Attachment G:
Evacuation Capacity Analysis

Kimley»Horn

TECHNICAL MEMORANDUM – DRAFT

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City of Agoura Hills

From: Laura Forinash, P.E., T.E.
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Kimley-Horn and Associates, Inc.

Date: July 29, 2022

Subject: Agoura Hills Emergency Evacuation Study

PURPOSE AND NEED

Kimley-Horn has prepared the following technical memorandum to document the methodology and findings from the Agoura Hills evacuation analysis and total travel time estimation. The purpose of this analysis is to quantify the effect of the Affordable Housing Overlay (AHO) on travel times during emergency evacuation in Agoura Hills. Due to the unpredictable nature of emergencies, the 2018 Woolsey Fire was reviewed and travel patterns, vehicle volumes, and travel times were utilized in this analysis.

STUDY METHODOLOGY

An evacuation analysis was conducted using Synchro models to estimate the additional travel times from the City's evacuation zones to their respective safe destination (i.e., US-101) during a mandatory evacuation under the General Plan Update conditions.

Study Area

Using the City's draft Evacuation Plan, the City was divided into nine evacuation zones as shown in **Figure 1**. As shown in **Figure 1**, each zone has a designated evacuation route to use during an emergency.

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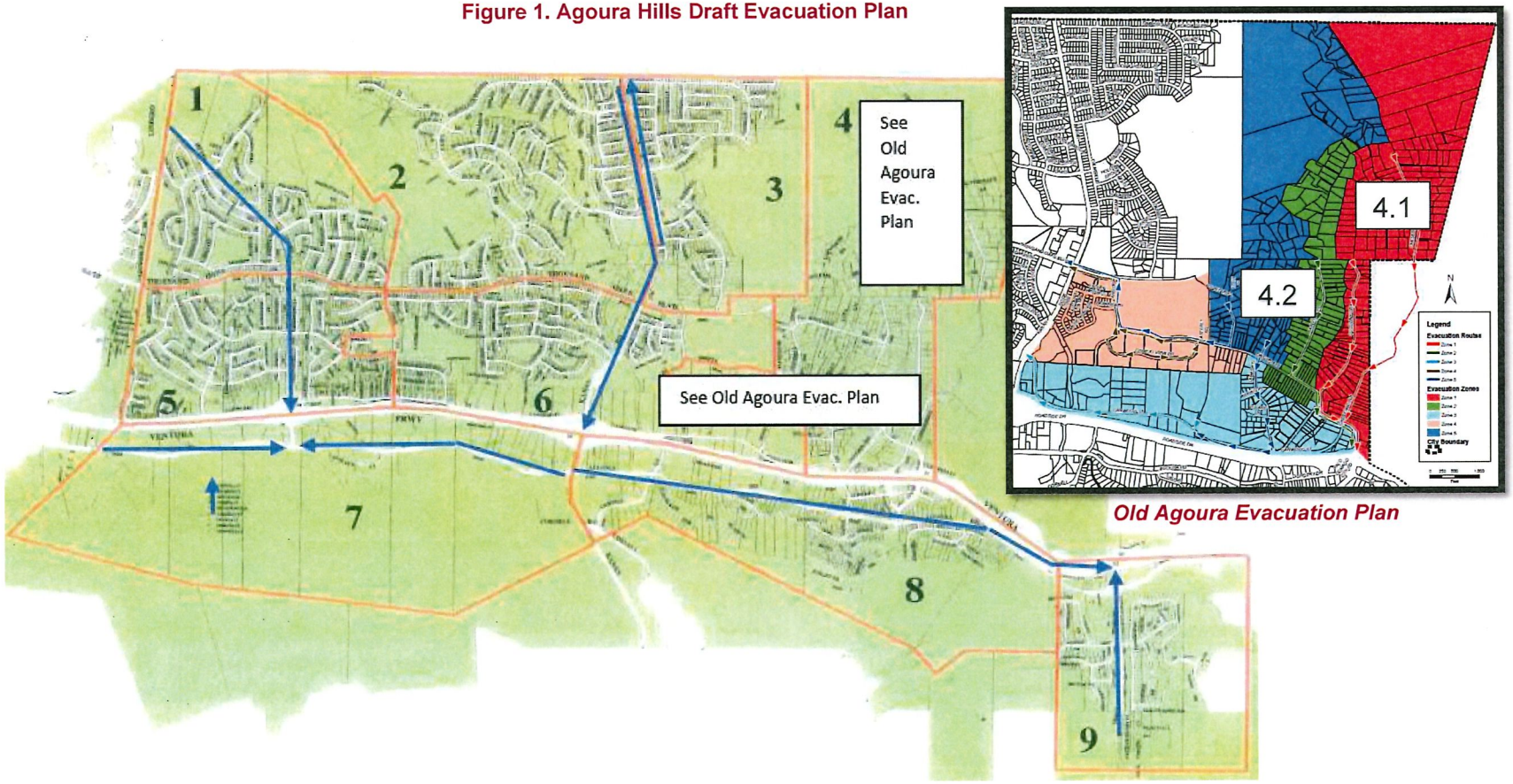
Figure 1. Agoura Hills Draft Evacuation Plan



Old Agoura Evacuation Plan

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Data Collection

To inform our analysis and use for comparison against real-world events, historical travel patterns and volumes were analyzed for the 2018 Woolsey Fire using data from the StreetLight Insight platform. This platform uses geospatial information acquired from anonymized cellular devices (scrubbed of personal information) to model travel patterns. This data was used to both quantify the percentage of households in each zone that evacuated under voluntary versus mandatory evacuation conditions as well as develop an understanding of which routes were used during the evacuation period. Travel time data during the evacuation was also gleaned where possible.

Travel data was pulled for the evacuation zones for Thursday, November 8th, and Friday, November 9th, 2018, and examined at an hourly basis. Two additional zones representing Oak Park and nearby communities in the Santa Monica Mountains were also analyzed.

Trip Generation

This analysis assumed that the evacuation would consist of every household and hotel room within the City. In addition, households from neighboring communities including Oak Park and the nearby communities in the Santa Monica Mountains were accounted for as well. Household and vehicle ownership data was pulled from the 2020 5-Year American Community Survey (ACS) for each Census Block Group (CBG) within the City and surrounding areas to estimate the number of vehicles that would be used by residents to evacuate the City. A vehicle ownership rate of two vehicles per household was multiplied by the number of dwelling units to determine the number of vehicles that would be evacuating each zone.

Voluntary vs Mandatory Evacuation

This analysis modeled the travel times during a mandatory evacuation. To determine voluntary and mandatory evacuation time periods, the "After Action Review of the Woolsey Fire Incident" was used as a reference. This document was produced by Los Angeles County to detail the timeline of emergency responses to the Woolsey Fire and provide recommendations for future emergencies. According to the review, voluntary evacuation orders were issued for the City and surrounding areas at 3:30 PM on Thursday, November 8, 2018. This was followed by mandatory evacuation orders for those zones north of the US-101 freeway at 7:09 PM and for those zones south of the US-101 freeway by 1:35 AM on Friday, November 9, 2018.

A zone activity analysis was performed using Streetlight Insight to determine the number of trips originating in each evacuation zone during the voluntary and mandatory evacuation periods. Mandatory evacuation periods used for analysis were kept to the same number of hours as the voluntary evacuation to compare levels of traffic activity across equal timespans. The results of this analysis are summarized in **Table 1** and were used to calculate the percentage of trips from each evacuation zone that occurred during the voluntary evacuation and after the mandatory evacuation order was issued.

Table 1: Voluntary vs Mandatory Evacuation Trips per Evacuation Zone during 2018 Woolsey Fire

Evacuation Zone	Voluntary Evacuation		Mandatory Evacuation	
	Time	% of Trips	Time	% of Trips
Zone 1	3PM – 7 PM	41%	7 PM – 11 PM	59%
Zone 2	3PM – 7 PM	55%	7 PM – 11 PM	45%
Zone 3	3PM – 7 PM	51%	7 PM – 11 PM	49%
Zone 4.1	3PM – 7 PM	39%	7 PM – 11 PM	61%
Zone 4.2	3PM – 7 PM	25%	7 PM – 11 PM	75%
Zone 5	3PM – 7 PM	59%	7 PM – 11 PM	41%
Zone 6	3PM – 7 PM	53%	7 PM – 11 PM	47%
Zone 7	3PM – 1 AM	70%	1 AM – 11 AM	30%
Zone 8	3PM – 1 AM	68%	1 AM – 11 AM	32%
Zone 9	3PM – 1 AM	61%	1 AM – 11 AM	39%
Oak Park	3PM – 7 PM	45%	7 PM – 11 PM	55%
Santa Monica Mountains	3PM – 1 AM	47%	1 AM – 11 AM	53%

Trip Distribution

The nine evacuation zones were sub-divided into sub-zones based on the number of housing units, the number of access points (intersections), and the shortest distance to the access points. We used PTV Vistro software to distribute vehicles from each evacuation zone to their respective safe destination (i.e., US-101) via the route(s) identified in the City's draft Evacuation Plan. For this study, the safe destinations include:

1. US-101 on-ramps at Reyes Adobe Road
2. US-101 on-ramps at Kanan Road
3. US-101 on-ramps at Chesebro Road/Palo Comado Canyon Road
4. US-101 on-ramps at Liberty Canyon Road

Using Vistro, the total number of vehicles projected to drive through each intersection between the residential zones and the US-101 freeway using the City's proposed evacuation routes was calculated. It should be noted that the analysis assumed that all evacuating vehicles would be going to their designated "safe destination", and other non-evacuating vehicles would not be present on the roads during evacuation.

Model Development

The developed traffic volumes from Vistro were loaded onto the City's Synchro models. Modifications to the Synchro models such as adding local streets and collectors were made to capture the entire evacuation route distance of a resident. The AM weekday peak hour timing plan was used because of the priority given to Kanan Road and US-101 during the morning commute which are similar priorities during evacuation. A SimTraffic simulation was run for a one-hour period for a total of five runs. Average travel times for each of the evacuation routes on the network were obtained using this SimTraffic analysis.

For the with General Plan Update scenario, additional trips were calculated for the additional 2,348 dwelling units using the existing vehicle ownership data and mandatory evacuation percentages. These trips were distributed using the routes identified in the City's draft Evacuation Plan. A SimTraffic simulation was run for a one-hour period for a total of five runs. Average travel times for each of the evacuation routes on the network were obtained using this SimTraffic analysis.

TRAVEL TIME RESULTS

Two scenarios were analyzed to estimate the additional travel time from the City's evacuation zones to their respective safe destination (i.e., US-101):

1. Existing lane configurations without General Plan Update conditions
2. Existing lane configurations with General Plan Update conditions

Table 2 presents the results of the analysis by evacuation zone. The voluntary and mandatory evacuation times are the maximum observed travel times during the Woolsey Fire. The added travel time represents the estimated impact of the AHO on each zone's travel time to the US-101 during a mandatory evacuation.

Table 2: Scenarios & Maximum Travel Time to US-101 Freeway

Evacuation Zone	Maximum Travel Time to US-101 Freeway			Designated US-101 Access Point per Evacuation Plan
	Voluntary Evac	Mandatory Evac	Added Travel Time with GPU Buildout	
Zone 1	10-20 mins	10-20 mins	2 mins	Reyes Adobe Rd
Zone 2	10-20 mins	30-40 mins	10 mins	Kanan Rd
Zone 3	20-30 mins	20-30 mins	10 mins	Kanan Rd
Zone 4.1	30-40 mins	20-30 mins	1 min	Chesebro Rd/Palo Comado Canyon Rd
Zone 4.2	10-20 mins	30-40 mins	1 min	Chesebro Rd/Palo Comado Canyon Rd
Zone 5	10-20 mins	20-30 mins	3 mins	Reyes Adobe Rd
Zone 6	20-30 mins	10-20 mins	5 mins	Kanan Rd
Zone 7	20-30 mins	20-30 mins	1 min	Kanan Rd
Zone 8	20-30 mins	30-40 mins	4 mins	Chesebro Rd/Palo Comado Canyon Rd
Zone 9	20-30 mins	0-10 mins	0 mins	Liberty Canyon Rd
Oak Park	20-30 mins	40-50 mins	10 mins	Kanan Rd
Santa Monica Mountains	70-80 mins	20-30 mins	8 mins	Kanan Rd

Table 2 shows that the additional trips generated by the AHO during a mandatory evacuation will increase the travel time of each zone's evacuation by ten minutes or less.

EVACUATION ROUTES

A subsequent analysis was conducted to determine the most common routes used to exit the City among trips that originated in each zone during their Woolsey Fire mandatory evacuation period. This information aids the City in determining whether designated evacuation routes are utilized. An overview of the top routes used for each zone during the Woolsey Fire is as follows:

- Zone 1
  - Reyes Adobe Road to US-101 on-ramps – 68%
  - Thousand Oaks Boulevard westbound to Lindero Canyon Road or points west – 26%
  - Thousand Oaks Boulevard eastbound to Kanan Road – 6%
- Zone 2
  - Kanan Road to US-101 on-ramps – 75%
  - Thousand Oaks Boulevard westbound to Reyes Adobe Road – 20%
  - Thousand Oaks Boulevard westbound to points west – 5%
- Zone 3
  - Kanan Road to US-101 on-ramps – 79%
  - Thousand Oaks Boulevard westbound to points west – 16%
  - Driver Avenue to Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 5%
- Zone 4.1
  - Driver Avenue to Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 90%
  - Thousand Oaks Boulevard westbound to Reyes Adobe Road US-101 on-ramps – 10%
- Zone 4.2
  - Driver Avenue to Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 76%
  - Driver Avenue to Kanan Road northbound – 26%
- Zone 5
  - Reyes Adobe Road to US-101 on-ramps – 65%
  - Thousand Oaks Boulevard to points west – 20%
  - Canwood Street to Kanan Road US-101 on-ramps – 10%
  - Reyes Adobe Road to Agoura Road – 5%
- Zone 6
  - Thousand Oaks Blvd or Kanan Road to Kanan Road US-101 on-ramps, Driver Avenue, or Canwood Street – 55%
  - Kanan Road northbound – 15%
  - Thousand Oaks Boulevard to Reyes Adobe Road US-101 on-ramps – 10%

- Zone 6 (continued)
  - Thousand Oaks Boulevard to points west – 5%
  - Driver Avenue or Canwood Street to Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 5%
- Zone 7
  - Kanan Road to US-101 on-ramps – 55%
  - Agoura Road to points west – 22%
  - Reyes Adobe Road to US-101 on-ramps – 16%
  - Agoura Road to points east – 7%
- Zone 8
  - Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 44%
  - Agoura Road to points west – 17%
  - Kanan Road to US-101 on-ramps – 15%
  - Agoura Road to points east – 9%
  - Kanan Road to points south – 8%
  - Liberty Canyon Road to US-101 on-ramps – 7%
- Zone 9
  - Agoura Road to points east – 67%
  - Liberty Canyon Road to US-101 on-ramps – 33%
- Oak Park
  - Kanan Road southbound to US-101 on-ramps – 59%
  - Kanan Road northbound – 28%
  - Driver Avenue or Canwood Street to Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 8%
  - Agoura Road to points east – 3%
  - Thousand Oaks Boulevard to points west – 2%
- Santa Monica Mountains
  - Kanan Road northbound to US-101 on-ramps – 58%
  - Agoura Road to points west – 13%
  - Agoura Road to Liberty Canyon Road US-101 on-ramps – 10%
  - Agoura Road to Reyes Adobe Road US-101 on-ramps – 10%
  - Agoura Road to Chesebro Road/Palo Comado Canyon Road US-101 on-ramps – 9%

Illustrations of the top routes by zone used during Woolsey Fire are included in **Attachment A.**

FINDINGS AND RECOMMENDATIONS

In summary, trips generated by additional housing units from the AHO will result in increases in travel time of no more than 10 minutes for each zone during an emergency evacuation. Furthermore, those travel time increases overwhelmingly concentrated along Kanan Road, leaving other evacuation routes relatively unimpacted and thus available if traffic needs to be redirected off Kanan Road. As determined from our analysis of Woolsey Fire evacuation patterns, multiple corridors are already used by residents of each zone to evacuate the City.

Evacuation Signal Timing Plan

Going forward, to make evacuation procedures as smooth as possible, the City should consider developing an evacuation signal timing plan. As part of this analysis, the effect of making signal timing adjustments at key intersections to improve the evacuation flow reviewed, with the "Maximum Split" increased for intersections along Kanan Road and Agoura Road to provide additional green time for the phases serving vehicles traveling in the evacuating direction. Adjusting the signal timing at key intersections was found to result in a reduction of total evacuation time. Furthermore, the evacuation signal timing plans may include adjustments to offsets for intersections currently operating in coordination and implementation of coordination for intersections not currently operating in coordination.

Counterflow Operations

In addition, if deemed necessary due to congestion levels, a counterflow operation should be developed to use opposing travel lanes for evacuation along Kanan Road and Reyes Adobe Road, with all vehicles directed toward the US-101 freeway on-ramps. Counterflow operations are not recommended along Thousand Oaks Boulevard or Agoura Road, where evacuees were shown traveling in both directions along these corridors during the Woolsey Fire evacuation.

Street segments would need to provide sufficient space for counterflow lanes while still maintaining 20 feet of roadway for emergency vehicles access. To successfully use counterflow lanes during an evacuation, traffic control devices would need to be placed on the roadway extremely quickly and the public would need to be familiar with the use of counterflow driving.

To prepare for a potential evacuation using counterflow lanes, practice evacuations should be staged, and flyers should be sent out to educate the public on the evacuation route's potential counterflow plan. The City should develop a plan to quickly install traffic control devices such as cones to designate counterflow lanes. Traffic control officers should be present to direct vehicles at intersections with high traffic volumes. Having traffic control officers to guide traffic through these intersections will reduce bottlenecks in the network and provide clarity for vehicles using counterflow lanes to travel through the intersections.

Additional Recommendations

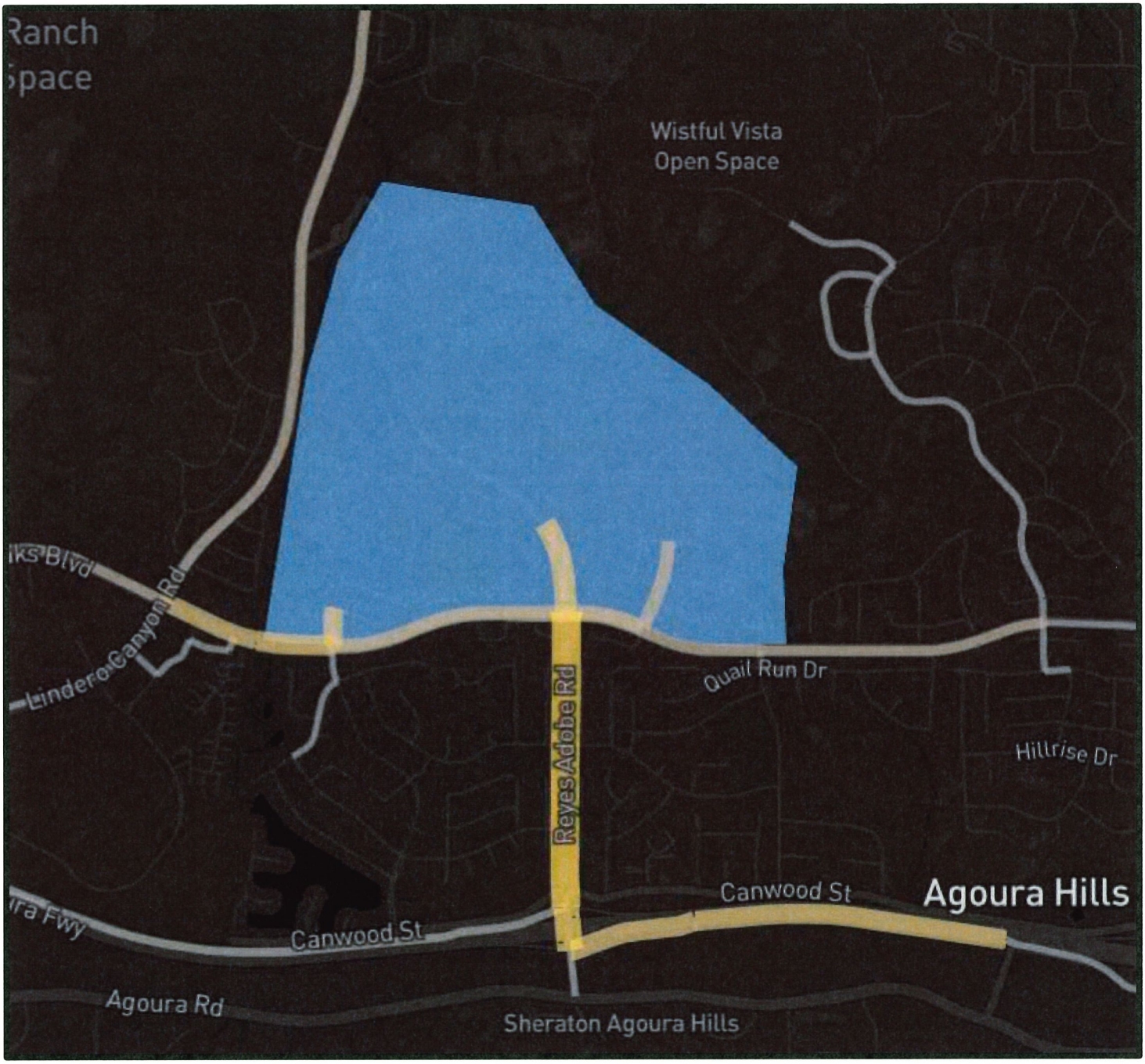
In addition to specific signal timing plans and counterflow operations, additional recommendations that the City may want to consider in updates to the evacuation plan include:

- To lower demand on Kanan Road, consider redirecting vehicles originating from neighborhoods north of Thousand Oaks Boulevard to utilize Thousand Oaks Boulevard westbound to access the US-101 on-ramps at Reyes Adobe Road.

- If the US-101 on-ramps at Reyes Adobe Road experience excessive queuing, consider:
    - Redirecting vehicles originating south of US-101 to travel eastbound along Agoura Road to utilize the on-ramps at Chesebro Road/Palo Comado Canyon Road
    - Redirecting vehicles originating north of US-101 to travel westbound along Thousand Oaks Boulevard to Lindero Canyon Road or points west. Close coordination with authorities and emergency responders in Westlake Village and Ventura County must be taken to ensure such decisions would not negatively impact any emergency evacuation procedures ongoing in those jurisdictions.
- If left-turning vehicles accessing US-101 on-ramps at Reyes Adobe Road or at Kanan Road cause excessive queuing, consider closing the bridges to left-turning vehicles and forcing vehicles to access only the nearside on-ramps.

ATTACHMENT A

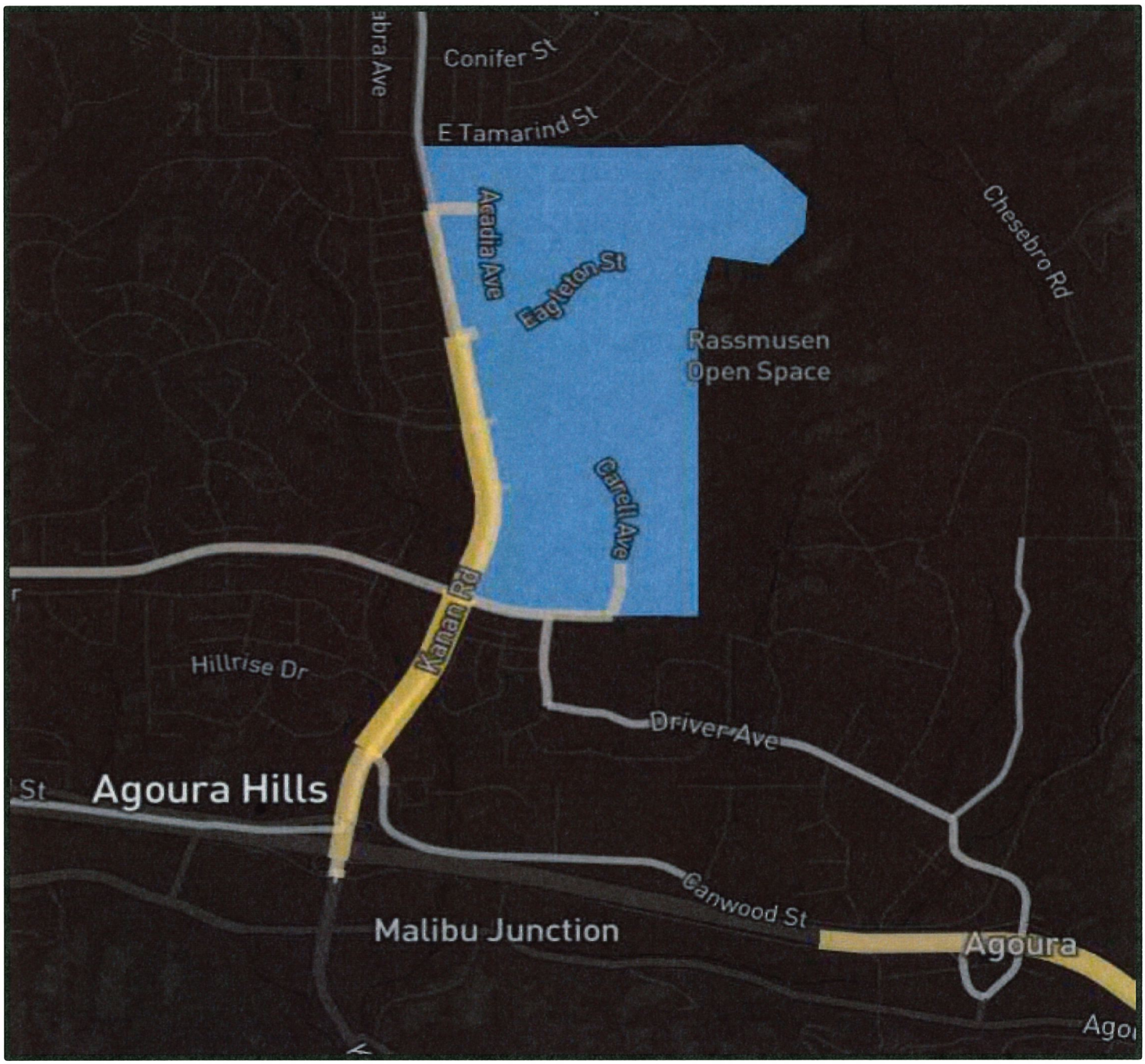
Zone 1


Ranch
Space
Wistful Vista
Open Space
Lindero Canyon Rd
Quail Run Dr
Reyes Adobe Rd
Hillrise Dr
Canwood St
Agoura Hills
Canwood St
Agoura Rd
Sheraton Agoura Hills

Zone 2


abra Ave
Conifer St
Wistful Vista
Open Space
E Tamarind St
Acadia Ave
Eagleton St
Carell Ave
Quail Run Dr
Reyes Adobe Rd
Hillrise Dr
Kanan Rd
Canwood St
Agoura Hills
Sheraton Agoura Hills

Zone 3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Arcadia Ave
Eagleton St
Chesebro Rd
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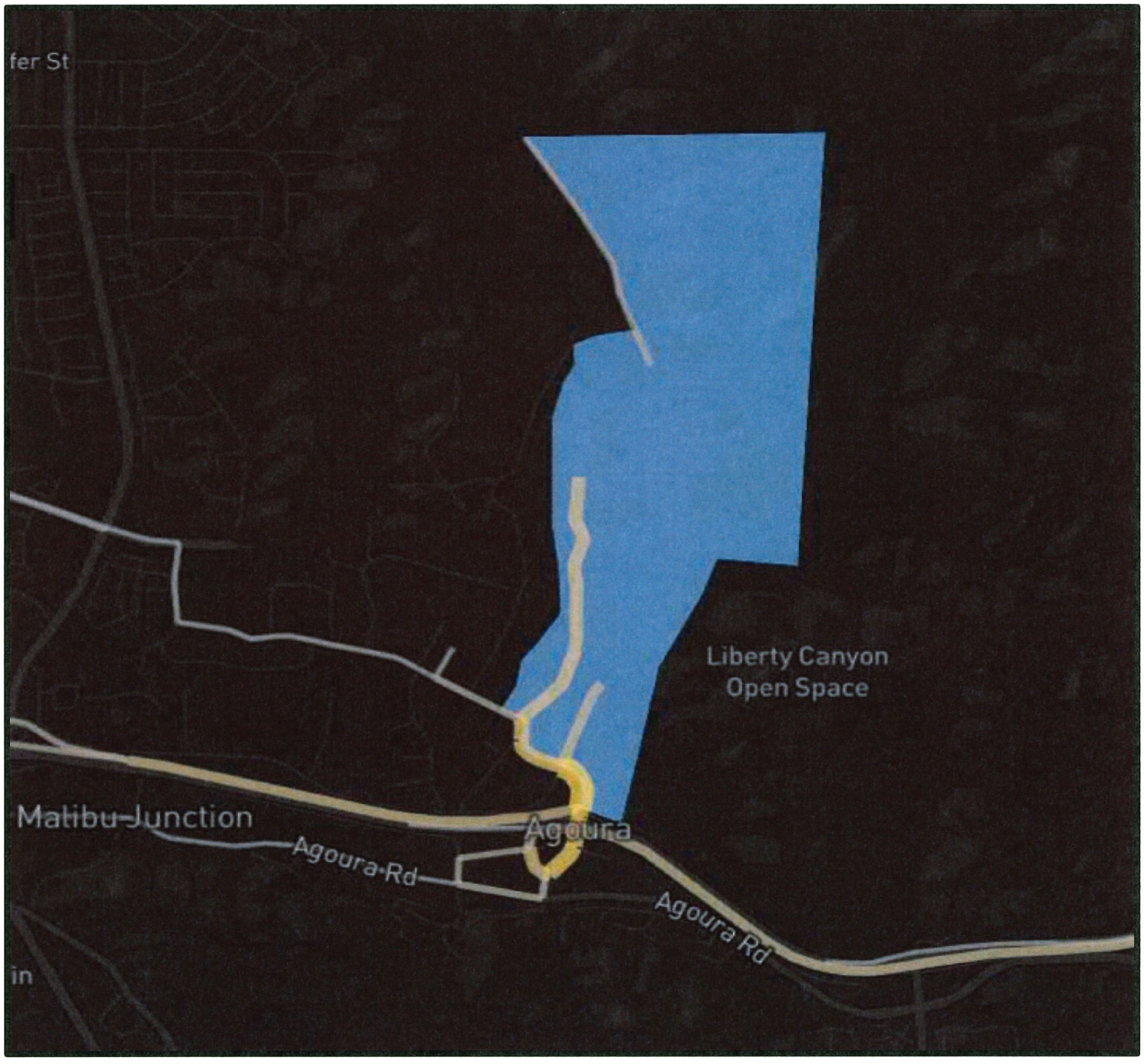
Open Space
Carell Ave
Kanan Rd
Hillrise Dr
Driver Ave
Agoura Hills
Canwood St
Malibu Junction
Agoura

Zone 4.1

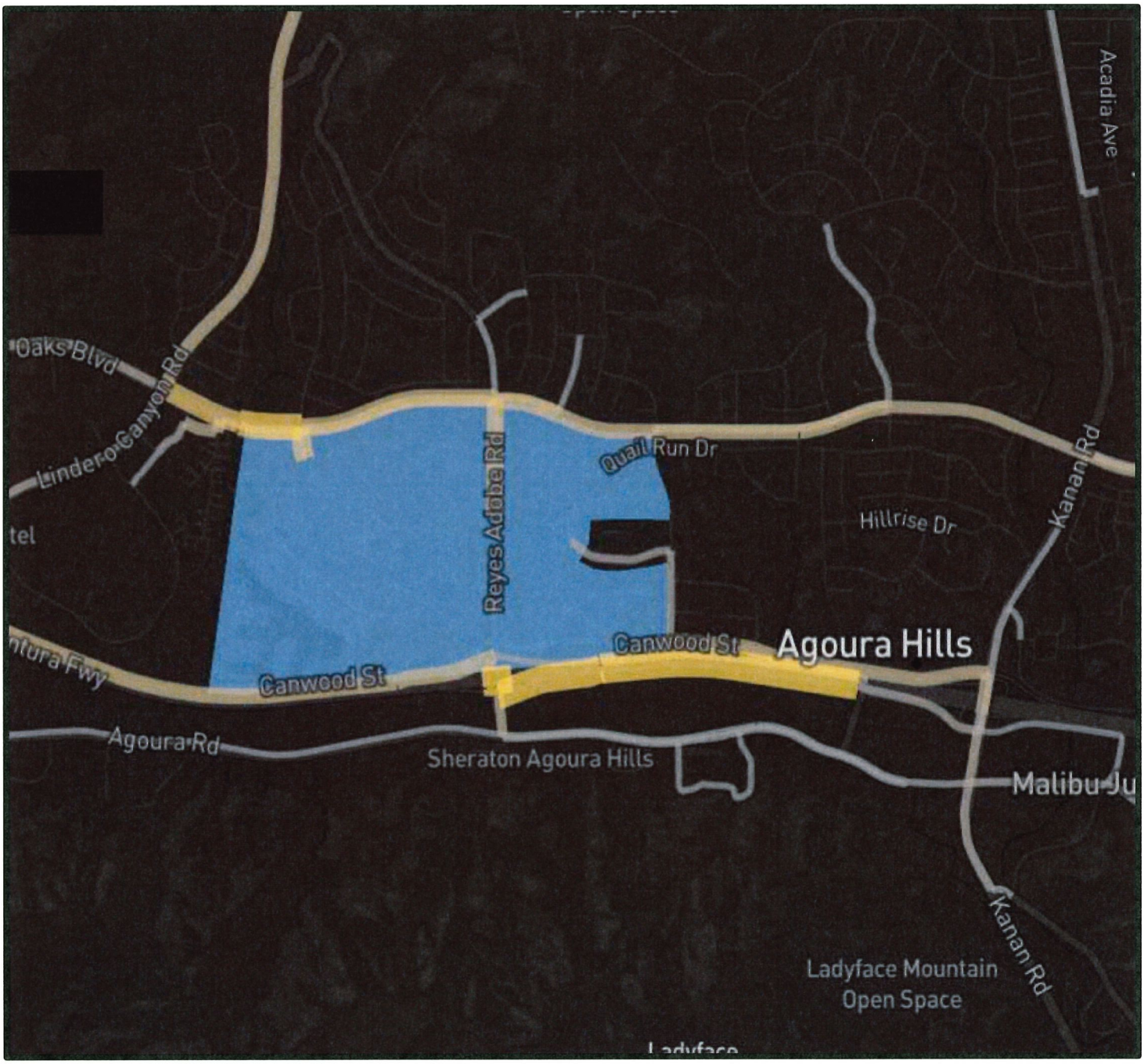

fer St
Liberty Canyon
Open Space
Malibu Junction
Agoura
Agoura Rd
Agoura Rd
in

Zone 4.2


Conifer St
Agoura Hills
Liberty Canyon
Open Space
Malibu Junction
Agoura
Agoura Rd
Agoura Rd
Ladyface Mountain
Open Space

Zone 4.3 (non-residential)

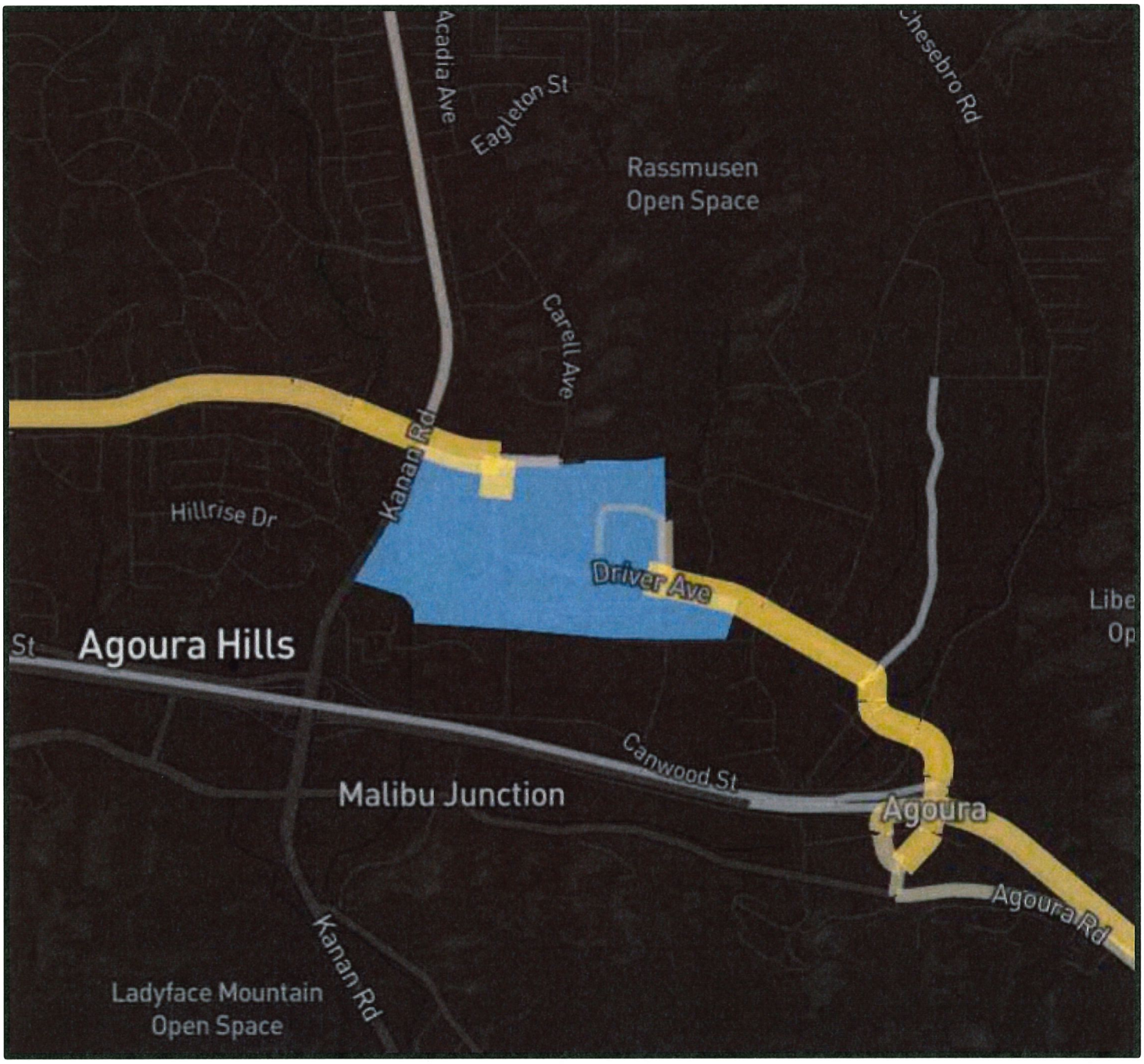
Zone 5


Acadia Ave
Oaks Blvd
Lindero Canyon Rd
Reyes Adobe Rd
Quail Run Dr
Kanan Rd
Hillrise Dr
Canwood St
Agoura Hills
Canwood St
Agoura Rd
Sheraton Agoura Hills
Malibu Ju
Kanan Rd
Ladyface Mountain
Open Space

Zone 6


Acadia Ave
Eagleton St
Carell Ave
Quail Run Dr
Reyes Adobe Rd
Hillrise Dr
Kanan Rd
Canwood St
Agoura Hills
Sheraton Agoura Hills
Malibu Junction
Kanan Rd
Ladyface Mountain
Open Space
Ladyface

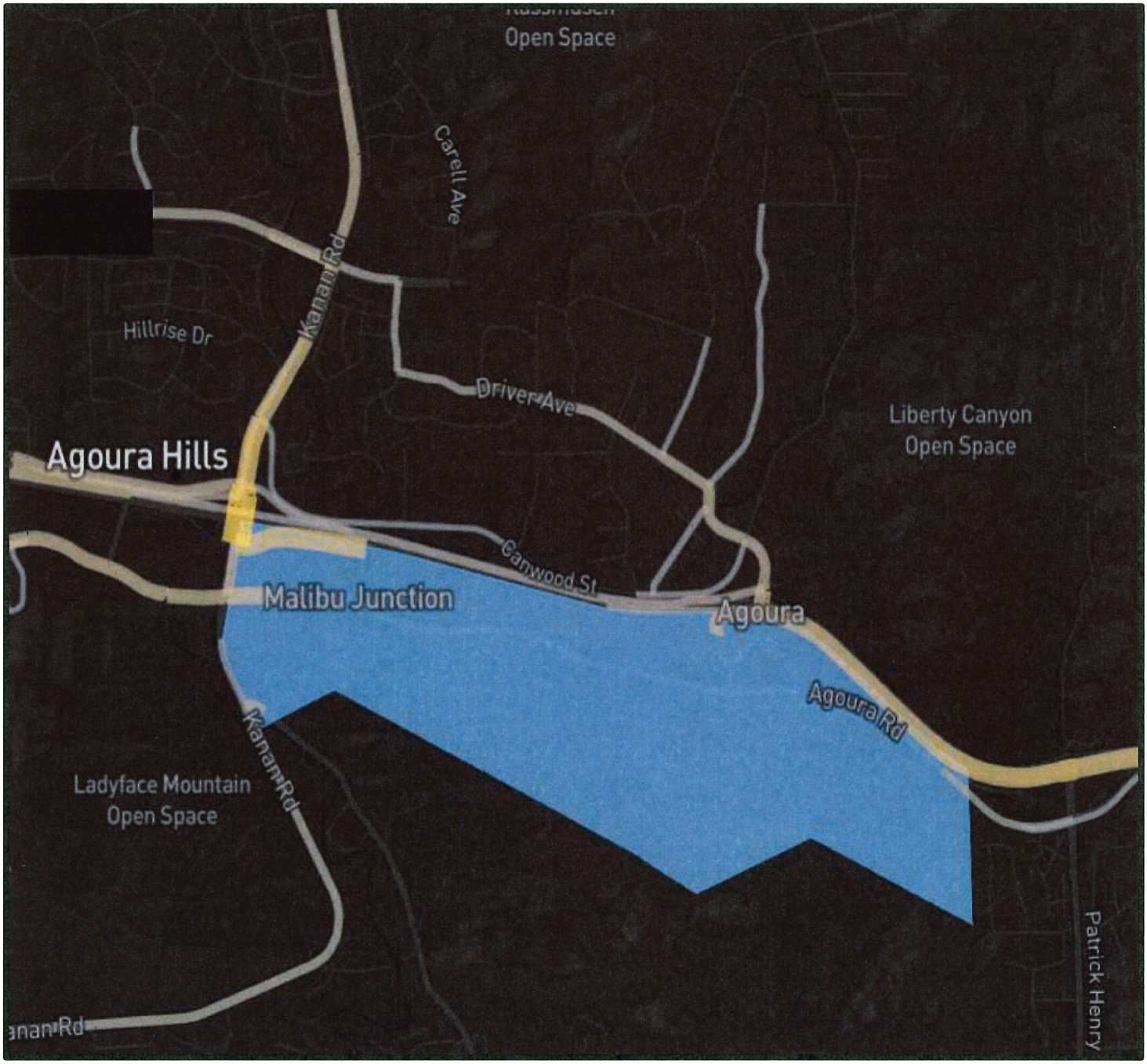
Zone 6 (analyzed separately only on Streetlight)



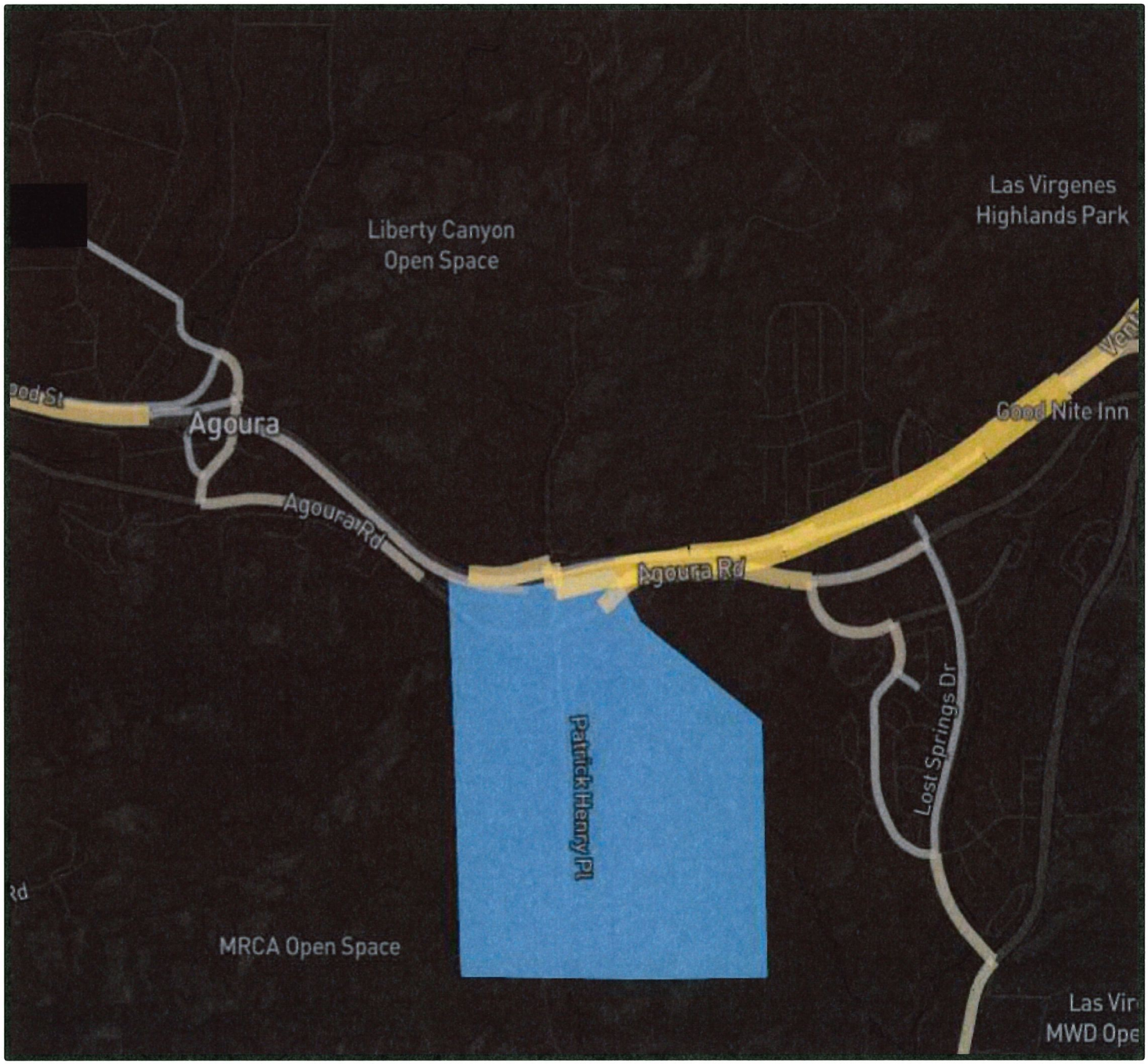
Zone 7


Eag
Blvd
Lindero Canyon Rd
Reyes Adobe Rd
Quail Run Dr
Kanan Rd
ons Hotel
Hillrise Dr
Ventura Fwy
Canwood St
Agoura Hills
Canwood St
Agoura Rd
Sheraton Agoura Hills
Malibu Juncti
Kanan Rd
Ladyface Mountain
Open Space
Ladyface
Triunfo Canyon
Open Space

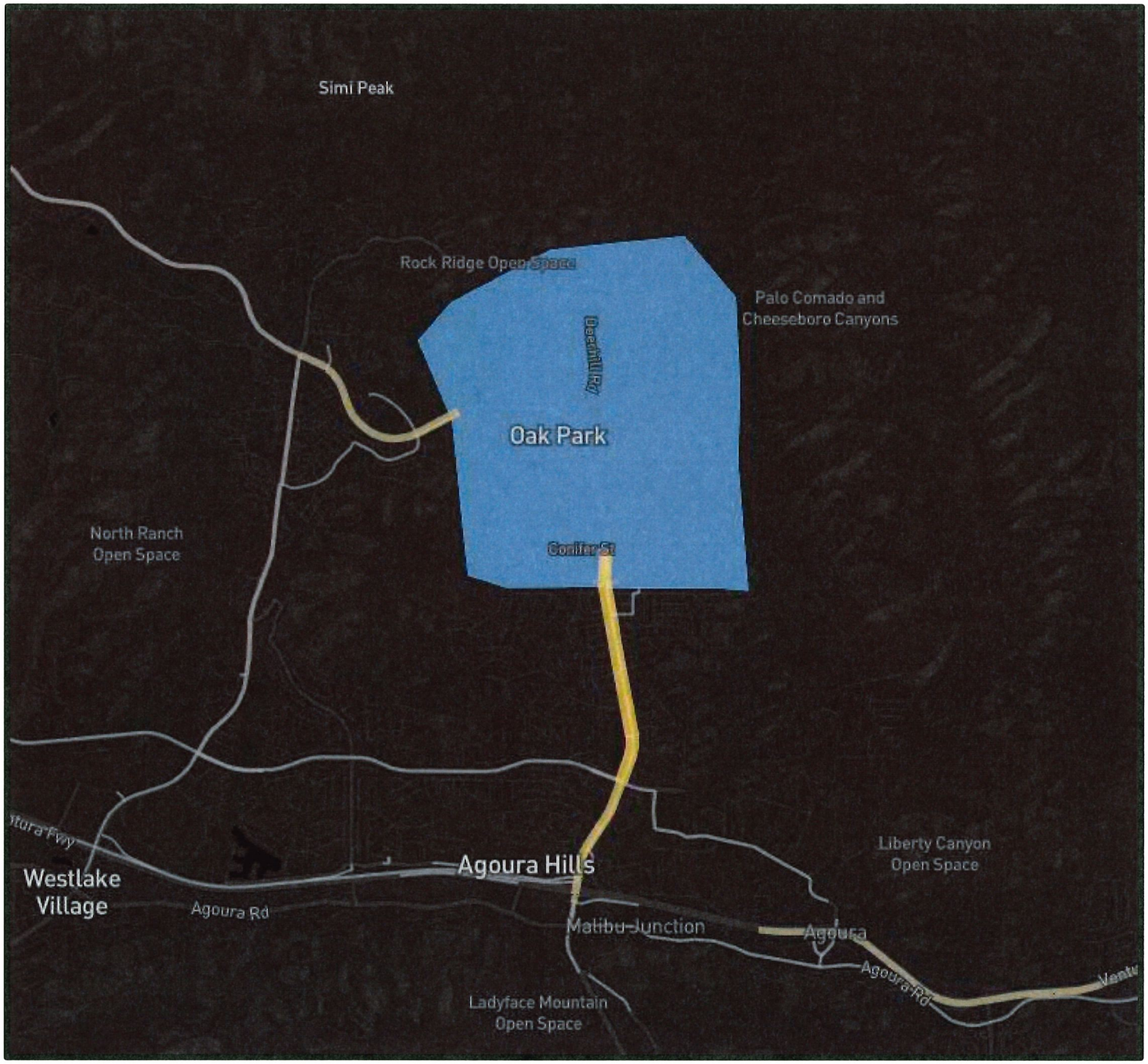
Zone 8


Open Space
Carell Ave
Kanan Rd
Hillrise Dr
Driver Ave
Agoura Hills
Liberty Canyon
Open Space
Canwood St
Malibu Junction
Agoura
Agoura Rd
Kanan Rd
Ladyface Mountain
Open Space
Patrick Henry

Zone 9


Liberty Canyon
Open Space
Las Virgenes
Highlands Park
Agoura
Agoura Rd
Agoura Rd
Good Nite Inn
Patrick Henry Pl
Lost Springs Dr
MRCA Open Space
Las Vir
MWD Ope

Oak Park


Simi Peak
Rock Ridge Open Space
Palo Comado and
Cheeseboro Canyons
Deer Hill Rd
Oak Park
North Ranch
Open Space
Conifer St
Liberty Canyon
Open Space
Agoura Hills
Westlake
Village
Agoura Rd
Malibu Junction
Agoura
Agoura Rd
Ladyface Mountain
Open Space

Santa Monica Mountains