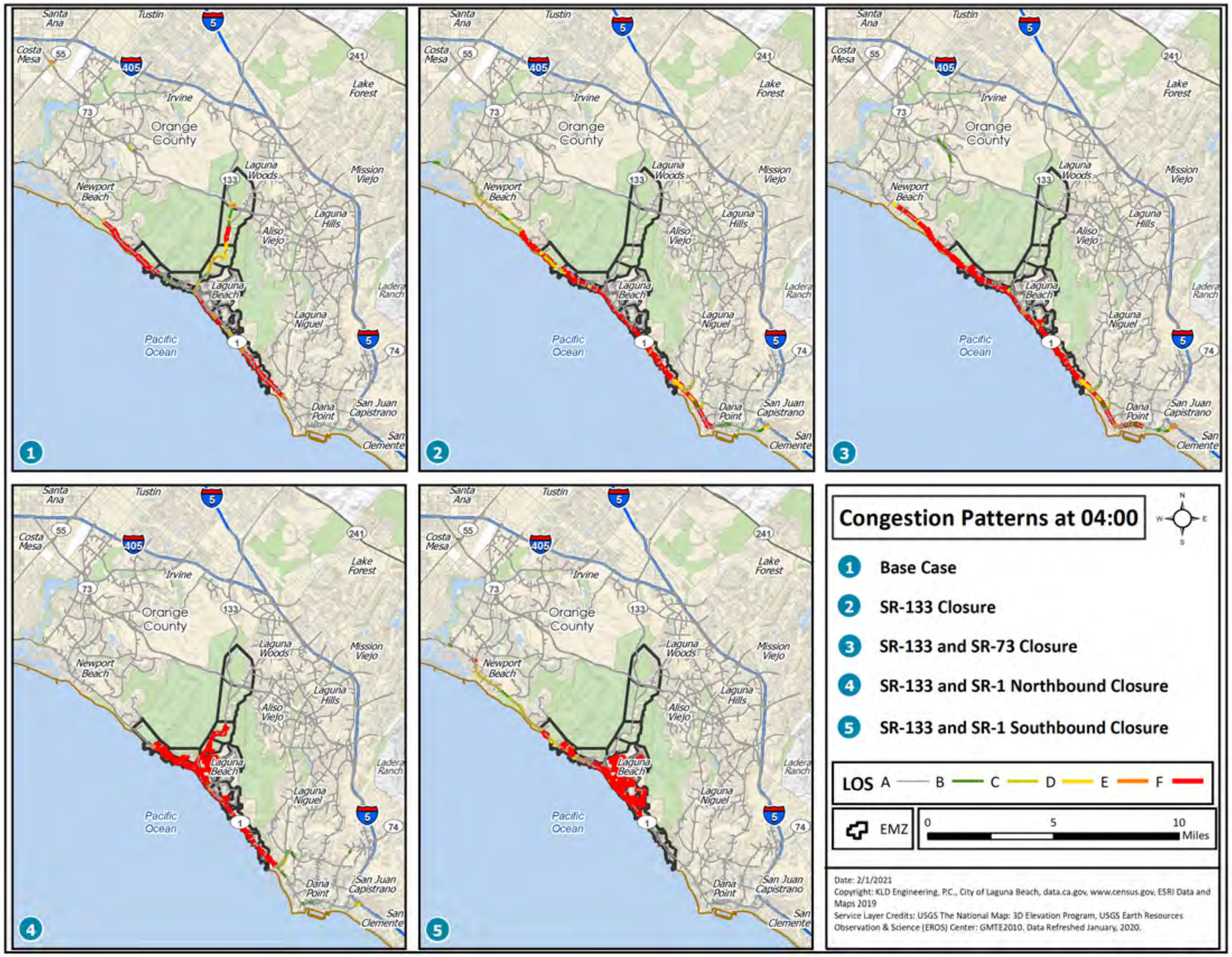


Figure J-4. Road Closure Congestion Patterns at 4 Hours after the Advisory to Evacuate

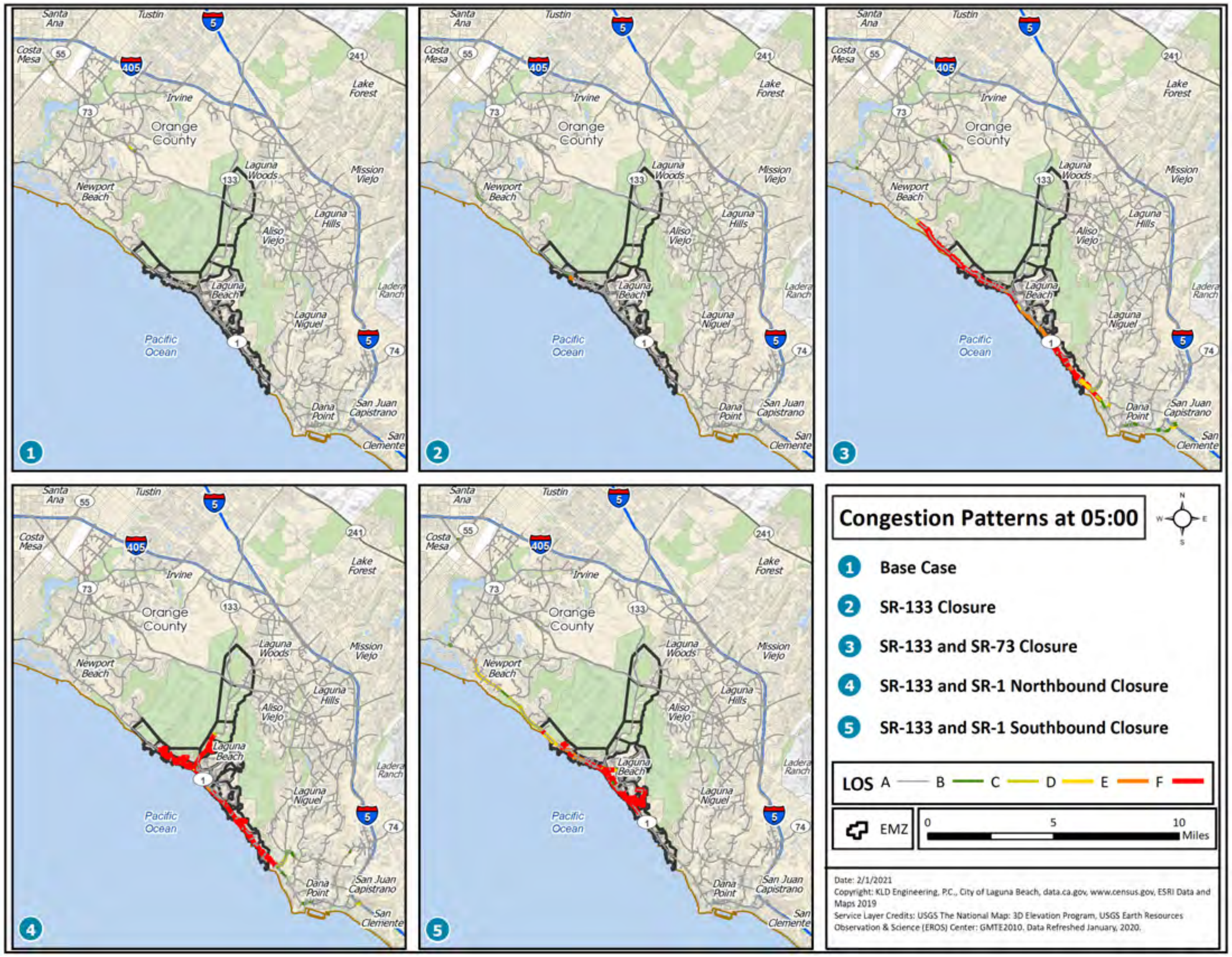


Figure J-5. Road Closure Congestion Patterns at 5 Hours after the Advisory to Evacuate

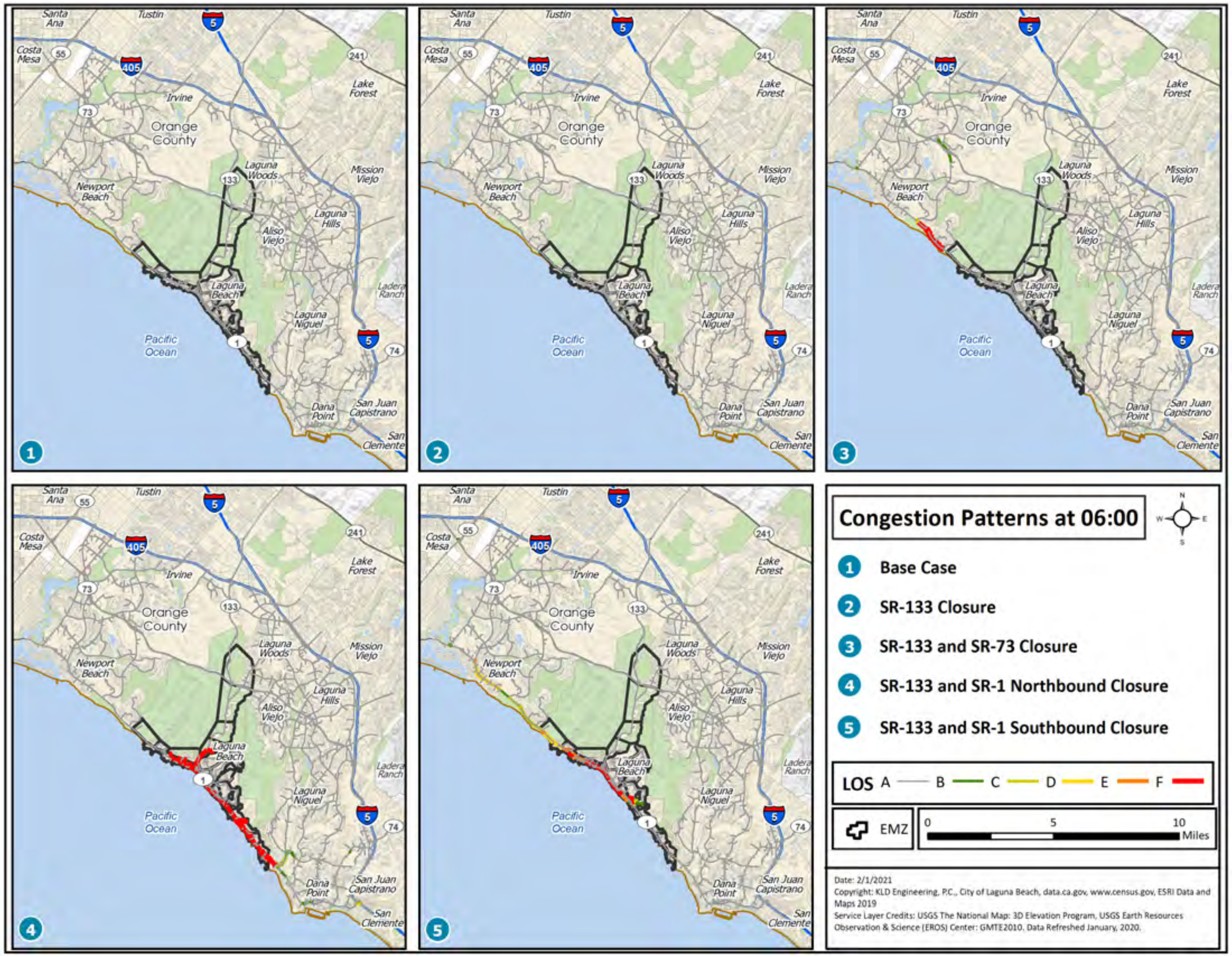


Figure J-6. Road Closure Congestion Patterns at 6 Hours after the Advisory to Evacuate

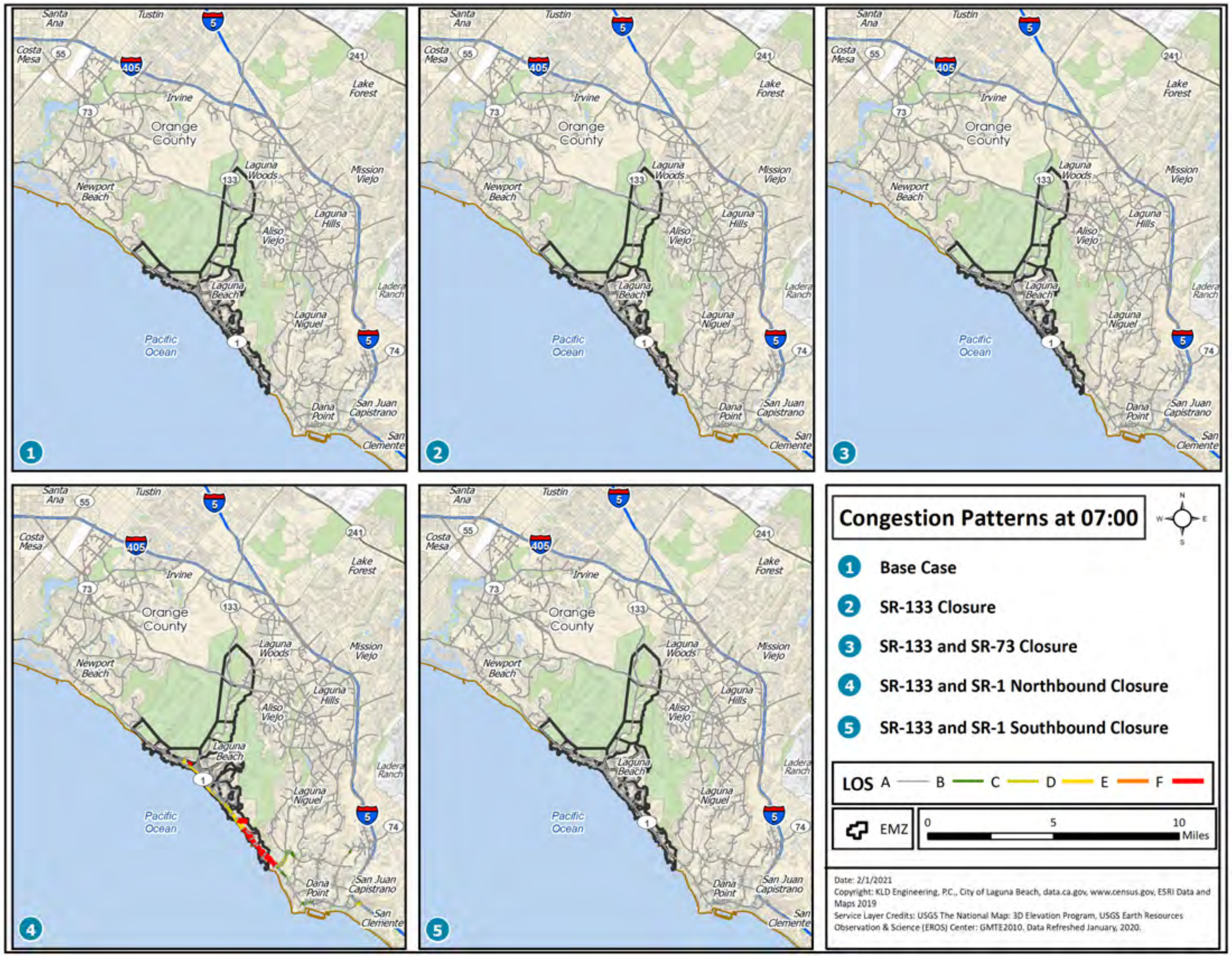


Figure J-7. Road Closure Congestion Patterns at 7 Hours after the Advisory to Evacuate