Appendix I

Emergency Evacuation Time Assessment

FEHR PEERS

Memorandum

Date: October 25, 2023

To: Karly Kaufman, Rincon Consultants

From: Sam Tabibnia

Subject: City of Piedmont 2023-2031 Housing Element Update – Emergency Evacuation Time Assessment

OK21-0442

Fehr & Peers has prepared an assessment of the effect that the City of Piedmont 2023-2031 Housing Element Update Implementation Project may have on emergency evacuation times. The analysis consisted of assessment of the evacuation capacity under different scenarios, including a complete evacuation of all residents and employees in the City.

This memorandum consists of the following sections:

1. ***Background*** (page 2) – discusses the purpose of the analysis, the legislative background, and some of the limitations of the analysis.
2. ***Housing Element Update Implementation Project*** (page 3) – describes the proposed 2023-2031 Housing Element Update Implementation Project and the additional housing units that could be developed under the Project.
3. ***Evacuation Capacity Analysis Overview*** (page 3) – presents the methodology and assumptions used in the analysis, including the designated evacuation routes, identified evacuation zones, and the evacuation scenarios analyzed in this memorandum.
4. ***Evacuation Capacity Assessment*** (page 6) – describes the results of the analysis for the Existing and Existing Plus Project conditions under the three analyzed evacuation scenarios.
5. ***Recommendations*** (page 11) – presents potential recommendations that could improve emergency evacuation times.

1. Background

This assessment is intended to provide information to comply with the requirements of Assembly Bill (AB 747), signed in October 2019, which requires that the General Plan Safety Element be reviewed and updated to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. This is a requirement for all Safety Elements or updates to a Local Hazard Mitigation Plan (LHMP) completed after January 2022.

In response to AB 747, other recent legislative requirements, and related CEQA lawsuits, the Office of the California Attorney General published the *Best Practices for Analyzing and Mitigating Wildfire Impacts of Development Projects Under the California Environmental Quality Act* (AG Guidance) in October 2022. The AG Guidance provides "suggestions for how best to comply with CEQA when analyzing and mitigating a proposed project's impacts on wildfire ignition risk, emergency access, and evacuation."

As the AB 747 requirement and the AG Guidance are new, there is no standard methodology or standard of care for this analysis. In consultation with the City of Piedmont, we have adapted available traffic analysis methodologies and resources that, in our knowledge and experience, we believe meet the intent of the AB 747 requirement and are consistent with the AG Guidance. Nevertheless, these methodologies are necessarily limited by the parameters for our work for this project and the current state of our knowledge.

This document is intended to provide an assessment of roadway capacity and time needed to evacuate under the described evacuation scenarios and should not be considered an evacuation plan. Emergency evacuation can occur due to any number of events. Additionally, any emergency-caused movement is unpredictable because it has an element of individual behavior related to personal risk assessment for each hazard event as the associated evacuation instructions are provided. As such, this assessment is intended to provide the City of Piedmont with a broad understanding of the capacity of the transportation system during an evacuation scenario; it does not provide a guarantee that evacuations will follow modeling that is used for analysis purposes, nor does it guarantee that the findings are applicable to any or all situations. This memorandum was prepared for the specific and limited purpose of this project. It is not intended to be an exhaustive analysis of evacuation planning in the City of Piedmont or to be used as a specific evacuation plan.

While this assessment should help the City of Piedmont better prepare for hazard related events and associated evacuations, the City should take care in planning and implementing any potential evacuation scenario. Fehr & Peers cannot and does not guarantee the efficacy of any of the information used from this assessment as such would be beyond our professional duty and capability.

2. Housing Element Update Implementation Project

The proposed 2023-2031 Housing Element Update Implementation Project (referred to as the Project in this memorandum) would consist of amendments to the City's General Plan and City Code to allow for the capacity to build housing in accordance with the Regional Housing Needs Allocation (RHNA) assigned to the City of Piedmont. As described in Chapter 2, Project Description, of the *City of Piedmont 2023-2031 Housing Element Implementation Project Draft EIR*, the Project would facilitate the construction of up to 1,048 new residential units, consisting of the Housing Element RHNA plus additional units that may be constructed throughout the City under State and City programs. **Figure 1** shows the distribution of these residential units throughout the City by transportation analysis zones (TAZ)[1] as assumed in the Draft EIR analysis.

3. Evacuation Capacity Analysis Overview

Various aspects of the evacuation capacity analysis, including the designated evacuation routes, the evacuation zones, the evacuation scenarios, and the various assumptions used in completing this analysis are described below.

Evacuation Routes

According to the City of Piedmont Police Department *Emergency Operations Procedures* (December 2022), the evacuation routes for the city normally consist of the following corridors, which are shown on **Figure 2**:

- Moraga Avenue to State Route (SR) 13 or Pleasant Valley Avenue
- Oakland Avenue to Grand Avenue or Bayo Vista Avenue
- Crocker Avenue to Mandana Avenue
- Hampton Road to Estates Drive onto Park Boulevard
- LaSalle Avenue to Mountain Boulevard
- Wildwood Avenue to Winsor Avenue or Grand Avenue
- Blair Avenue to Harbord Drive

Although Park Boulevard is not in the City of Piedmont, it forms the south border of the City and provides access to both SR 13 and Interstate-580 (I-580). Therefore, it is expected to be used as an evacuation route to the south. The City of Oakland *2045 General Plan Safety Element* (Public Hearing Draft, July 2023) identifies Park Boulevard as a primary local evacuation route.

[1] TAZs are representation of neighborhoods in travel demand models. The Alameda CTC Model includes six TAZs in the City of Piedmont. TAZs are used in transportation planning models for transportation analysis and other planning purposes.

Evacuation Zones

Evacuation areas are defined by the Genasys Protect (formerly known as Zonehaven) emergency response zones as directed by emergency responders. **Figure 3** shows the ten Genasys Protect zones in the City of Piedmont as well as the nearby zones in the City of Oakland that may be evacuated at the same time and use the same evacuation routes.

Evacuation Scenarios

The following three events requiring evacuation were chosen by City's emergency responder staff and evaluated in this memorandum:

- ***Scenario 1: Hazardous Material Spill on Park Boulevard –*** A hazardous material spill occurs on Park Boulevard at Hollywood Drive in Oakland, CA, at 4:00 AM on a Monday morning, necessitating the evacuation of nearby residents. Affected residents in the City of Piedmont are directed to evacuate to the City's Corporation Yard at 898 Red Rock Road. Affected areas in the City of Oakland are directed to evacuate east and west on Park Boulevard. **Figure 4** shows the evacuated zones and the evacuation routes. The evacuation zones consist of Zone PIE-009 in Piedmont and Zones OKL-E102, OKL-E104, OKL-E108, and OKL-E245 in Oakland. The evacuation route for the Piedmont zone consists of Hampton Road to Crocker Avenue to Wildwood Avenue to Highland Avenue to Moraga Avenue to Red Rock Road. The Oakland zones are expected to use Park Boulevard to evacuate to SR 13 in the east and I-580 in the west.
- ***Scenario 2: Wildfire Originating near Coaches Field (Local Evacuation) –*** A brush fire originates in the grassy area behind Coaches Field at 11:00 AM on a weekday in late September with schools in normal session. Fire spreads in a southwest direction. An evacuation is ordered at noon for portions of Piedmont and Oakland. The fire is contained by 3:00 PM and no further evacuation is necessary. **Figure 5** shows the evacuated zones and the evacuation routes. The evacuation zones consist of Zone PIE-003B in Piedmont and Zones OKL-E044 through OKL-E047 in Oakland. The evacuation routes comprise Moraga Avenue east to SR 13 and west to Pleasant Valley Avenue and Broadway.
- ***Scenario 3: Wildfire Originating near Coaches Field (Citywide Evacuation) –*** A brush fire originates in the grassy area behind Coaches Field at 11:00 AM on a weekday in late September with schools in normal session. Fire spreads in a southwest direction. An evacuation is ordered at noon for all of Piedmont and parts of Oakland. **Figure 6** shows the evacuated zones and the evacuation routes. The evacuation zones consist of all zones in Piedmont (Zones PIE-001 through PIE-009) and Zones OKL-E041, OKL-E042, OKL-E044 thru OKL-E047, and OKL-E091 in Oakland. The evacuation routes consist of the designated evacuation routes in the City of Piedmont that generally evacuate to the south and west.

These scenarios were chosen by the City staff based on the likelihood of occurrence, availability of evacuation routes, and the judgment of the emergency responder representatives.

Analysis Assumptions

Emergency events and corresponding evacuations can occur in myriad ways, some allowing for a range of advanced logistical planning, and others requiring more immediate responses such as shelter-in-place for certain sites (such as schools). Given the infinite range of potential timelines and event and evacuation characteristics, the following baseline assumptions are used in this analysis:

1. The entire evacuation area is directed to evacuate at the same time.
2. The City of Piedmont includes footpaths that provide pedestrian connectivity between various parts of the City. Although some residents could use these footpaths during an evacuation, this analysis assumes that all evacuations would be by personal vehicle.
3. Conceptually, the time it takes to evacuate is fundamentally constrained by capacity constraints along the roadway system, otherwise known as "bottlenecks." Thus, the evacuation times for each route and scenario are assessed on a bottleneck basis, whereby key collection points along each evacuation route are evaluated relative to the capacity and the estimated evacuating vehicles. The capacities incorporate operational assumptions as defined in the Transportation Research Board's *Highway Capacity Manual* (6th Edition), including the following per-lane flow rates by lane type and capacity limits based on opposing flows. Evacuation times for each route include the bottleneck-based time required to serve the entire evacuating flow to reach the designated evacuation destination:

    - Through lane: 750 vehicles/hour
    - Channelized right turn lane: 750 vehicles/hour
    - Right turn lane: 400 vehicles/hour
    - Left turn lane: 400 vehicles/hour
    - Shared lane (left-through-right, left-through, through-right, left-right): 400 vehicles/hour
    - Freeway on-ramps: 800 vehicles/hour

    At some locations, these capacity assumptions were adjusted to reflect local network conditions.

4. For scenarios that require evacuation of schools, parents/guardians will pick-up students at the schools before evacuating the City.
5. School staff will evacuate in their own vehicles.

6. Evacuating school students and staff is based on the 2022-2023 enrollment and staff counts as provided in June 2023.
7. The analysis also accounts for the adjacent areas in the City of Oakland that would likely need to be evacuated at the same time and would use the same evacuation routes. The affected zones in the City of Oakland for each scenario are described in the previous section of this memorandum.
8. The number of existing residents and employees that would evacuate are based on the 2020 land use database in the Alameda County Transportation Commission (CTC) Countywide Travel Demand Model by TAZ. Correspondence between the TAZs and the Genasys Protect zones, and determination of best available evacuation routes, is estimated by Fehr & Peers; in many cases, the estimated evacuating vehicles are distributed to multiple evacuation routes.
9. Based on US Census data,[2] the average vehicle ownership in Piedmont is about 2.1 vehicles per household and the average vehicle ownership in the neighboring areas of Oakland is about 1.9 vehicles per household. This analysis assumes an average of 2.0 vehicles per household for all evacuating households in Piedmont and Oakland under both Existing and Existing Plus Project conditions. This is a somewhat conservative assumption for the Existing Plus Project condition because the housing that would be built under the Housing Element Update would likely be smaller in size than the existing housing with fewer vehicles per household.
10. For scenarios that include evacuation of employment uses, it is assumed that every employee has their own vehicle and will generate a trip during an evacuation.
11. This analysis assumes that the 2023-2031 Housing Element Update Implementation Project would not affect the employment levels in the City of Piedmont and that the number of jobs in the City would remain same as the Existing Condition.
12. To ensure a conservative analysis, and because reliable data on the number of adult residents who would be at work during daytime evacuation scenarios is not available, no reduction in residential evacuating vehicles is made for the daytime scenarios (Scenarios 2 and 3).

4. Evacuation Capacity Assessment

This section discusses the results of the evacuation analysis for Scenarios 1, 2 and 3 under Existing and Existing Plus Project conditions based on the methodology and assumptions presented in the previous section.

[2] US Census American Communities Survey 5-year average (2022).

Scenario 1 - Hazardous Material Spill on Park Boulevard

Table 1 summarizes the land uses and the estimated number of vehicles that would be evacuating under Scenario 1 based on the assumptions and sources described above.

Table 1: Land Uses and Evacuating Vehicles – Scenario 1

Land Use	Existing		Existing Plus Project	
	Amount	Vehicles[1]	Amount	Vehicles[1]
Households	252	504	321	642
Employment[2]	0	0	0	0
School Students[2]	0	0	0	0
Total Vehicles		504		642

Note:
1. Assume 2.0 vehicles per household.
2. No employment or school students included in this scenario because evacuation is at 4:00 AM when employment locations and schools are closed.

Source: The Alameda CTC Model Travel Demand Model; US Census; Fehr & Peers, 2023.

Table 2 shows the estimated evacuation times for Scenario 1 under Existing and Existing Plus Project conditions. This analysis assumes that all evacuating vehicles would use the designated evacuation route and evacuate to the designated evacuation area at the City's facilities near the Corporation Yard at 898 Red Rock Road (for Piedmont evacuees) and to SR 13 or I-580 (for Oakland evacuees). It is also assumed that evacuating vehicles can be accommodated at the evacuation destination. Since Piedmont evacuees would have minimal use of Park Boulevard and the Project would not meaningfully affect the evacuation times for the Oakland evacuees who would use Park Boulevard, Table 2 does not report the evacuation times on Park Boulevard.

Table 2: Estimated Evacuation Times by Route – Scenario 1

Evacuation Route	Total Time to Evacuate (Hours)	
	Existing	Existing Plus Project
Hampton Road to Crocker Avenue to Wildwood Avenue to Highland Avenue to Moraga Avenue to Red Rock Road	1.26	1.61

Source: Fehr & Peers, 2023.

It is estimated that the evacuation would take about 1.26 hours to complete under Existing Conditions, and that the addition of the Project evacuees (i.e., the additional housing implemented under the 2023-2031 Housing Element Update Implementation Project) would increase the evacuation time by about 20 minutes to 1.61 hours.

Scenario 2 - Wildfire Originating near Coaches Field (Local Evacuation)

Table 3 summarizes the land uses and the estimated number of vehicles that would be evacuating under Scenario 2 based on the assumptions and sources described above.

Table 3: Land Uses and Evacuating Vehicles – Scenario 2

Land Use	Existing		Existing Plus Project	
	Amount	Vehicles[1]	Amount	Vehicles[1]
Households	877	1,754	971	1,942
Employment	403	403	403	403
School Students[2]	0	0	0	0
Total Vehicles		2,157		2,344

Note:
1. Assume 2.0 vehicles per household and 1.0 vehicle per employment.
2. No school students included in this scenario because no schools are in the evacuation zones.
Source: The Alameda CTC Model Travel Demand Model; US Census; City of Piedmont; Fehr & Peers, 2023.

Table 4 shows the estimated evacuation times for Scenario 2 under Existing and Existing Plus Project conditions. This analysis assumes that all evacuating vehicles would use Moraga Avenue, the designated evacuation route, and evacuate either to SR 13 in the east or Pleasant Valley Avenue and Broadway in the west. It is estimated that the evacuation would take about 2.07 hours to the east and 1.52 hours to the west to complete under Existing Conditions. The addition of the Project evacuees (i.e., the additional housing implemented under the 2023-2031 Housing Element Update Implementation Project) would increase the evacuation time by a few minutes to the east and by about 17 minutes to the west.

Table 4: Estimated Evacuation Times by Route – Scenario 2

Evacuation Route	Total Time to Evacuate (Hours)	
	Existing	Existing Plus Project
Eastbound Morage Avenue to SR 13	2.07	2.14
Westbound Morage Avenue to Pleasant Valley Avenue to Broadway	1.52	1.84

Source: Fehr & Peers, 2023.

Scenario 3 - Wildfire Originating near Coaches Field (Citywide Evacuation)

Table 5 summarizes the land uses and the estimated number of vehicles that would be evacuating under Scenario 3 based on the assumptions and sources described above. The totals include both the City of Piedmont and the affected zones in the City of Oakland that would evacuate at the same time and use the same evacuation routes.

Table 5: Land Uses and Evacuating Vehicles – Scenario 3

Land Use	Existing		Existing Plus Project	
	Amount	Vehicles[1]	Amount	Vehicles[1]
Households[2]	6,082	12,164	7,130	14,260
Employment[3]	3,587	3,587	3,587	3,587
School Students[4]	2,316	0	2,316	0
Total Vehicles		15,571		17,847

Note:
1. Assume 2.0 vehicles per household and 1.0 vehicle per employment.
2. Consists of 3,776 households under Existing Condition and 4,824 households under Existing Plus Project Condition in the City of Piedmont, and 2,306 households in the affected areas of Oakland under both Existing and Existing Plus Project conditions.
3. Consists of 2,033 workers in the City of Piedmont and 1,554 workers in the affected areas of Oakland under both Existing and Existing Plus Project conditions.
4. Since students would be picked up by parents/guardians first and parent/guardian trips are included in the household numbers, no additional vehicle trips assumed for the school students to avoid double-counting vehicles at bottlenecks.

Source: The Alameda CTC Model Travel Demand Model; US Census; City of Piedmont; Fehr & Peers, 2023.

Table 6 shows the estimated evacuation times for Scenario 3 under Existing and Existing Plus Project conditions. This analysis assumes that the evacuating vehicles would use the designated evacuation routes, and evacuate either to SR 13 in the east, I-580 in the south, or Pleasant Valley Avenue and Broadway in the west. It is estimated that the evacuation would take between 1.74 and 3.01 hours to complete for each evacuation route under Existing Conditions. The addition of the Project evacuees (i.e., the additional housing implemented under the 2023-2031 Housing Element Update Implementation Project) would increase the evacuation time by between a few minutes and up to about 45 minutes depending on the evacuation route.

Table 6: Estimated Evacuation Times by Route – Scenario 3

Evacuation Route	Total Time to Evacuate (Hours)	
	Existing	Existing Plus Project
Eastbound Morage Avenue to SR 13	2.81	2.95
Westbound Morage Avenue to Pleasant Valley Avenue to Pleasant Valley Avenue to Broadway	1.74	2.40
Grand Avenue to Pleasant Valley Avenue to Broadway	2.16	2.85
Oakland Avenue to Bayo Vista Avenue to Harrison Street to I-580	2.67	3.42
Grand Avenue to I-580	2.63	3.20
Winsor Avenue to Lakeshore Avenue to I-580	2.58	2.85
Crocker Avenue to Mandana Boulevard to Lakeshore Avenue to I-580	2.89	3.19
Park Boulevard to SR 13	3.01	3.17
Estates Drive to Park Boulevard to I-580	2.28	2.76

Source: Fehr & Peers, 2023.

Analysis Limitations

Note that the evacuation time estimates presented above may not capture the following conditions:

- Evacuation times would vary depending on directions residents and employees may receive from emergency responders and individual decisions regarding which route to take or which destination to evacuate to.
- Emergency scenarios are unpredictable and driver behavior can be disorderly.
- There is also general unpredictability in operational issues such as traffic signal timing coordination issues, or power issues that could trigger traffic signals to operate in "red flash."
- Smoke generated by wildfires could limit visibility and result in slower travel speeds by evacuees.
- Evacuation events are not linear in nature (that is, having an even distribution during the evacuation time period) and it is anticipated that evacuees would vacate at a rate that more closely resembles a bell curve from the time that the evacuation order is issued. These are conditions which would affect the total evacuation time estimated in our assessment that are not captured in the methodology used in this assessment.

5. Recommendations

The City of Piedmont maintains resources to inform residents and employees about emergency preparedness and evacuation procedures. These resources should be updated as technologies and best practices evolve. The results of the above analysis indicate the following potential improvements and enhancements to existing resources could reduce evacuation times:

- Coordinate with the City of Oakland to maintain the designated evacuation routes that serve both Cities.
- Develop emergency evacuation traffic signal timing plans for traffic signals on evacuation routes, prioritizing evacuation flows and minimizing opposing traffic flows. Emergency response vehicle access into evacuation areas can be maintained through traffic signal pre-emption. Coordinate with City of Oakland and Caltrans to develop corridor evacuation timing plans.
- Identify corridors where temporary evacuation capacity, such as reversible traffic lanes, temporary use of parking lanes, shoulders, or two-way-left-turn lanes, could be provided while maintaining emergency responder access in the opposite direction.
- Explore limiting on-street parking on designated evacuation routes either permanently or during high fire risk periods to reduce potential conflicts with evacuating vehicles.
- As part of evacuation messaging, ensure evacuees are informed of the availability of multiple evacuation routes, to allow effective use of all available capacity.
- Work with Piedmont Unified School District (PUSD) and private schools to develop evacuation plans for the schools in the City of Piedmont.
- Consider staggering the evacuation orders for citywide or large area evacuations for different zones and account for the impact on potential bottleneck locations when determining the timing for evacuation of different zones.
- When considering roadway or intersection design modifications, especially in areas that have less accessibility and on key evacuation routes, consider evacuation capacity and consider design treatments that could allow reversible lanes or temporary use of parking lanes or shoulders as auxiliary lanes to provide additional capacity during an evacuation event.
- Educate residents and employees about the importance of carpooling in evacuations to reduce the number of evacuating vehicles and minimize evacuation times.
- Explore the potential use of the footpath and bicycle networks in evacuating pedestrians and cyclists to reduce the number of evacuating vehicles and minimize evacuation times.
- Examine areas that have a high concentration of residents with social vulnerability indicators such as age, disability, and other mobility factors to determine other potential barriers to evacuation besides distance to and capacity of evacuation routes. Advanced

coordination between first responders to ensure an efficient and well-communicated process for evacuation may be needed in response to various hazard scenarios.

- Conduct community-wide evacuation exercises to test the recommendations and plans associated with these scenarios.

Please contact us if you have questions about this analysis.

Attachments:

Figure 1: Housing Element Update Sites Allocation by Transportation Analysis Zone

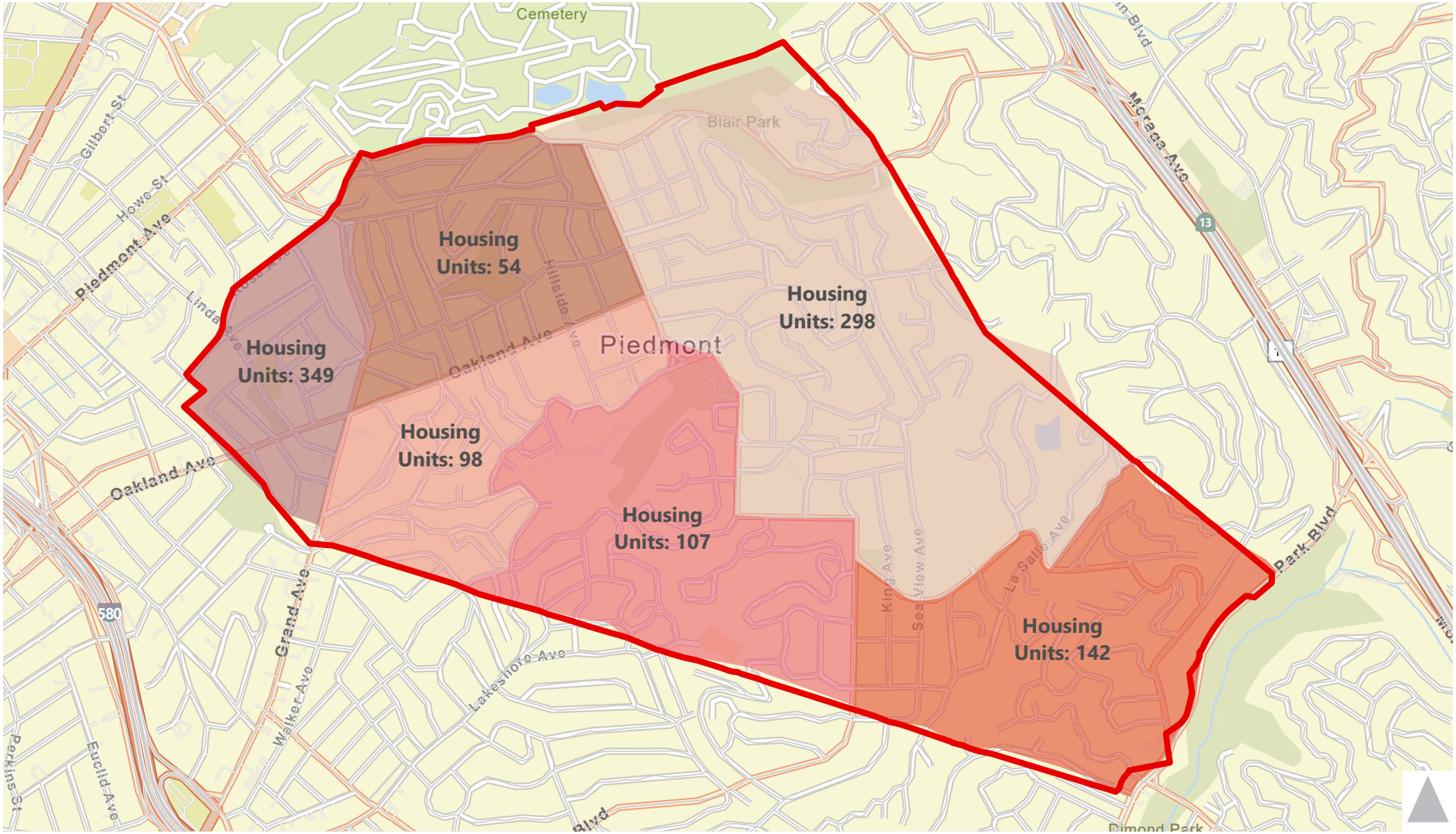
Figure 2: Evacuation Routes

Figure 3: Genasys Protect Zones

Figure 4: Scenario 1 Evacuation Area and Routes

Figure 5: Scenario 2 Evacuation Area and Routes

Figure 6: Scenario 3 Evacuation Area and Routes



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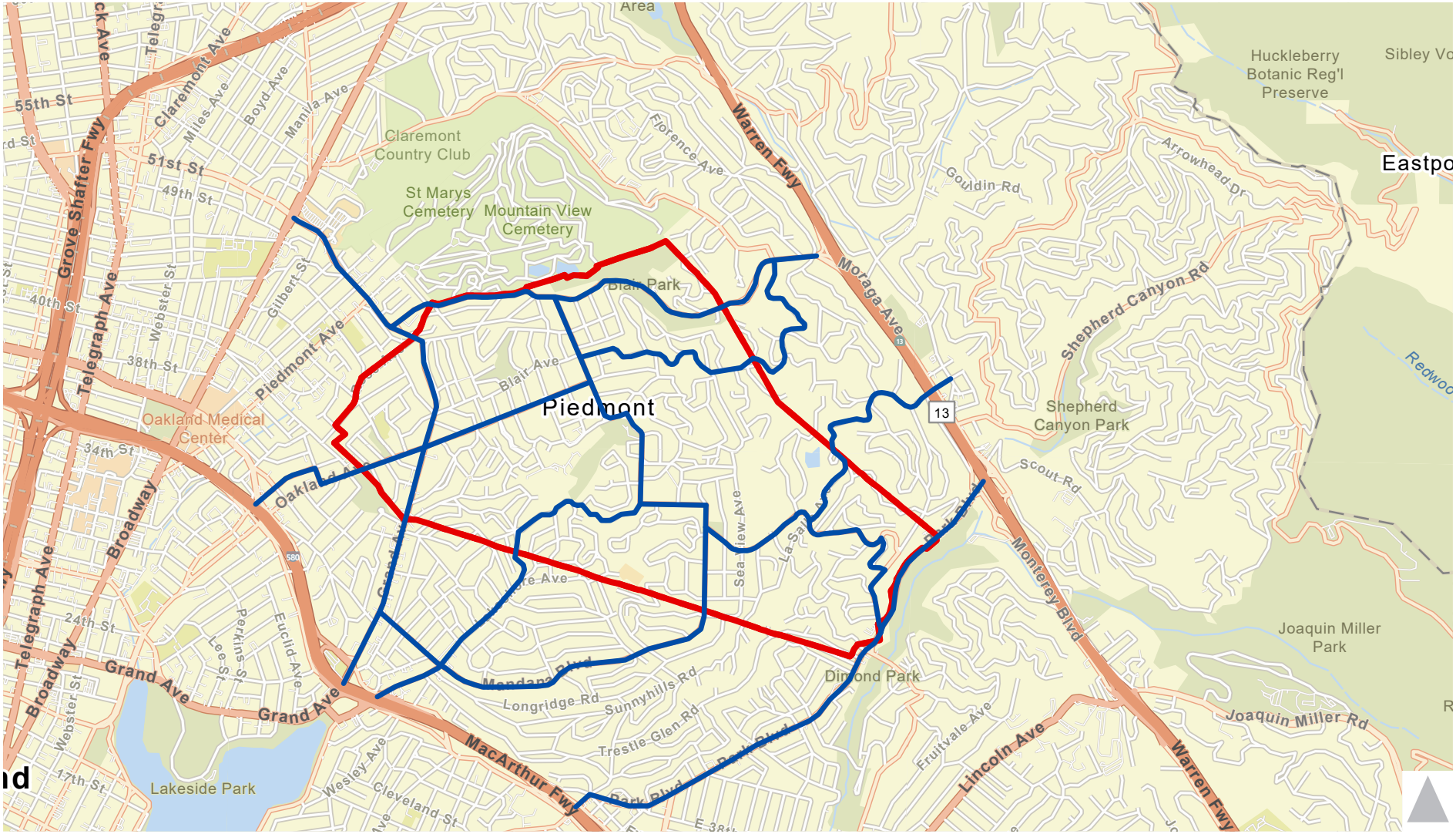
City of Piedmont

Transportation Analysis Zones (TAZ)

Figure 1

Housing Element Update Sites Allocation by Transportation Analysis Zone



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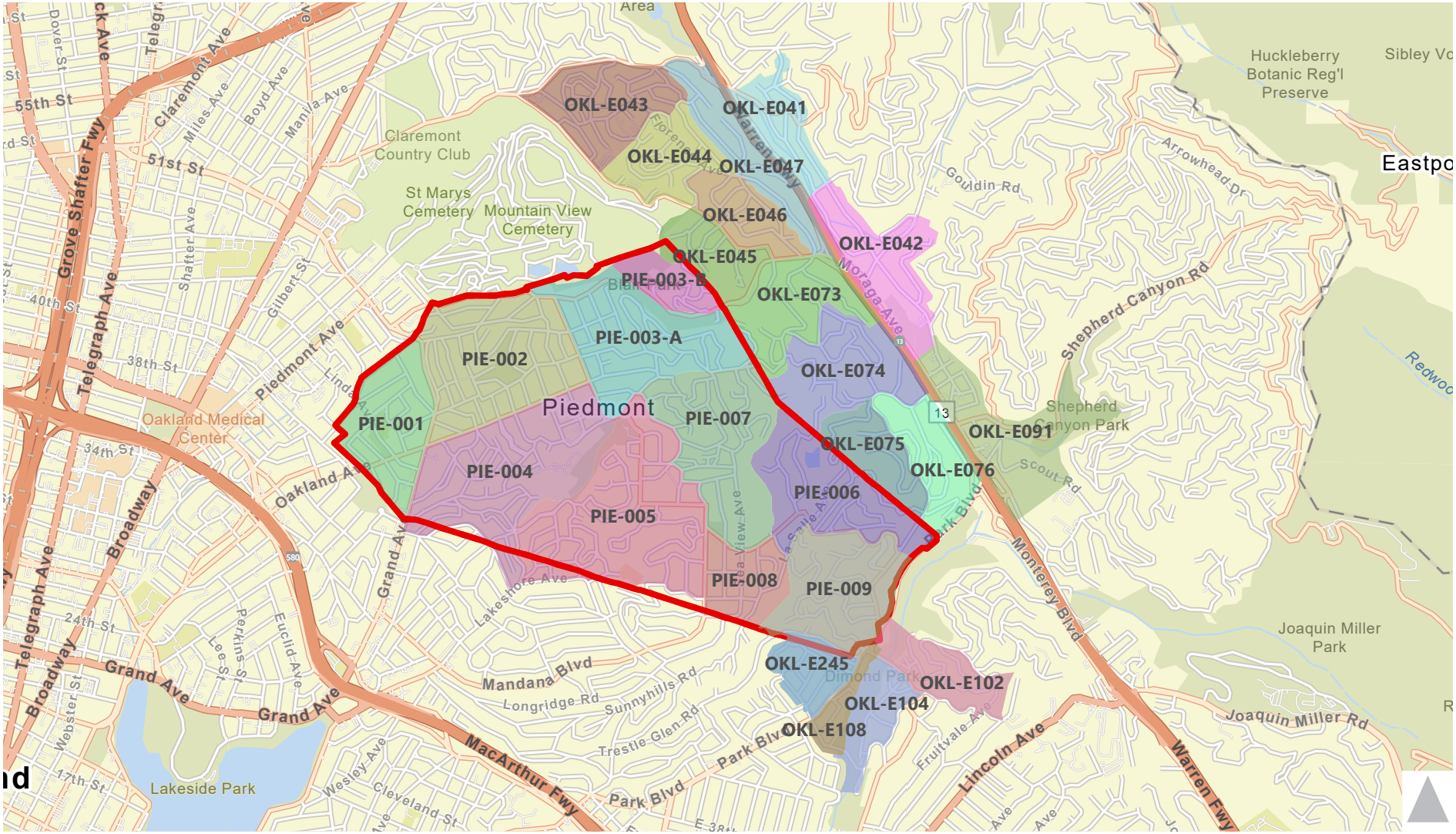
City of Piedmont

Evacuation Routes

Figure 2

Evacuation Routes



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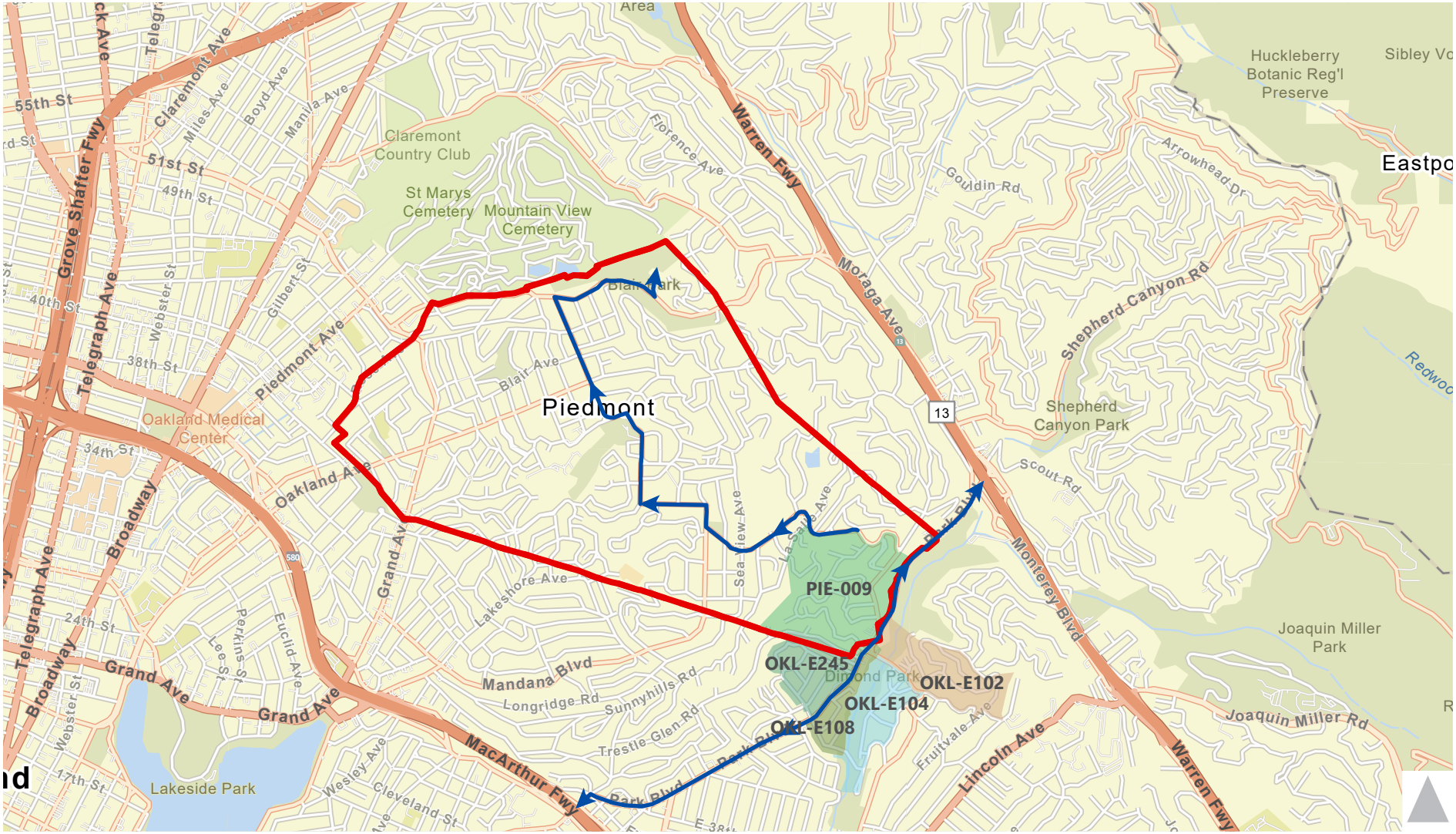
City of Piedmont

Evacuation Zones

Figure 3

Genasys Protect Zones



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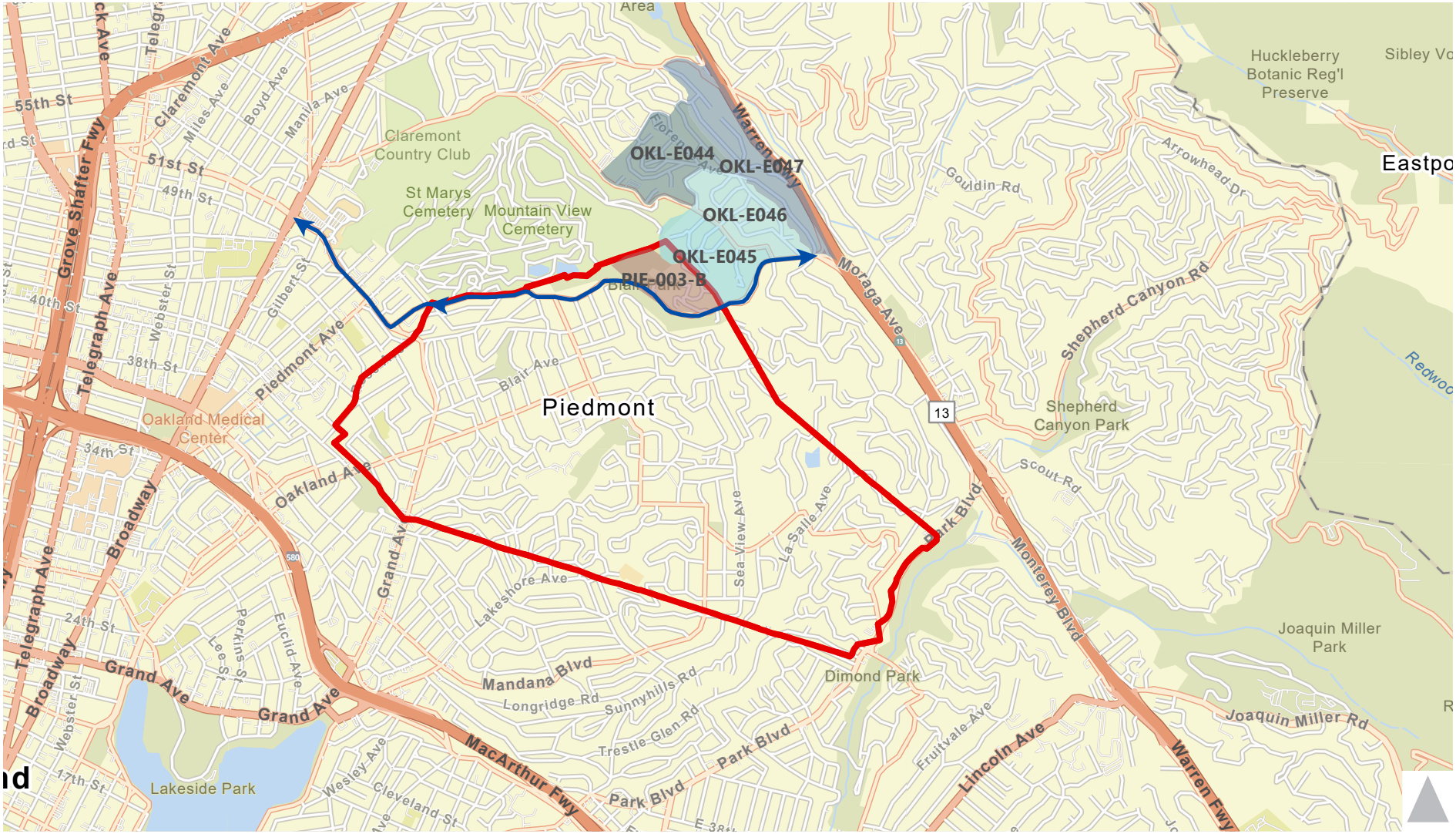
City of Piedmont

Evacuation Zones

Evacuation Routes

Figure 4

Scenario 1 Evacuation Area and Routes



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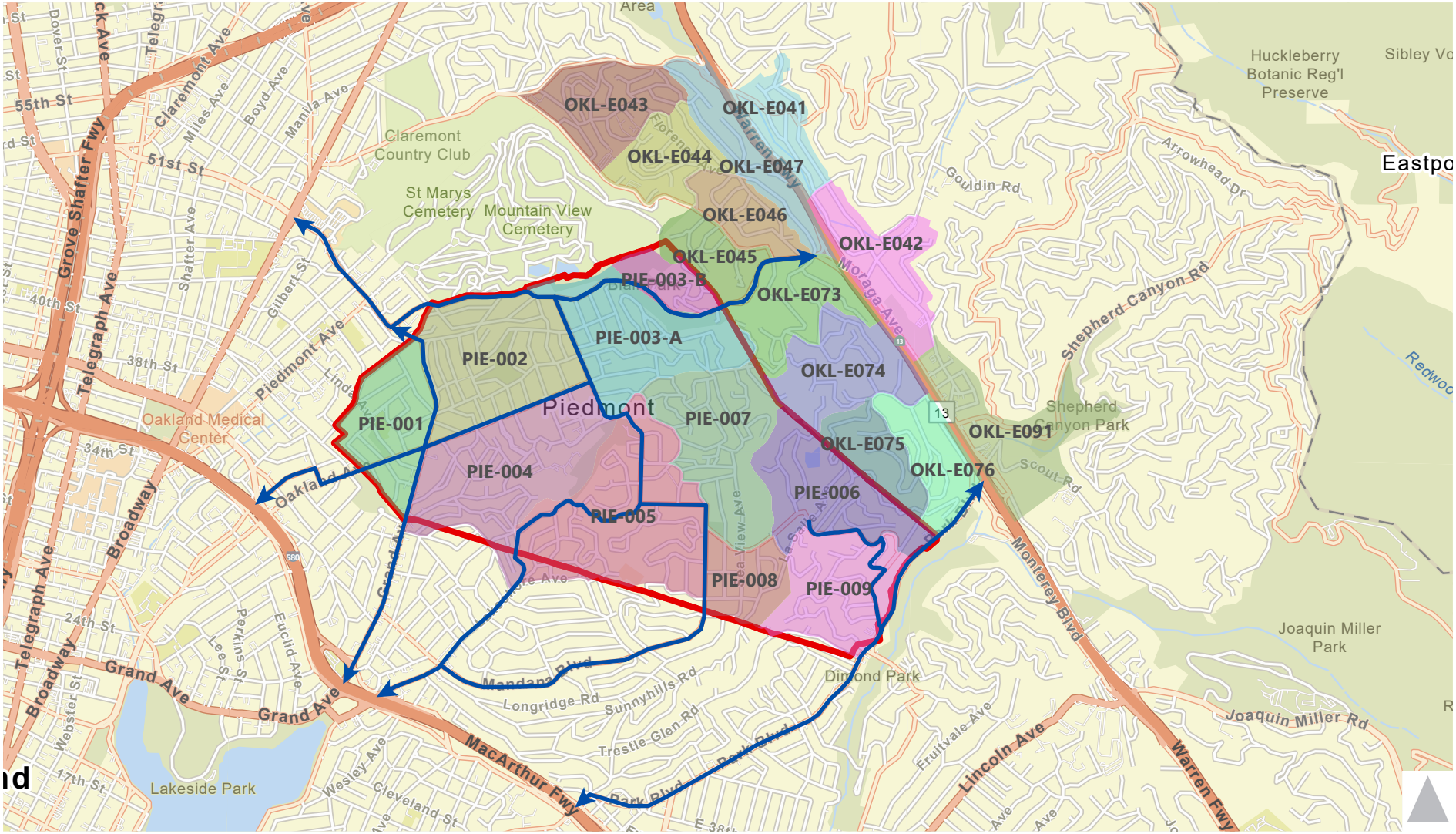
City of Piedmont

Evacuation Zones

Evacuation Routes

Figure 5

Scenario 2 Evacuation Area and Routes



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City of Piedmont

Evacuation Zones

Evacuation Routes

Figure 6

Scenario 3 Evacuation Area and Routes