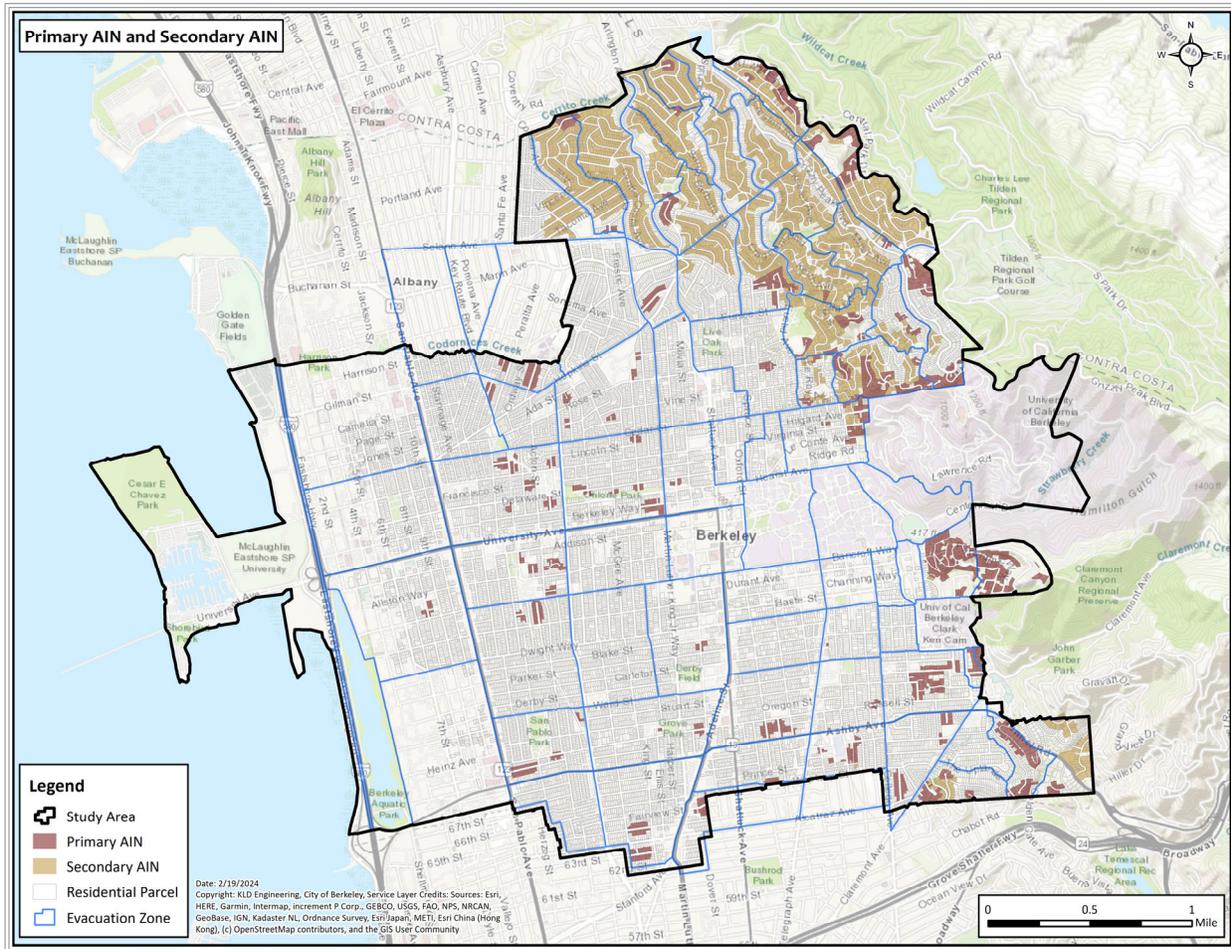


**City of Berkeley, California**  
**Access Impaired Neighborhood Analysis**  
**Senate Bill 99 Requirement**



**Work performed for the City of Berkeley, by:**

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## Introduction

Number five (5) of item G of Section 1 of Section 65302 of Senate Bill 99 stipulates that a safety element for the protection of the community “shall be reviewed and updated to identify residential developments in any hazard area identified in the safety element that do not have at least two emergency evacuation routes.”

The City of Berkeley, California has contracted KLD Engineering, P.C. to help identify residential developments, or neighborhoods, that are in a hazard area with limited means of egress. These neighborhoods may experience more challenges evacuating and should be given special consideration when planning for emergencies that require evacuation. This memo describes the data, assumptions, analysis and results of these Access Impaired Neighborhoods (AIN) within the City of Berkeley.

## Data Sources

- The latest parcel data from the city Open Data portal<sup>1</sup> was used as the base data for the AIN analysis.
- Fire Hazard Severity Zones (FHSZ) data obtained from the City of Berkeley. FHSZ are scored based on factors that influence fire likelihood and fire behavior. Fire Zones 2 and 3 were considered at-risk in this study.
- Federal Emergency Management Agency’s (FEMA) 500-year flood zones<sup>2</sup>. This data identifies areas that have a 0.2% chance of flooding in any given year.
- California Department of Conservation tsunami zones<sup>3</sup>. This dataset includes all populated areas that are at risk of tsunamis.
- California Department of Conservation<sup>3</sup> earthquake zones and the United States Geological Survey (USGS) Hayward Fault Scenario<sup>4</sup>. This dataset includes areas that are at risk for seismic hazards which includes:
  - deep-seated landslide susceptibility based on estimates of rock strength and steepness of slopes,
  - liquefaction,
  - surface fault rupture,
  - and ground shaking.
- The street centerline data was provided by the city and was used to identify dead ends, narrow roads, and winding roads. In addition, the dead-end data provided by the city and those obtained from the road survey were also considered in this analysis.

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<sup>1</sup> <https://data.cityofberkeley.info/City-Government/Parcels/bhxd-e6up>

<sup>2</sup> <https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd>

<sup>3</sup> <https://maps.conservation.ca.gov/cgs/#datalist>

<sup>4</sup> <https://earthquake.usgs.gov/education/shakingsimulations/hayward/M7.0.php#>

## Assumptions

An additional consideration of risk is the distance of a neighborhood from safety resources, like fire stations. To analyze this risk, the following assumptions must be made:

- A threshold of 5 minutes for urban and suburban areas is assumed to be the maximum drive time from a fire station<sup>5</sup>. A 5-minute service area for each fire station was generated using ArcGIS Network Analyst extension. The service area for this analysis represents an area that can be driven by a fire truck from the fire station within a defined period of travel time.
- The maximum dimensions for fire trucks within the city are 11.25 feet high, 60 feet long and 9.25 feet wide<sup>6</sup>.

For the analysis on pavement width (narrow roadways), the following assumptions were made:

- Parking stalls are 8 feet wide. Using the city's curb data for parking information, pavement width was reduced by 8 feet to account for roadways with street parking (or 16 feet if parking is permitted on both sides of the road).
- A minimum of 10 feet is necessary for large vehicles (delivery trucks, buses, etc.) to evacuate.

## Analysis

To identify the hazardous areas within the city that meet the SB 99 criteria, the residential parcel layer was overlaid, in ArcGIS, with the hazard area layers for wildfire, flooding, earthquake, tsunami, liquefaction, and landslide. Figure 1. Hazards affecting the City of Berkeley shows all the different hazard areas that can affect the city that were considered in this study.

In addition, residential parcels outside of the service areas of fire stations are considered vulnerable in this analysis. As such, an additional analysis was performed to assess the serviceability of the neighborhoods within the city based on their distances from fire stations. Figure 2. Fire Station Service Area shows an overview of the service areas of all the fire stations within the city. Although this analysis is not designed to address responder ingress, it is presumed that if responders cannot quickly access an area, then that area is at a higher risk in an emergency.

It should be noted that the entire city falls within at least one hazard area. For this reason, the entire city was considered *at-risk* and was included in this analysis. Although every hazard is not included in this analysis, inclusion of additional hazards would not affect the outcome as the entire city was analyzed for one way in/out to meet the SB 99 requirement.

Next, ESRI's ArcGIS was used to identify all the dead-end roadways within the street network. These dead-end roadways were supplemented with the dead-end roadways provided by the city and those identified during the road survey. The dead ends in this analysis include natural dead ends (e.g., cul-de-sacs, etc.) and man-made barriers (e.g., bollards, gates, traffic calming islands, etc.). Each dead end was verified using aerial imagery. Residential parcels that are within any

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<sup>5</sup> Based on the city's recent Standards of Coverage assessment.

<sup>6</sup> This represents the largest truck (ladder truck) that the city owns. The height does not include antenna.

hazard area, as well as are located outside of the fire station 5-minute service area and are located along dead-end roadways are considered as the AIN. Those areas are shown in Figure 3. Primary Access Impaired Neighborhoods. Since all of these neighborhoods are within a hazard zone and have only one evacuation route available, these are Berkeley's AIN as defined using SB99 criteria.

Once the primary AIN were identified, they were inspected for man-made barriers (e.g., bollards, gates, traffic calming islands, etc.) that could be lifted in an emergency to provide additional evacuation routes out of the neighborhood. These AIN were flagged as having emergency exits since they could have multiple ways out in an emergency if the man-made barrier was removed (or vehicles with high clearance could traverse the barrier in the case of the traffic calming bollards). Figure 4. Primary Access Impaired Neighborhoods with Removeable/Traversable Barriers highlights the primary AIN that have more than one way in/out if a barrier was removed, or a vehicle is high enough to clear a low-profile bollard. These AIN are flagged in Table 1. Access Impaired Neighborhoods as having a “potential emergency exit”.

In addition to the risk factors considered above, narrow and/or winding roadways were also considered. These roadways pose their own risks and can significantly impede evacuation. For this reason, a second level of analysis was completed for those neighborhoods that have more than one evacuation route, but one or more of those routes is narrow and/or winding leaving one *viable* evacuation route. These *secondary* neighborhoods are not considered single lane egress AIN but are within a hazard risk area and only have one *viable* way out. As such, they are identified as *Secondary AIN*. These are additional neighborhoods to those that meet the SB99 criteria.

The city centerline dataset was utilized to determine which roadways were narrow (with a travel lane of less than 10 feet wide<sup>7</sup>). Those roadways which meet or exceed 10 feet wide<sup>8</sup> were not considered in the analysis. To identify the winding roads, the curvature of the roadway was calculated based on its geometry. Each roadway segment within the city's centerline data is made up of vertices defined by longitude and latitude. Three sequential vertices along a roadway segment were utilized to create a triangle. The distances of the sides of the triangle (x, y, and z) were computed based on the longitude and latitude of the three sequential vertices. The radius of the circumscribed circle<sup>9</sup>, or circumcircle radius, was then computed using Equation 1. This circumcircle radius corresponds to the curvature of the roadway at the middle of the three sequential vertices and is assigned to that vertex, or point. A larger radius corresponds to a straighter segment; a smaller radius corresponds to a more curved segment. This process is repeated for every three sequential vertices along the roadway centerline. The curvature of the roadway segment between vertices is computed as the average of the circumcircle radii of the

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<sup>7</sup> Based on discussions with staff from the City's Public Works and Fire Departments, a viable evacuation travel lane width of 10 feet was chosen to account for larger vehicles (8 feet wide) and sideview mirrors. It is assumed that even larger vehicles (10 feet wide) are operated by professional drivers with a higher degree of skill to reduce or eliminate driver error.

<sup>8</sup> Pavement width was utilized (with modifications made for side street parking). Eight feet of parking was removed from the pavement width for single side street parking and 16 feet was removed for street parking on both sides of the road. Eight feet was used since the typical width for a standard parking space is 8 feet. Although a width of 7.5 feet has been used to provide a balance among users, eight feet was used as vehicles are not always parked well, may not be parked in contact with the face of the curb or vegetation, and throughout the day, large vehicles may be parked on the side of the street. Overhanging vegetation was not accounted for.

<sup>9</sup> Circle that passes through all three vertices of a triangle.

two vertices that it connects. This methodology is illustrated in Figure 5. Curvature Radius Example.

Equation 1

$$r = \frac{xyz}{\sqrt{(x+y+z)(y+z-x)(z+x-y)(x+y-z)}}$$

Using a minimum radius of 81 feet<sup>10</sup>, roadway segments with tight turns (radii less than 81 feet) are flagged for review. Figure 6. Narrow and Winding Roads displays all of the roadways that were considered narrow and/or winding. The narrow roadways are color coded by tiers. Red roadways are considered severely constrained (6 feet or less wide), yellow roadways are considered moderately constrained (7 to 8 feet wide) and green roadways are considered constrained (9 to 10 feet wide).

A secondary analysis was then conducted on the residential parcels that have more than one way out but have exit paths along narrow and/or winding roadways (that are shown in Figure 6. Narrow and Winding Roads). If a residential parcel has access to multiple exits, but only one *viable* exit, it was flagged as a Secondary AIN. Since all parts of the city are considered to be within a hazard area, all the neighborhoods that were flagged were included as Secondary AINs. Figure 7. Secondary Access Impaired Neighborhoods shows the Secondary AINs. The primary and secondary AIN are shown together in Figure 8. Primary and Secondary Access Impaired Neighborhoods and are also listed in Table 1. Access Impaired Neighborhoods by priority, evacuation zone (Zonehaven), and street name. Table 1. Access Impaired Neighborhoods also provides the number of parcels that are within each AIN.

## Results and Recommendations

In total, there are 141 primary AIN (1,461 residential parcels) and 195 secondary AIN (3,687 residential parcels) within the City of Berkeley.

Evacuation Zones E013 and E058 (Panoramic Way neighborhood) have the most AIN parcels. This entire neighborhood has only one access point to the nearest evacuation route (at a stop-controlled intersection at Panoramic Way and Prospect St/Canyon Rd). There are some removable or traversable barriers, but these additional exits will not expedite the evacuation of these neighborhoods since they are located so far up the mountain and do not provide additional access points to Prospect St/Canyon Rd. This neighborhood is within Fire Zones 2 and 3 and is at risk of landslides. The neighborhood also is at risk of violent ground shaking. Most of this neighborhood is also outside of a 5-minute drive from the nearest fire station. Many of the roadways within this area are less than 10 feet across and do not have side street parking.

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<sup>10</sup> Table 3-7 of the 2018 AASHTO Policy on Geometric Design of Highways and Streets indicates the minimum radii for a curve with a design speed of 20mph is 81 feet. Based on the data collected during the road survey, the speed travelled on these curves was 20mph or less.

The vast majority of secondary AIN are in Berkeley Hills and Thousand Oaks due to the narrow and winding roadways in this area, as shown in Figure 7. Secondary Access Impaired Neighborhoods. Berkeley Hills and this part of Thousand Oaks are at risk of violent ground shaking. They are within Fire Zone 2 but are within a 5-minute drive of the nearest fire station. Parts of these areas are also at risk of landslides.

Depending on the hazard, these neighborhoods may require early notification to have sufficient time to evacuate before their safety is at risk. It is recommended that plans be put into place to ensure 100% notification of these areas and to notify these areas of an emergency even before they may be at risk.

**Table 1. Access Impaired Neighborhoods**

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels
Primary	ALB-E006	Acton St	No	29
	ALB-E006	Tevlin St	No	14
	BER-E002	Vincente Ave	No	2
	BER-E003	San Mateo Rd	No	1
	BER-E004	Florida Ave	No	6
	BER-E005	Vermont Ave	No	11
	BER-E007	My Way	No	8
		Rochdale Way	No	5
		Vistamont Ave	No	20
		Woodmont Ct	No	5
	BER-E010	San Mateo Rd	No	26
	BER-E011	Station Pl	No	5
		Vincente Ave	No	12
	BER-E013	Dwight Pl	No	11
		Dwight Way	No	27
		Panoramic Place	No	2
		Panoramic Place	Yes	2
		Panoramic Way	No	21
		Panoramic Way	Yes	5
	BER-E014	Carleton St	No	2
	BER-E016	Martin Ave	No	4
		Middlefield Rd	No	6
		Overlook Rd	No	10
		The Spiral	No	8
		Woodhaven Rd	No	11
		Woodmont Ave	No	1
	BER-E017	Stoddard Way	No	6
	BER-E018	Private Dr Off of Keith Ave	No	3
	BER-E019	Corona Ct	No	17
		Crystal Way	No	7
High Ct		No	27	
Laurel St		No	6	
Oak St		No	1	
BER-E021	Napa Ave	Yes	26	
BER-E025	Northside Ave	No	13	
BER-E026	Berryman St	No	3	
	Buena Ave	No	6	
	Grant St	No	4	
	Miramonte Ct	No	9	

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels
		North St	No	7
	<b>BER-E027</b>	Eunice St	No	1
	<b>BER-E028</b>	Private Drive Off of Arch St	No	4
		Spring Way	No	10
	<b>BER-E029</b>	Codornices Rd	No	8
		El Portal Ct	No	5
		Northgate Ave	No	14
		Ross St	No	3
	<b>BER-E030</b>	Columbia Cir	No	8
		Private Dr Off of Fairlawn Dr	No	5
	<b>BER-E031</b>	Ajax Pl	No	11
		Grizzly Peak Blvd	No	3
		Hill Rd	No	16
		Olympus Ave	No	6
		Private Driveway Off of Summit Rd	No	4
		Summit Rd	No	21
	<b>BER-E032</b>	Buena Vista Way	No	25
		Campus Dr	No	22
		Cedar St	No	1
		Harvard Cir	No	5
		Maybeck Twin Dr	No	19
		Olympus Ave	No	8
		Parnassus Ct	No	12
	<b>BER-E033</b>	Greenwood Commons	No	4
		Hill Ct	No	10
		Ross St	No	2
	<b>BER-E036</b>	Francisco St	No	14
		Lincoln St	No	15
		Short St	No	24
		Virginia Gardens	No	13
		West St	No	2
	<b>BER-E037</b>	Berkeley Way	Yes	17
		California St	No	5
		Delaware St	No	9
		Grant St	No	8
		Grant St	Yes	10
		Mc Gee Ave	No	5
	<b>BER-E038</b>	Bonita Ave	Yes	5
	<b>BER-E040</b>	Cedar St	No	2
		Higard Ave	No	9

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels
		La Vereda Rd	No	7
		Le Conte Ave	No	6
		Leroy Ave	No	4
		Virginia St	No	3
	<b>BER-E046</b>	Acroft Court	No	11
		Action Circle	No	20
		Noth Valley St	No	14
		West St	No	4
	<b>BER-E047</b>	8Th St	No	10
	<b>BER-E051</b>	Poe St	No	5
		Valley St	No	30
	<b>BER-E053</b>	Milvia St	Yes	5
	<b>BER-E058</b>	Arden Rd	No	14
		Canyon Rd	No	8
		Dwight Way	No	2
		Fernwald Rd	No	6
		Hillside Ct	No	7
		Mosswood Ln	No	3
		Mosswood Rd	No	14
		Panoramic Place	No	3
		Panoramic Way	No	63
		Private Drive Off of Panoramic Way	No	4
	<b>BER-E062</b>	Burnett St	Yes	36
		Russell St	No	10
		Sojourner Truth Way	No	3
	<b>BER-E063</b>	Grant St	No	2
		Russell St	Yes	10
	<b>BER-E064</b>	Deakin St	Yes	15
		Ellsworth St	Yes	6
		Fulton St	Yes	16
	<b>BER-E065</b>	Russell St	No	6
	<b>BER-E066</b>	Garber St	No	4
		Tanglewood Rd	Yes	5
	<b>BER-E067</b>	Bateman St	No	16
		Colby St	No	3
		Dana St	Yes	5
		Regent St	No	10
		Webster St	No	6
	<b>BER-E068</b>	Woolsey St	Yes	11
	<b>BER-E069</b>	Fairview St	No	21

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels
	BER-E070	63Rd St	Yes	24
		Harmon St	Yes	19
	BER-E072	Elmwood Ct	No	10
		Lewiston Ave	Yes	27
		Webster St	No	6
	BER-E073	Avalon Ave	No	12
		Claremont Blvd	Yes	10
		Garber St	No	28
		Kelsey St	Yes	14
		Palm Ct	No	6
		Stuart St	Yes	8
	BER-E078	El Camino Real	No	15
		Hillcrest Rd	No	6
		Oak Ridge Rd	No	31
		Private Drive Off of The Uplands	No	7
	OKL-E004	Tanglewood Rd	Yes	7
	OKL-E017	Eton Ct	No	6
		Mystic Ct	No	6
	OKL-E018	Brookside Ave	No	15
		Hillcrest Ct	No	8
Roslyn Ct		No	7	
OKL-E019	Roble Ct	No	7	
<b>Total Primary AIN</b>		<b>141</b>	<b>Total Primary AIN Parcels</b>	<b>1,461</b>
Secondary	BER-E001	Capistrano Ave	N/A	42
		Colusa Ave		2
		Vincente Ave		22
		San Lorenzo Ave		25
		Tacoma Ave		34
		Ensenada Ave		15
		Miramar Ave		1
		Solano Ave		1
	BER-E002	Arlington Ave		5
		Capistrano Ave		6
		Contra Costa Ave		70
		Mendocino Ave		35
		San Antonio Ave		29
		San Fernando Ave		16
		San Juan Ave		22
		San Ramon Ave		31
Santa Clara Ave	24			

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels	
		The Alameda		45	
		Thousand Oaks Blvd		31	
		Vallejo St		7	
		Yosemite Rd		60	
	<b>BER-E003</b>	Arlington Ave		3	
		Avis Rd		10	
		San Antonio Ave		22	
		San Diego Rd		10	
		San Luis Rd		21	
		Somerset Pl		1	
		Southampton Ave		29	
		<b>BER-E004</b>		Arlington Ave	2
				Boynton Ave	54
	Florida Ave			8	
	Montrose Rd			5	
	Northampton Ave			27	
	San Luis Rd			32	
	Santa Barbara Rd			73	
	Southampton Ave			7	
	Spruce St			5	
	Vermont Ave	1			
	<b>BER-E005</b>	Colorado Ave		9	
		Kentucky Ave		40	
		Maryland Ave		15	
		Michigan Ave		42	
		Spruce St		2	
		Vassar Ave		23	
		Vermont Ave		40	
		Rugby Ave		3	
	<b>BER-E006</b>	Acacia Ave		3	
		Alta Rd		7	
		Cragmont Ave		36	
		Creston Rd		1	
		Euclid Ave		1	
		Grizzly Peak Blvd		1	
		Rosemont Ave		1	
		Spruce St		2	
	Vassar Ave	25			
	<b>BER-E007</b>	Rochdale Way		1	
		Rosemont Ave		6	
		Sunset Ln		3	

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels	
		Vistamont Ave		21	
		Woodmont Ave		51	
	BER-E008	Bonnie Ln		22	
		Creston Rd		52	
		Grizzly Peak Blvd		3	
		Hilldale Ave		58	
		Keeler Ave		46	
		Marin Ave		6	
		Poplar St		10	
		Rosemont Ave		1	
		Sunset Ln		1	
		BER-E009		Acacia Ave	7
				Alamo Ave	24
	Cragmont Ave			79	
	Euclid Ave			1	
	Halkin Ln			6	
	Marin Ave			1	
	Poplar St			10	
	Regal Rd			18	
	Rock Ln			25	
	Spruce St			4	
	BER-E010	Indian Rock Ave		4	
		Marin Ave		17	
		Montrose Rd		8	
		Oxford St		32	
		San Diego Rd		16	
		San Luis Rd		27	
		San Mateo Rd		1	
		Santa Barbara Rd		37	
		Shattuck Ave		17	
		Spruce St		1	
	BER-E011	Capistrano Ave		31	
		Colusa Ave		3	
		Menlo Pl		26	
		San Miguel Ave		12	
		Santa Rosa Ave		47	
		The Alameda		45	
		Thousand Oaks Blvd		19	
		Vincente Ave		67	
		Visalia Ave		18	
		San Lorenzo Ave		25	

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels	
		San Pedro Ave		30	
		Tacoma Ave		32	
	BER-E015	Creston Rd		58	
		Forest Ln		29	
		Grizzly Peak Blvd		5	
		Hilldale Ave		36	
		Keeler Ave		37	
		Latham Ln		2	
		Marin Ave		7	
		Miller Ave		30	
		Poppy Ln		15	
		Regal Rd		26	
		Sunset Ln		2	
		BER-E016		Hillview Rd	19
				Latham Ln	2
	Middlefield Rd			25	
	Muir Way			1	
	Overlook Rd			31	
	Park Gate			1	
	Park Hills Rd			53	
	Shasta Rd			4	
	Sunset Ln			3	
	The Crescent			18	
	The Crossways			2	
	The Shortcut			1	
	Wildcat Canyon Rd			4	
	Woodhaven Rd			19	
	Woodside Rd			27	
	BER-E017	Creston Rd		21	
		Grizzly Peak Blvd		7	
		Keeler Ave		32	
		Latham Ln		5	
		Miller Ave		47	
		Muir Way		3	
		Private Drive Off of Whitaker Ave		3	
		Shasta Rd		11	
		Sterline Ave		52	
		Sterling Ave		3	
		Stevenson Ave		8	
	Twain Ave	5			

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels
		Whitaker Ave		7
	<b>BER-E018</b>	Bret Harte Rd		19
		Cragmont Ave		70
		Euclid Ave		22
		Keeler Ave		21
		Keith Ave		64
		Shasta Rd		8
		Tamalpais Rd		2
		<b>BER-E019</b>	Cragmont Ave	
	Euclid Ave			37
	Keith Ave			47
	Marin Ave			6
	Regal Rd			15
	Santa Barbara Rd			14
	Spruce St			3
	<b>BER-E020</b>	Del Norte St		17
		Marin Ave		8
		Oxford St		44
		San Benito Rd		23
		Santa Barbara Rd		2
		Shattuck Ave		30
		Spruce St		3
	<b>BER-E029</b>	Campus Dr		6
		Euclid Ave		10
		Le Roy Ave		6
		Northgate Ave		14
		Rose St		2
		Shasta Rd		53
		Tamalpais Rd		43
	<b>BER-E030</b>	Campus Dr		27
		Queens Rd		21
		Shasta Rd		7
	<b>BER-E031</b>	Avenida Dr		17
		Hill Rd		1
	<b>BER-E032</b>	Buena Vista Way		39
		Campus Dr		1
		Cedar St		1
		Del Mar Ave		14
		La Vereda Rd		12
		Olympus Ave		26
		Parnassus Rd		19

Priority	Evacuation Zone	Neighborhood	Potential Emergency Exit?	Number of Parcels
		Queens Rd		1
	<b>BER-E033</b>	Buena Vista Way		14
		Greenwood Terrace		3
		Le Roy Ave		24
	<b>BER-E040</b>	Hilgard Ave		2
		La Vereda Rd		10
		Le Loma Ave		2
		Virginia St		4
	<b>BER-E058</b>	Hillside Ave		3
	<b>BER-E067</b>	Bateman St		3
	<b>OKL-E008</b>	Alvarado Rd		14
	<b>OKL-E009</b>	Alvarado Rd		5
	<b>OKL-E010</b>	Vicente Rd		22
	<b>OKL-E015</b>	Vicente Rd		3
	<b>OKL-E018</b>	Hillcrest Rd		31
<b>Total Secondary AIN</b>		<b>195</b>	<b>Total Secondary AIN Parcels</b>	<b>3,687</b>

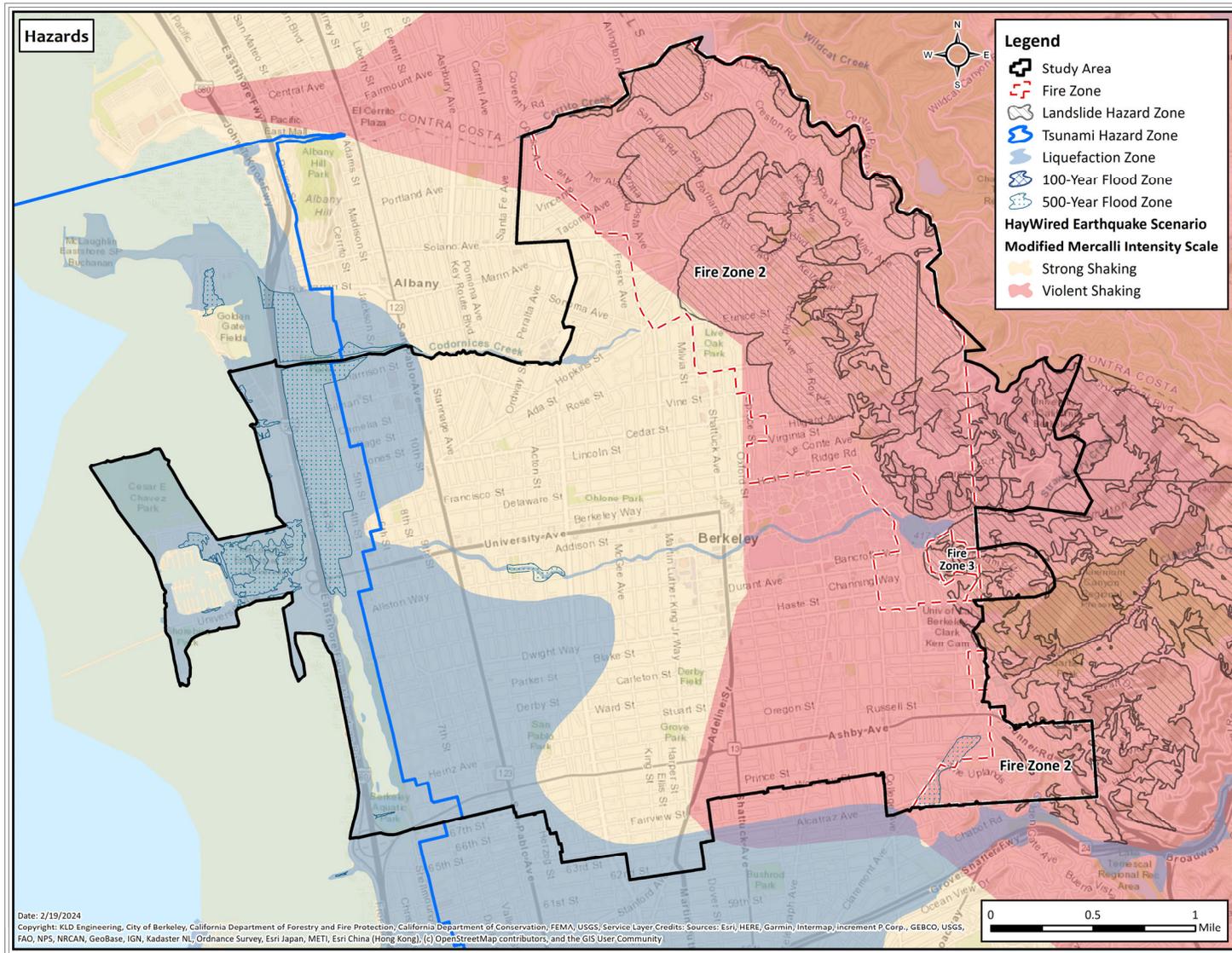


Figure 1. Hazards affecting the City of Berkeley

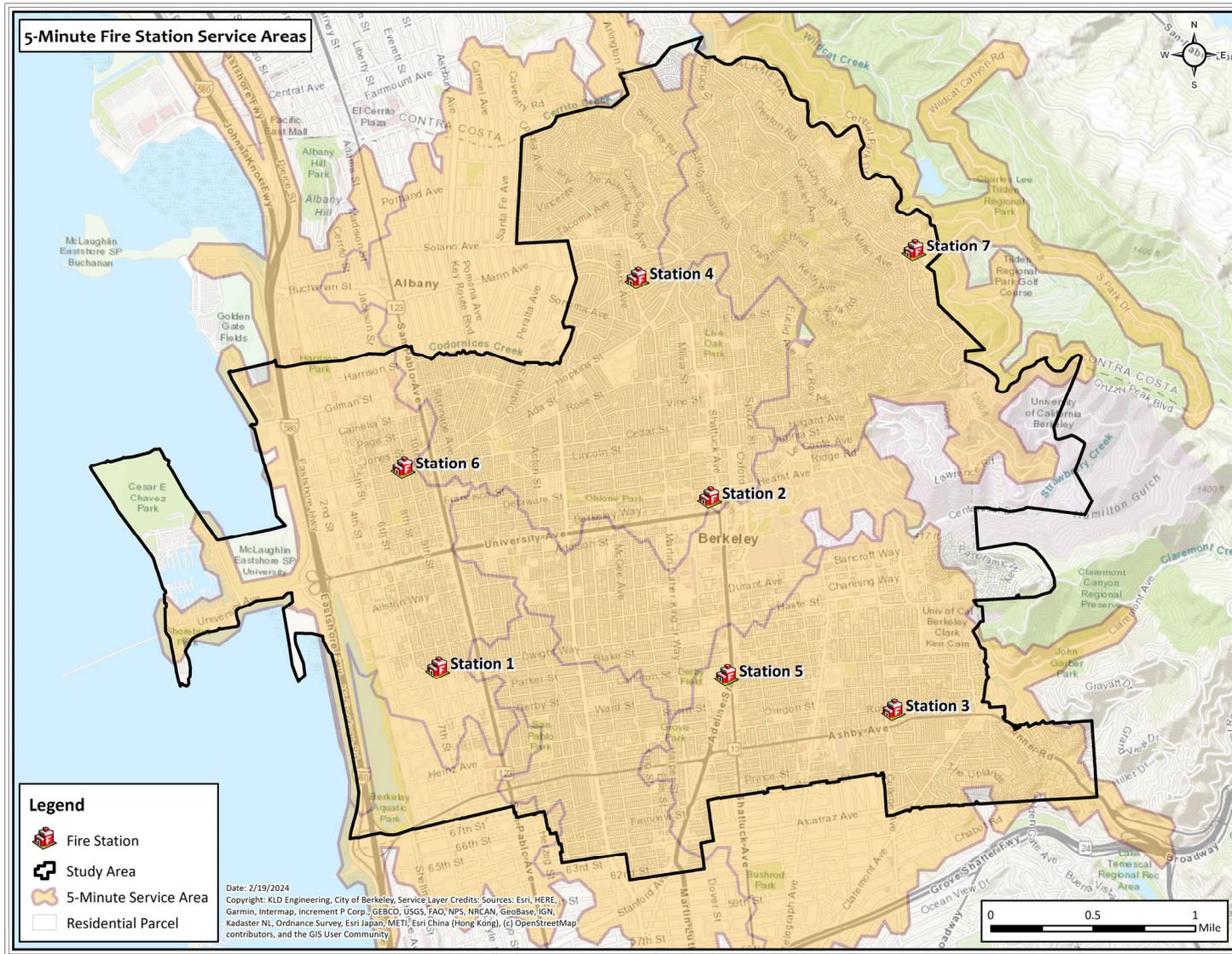
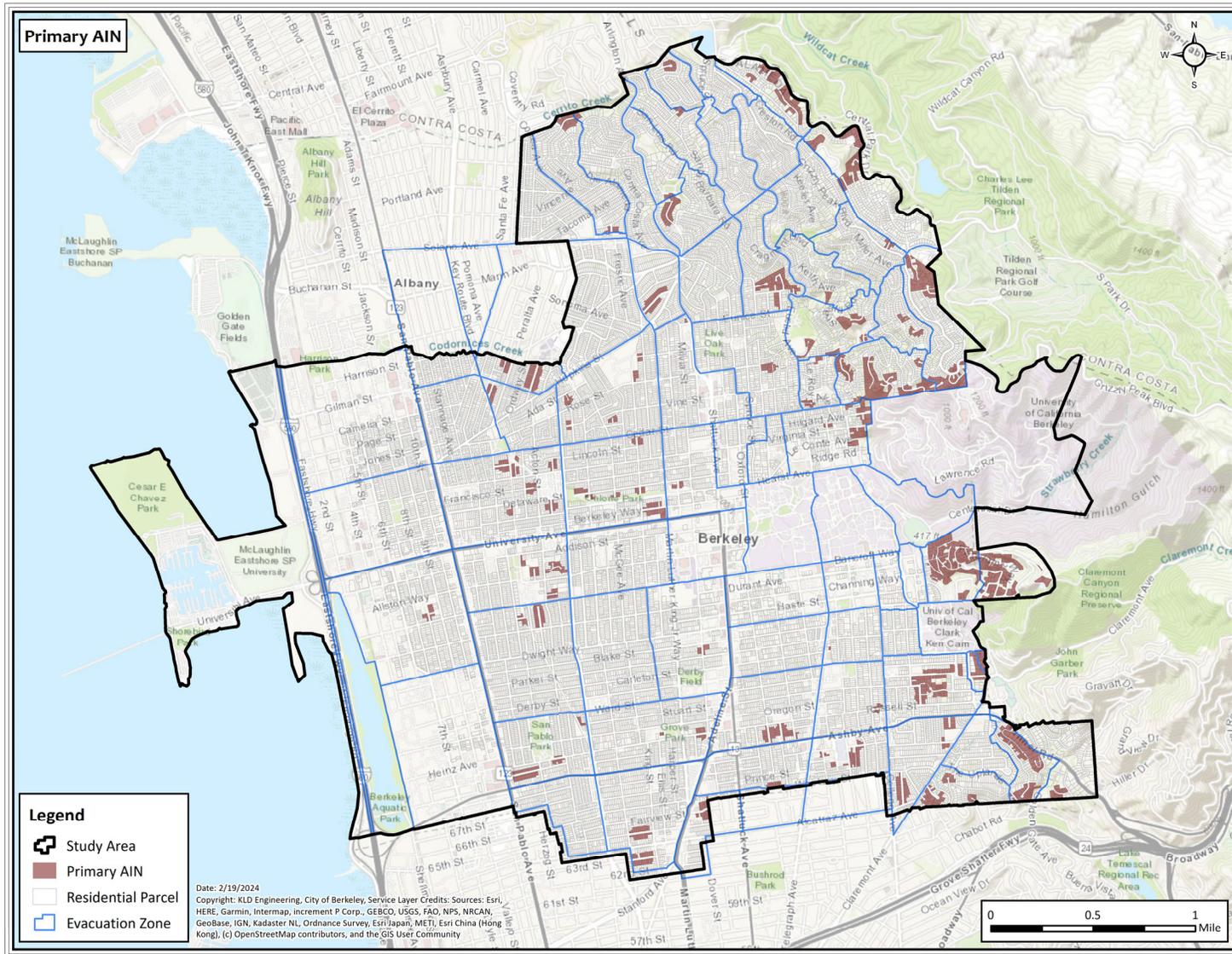
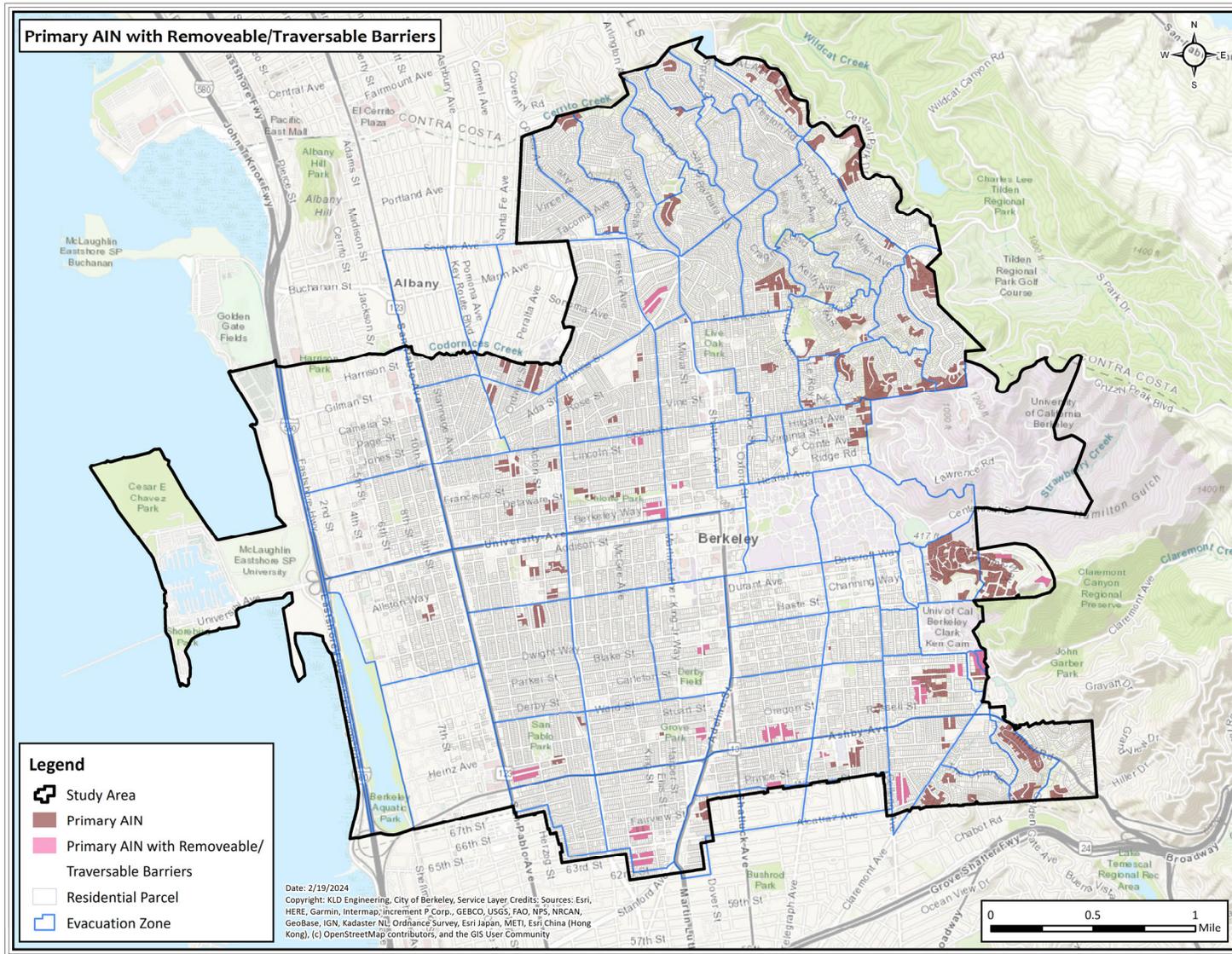


Figure 2. Fire Station Service Area



**Figure 3. Primary Access Impaired Neighborhoods**



**Figure 4. Primary Access Impaired Neighborhoods with Removeable/Traversable Barriers**



Figure 5. Curvature Radius Example

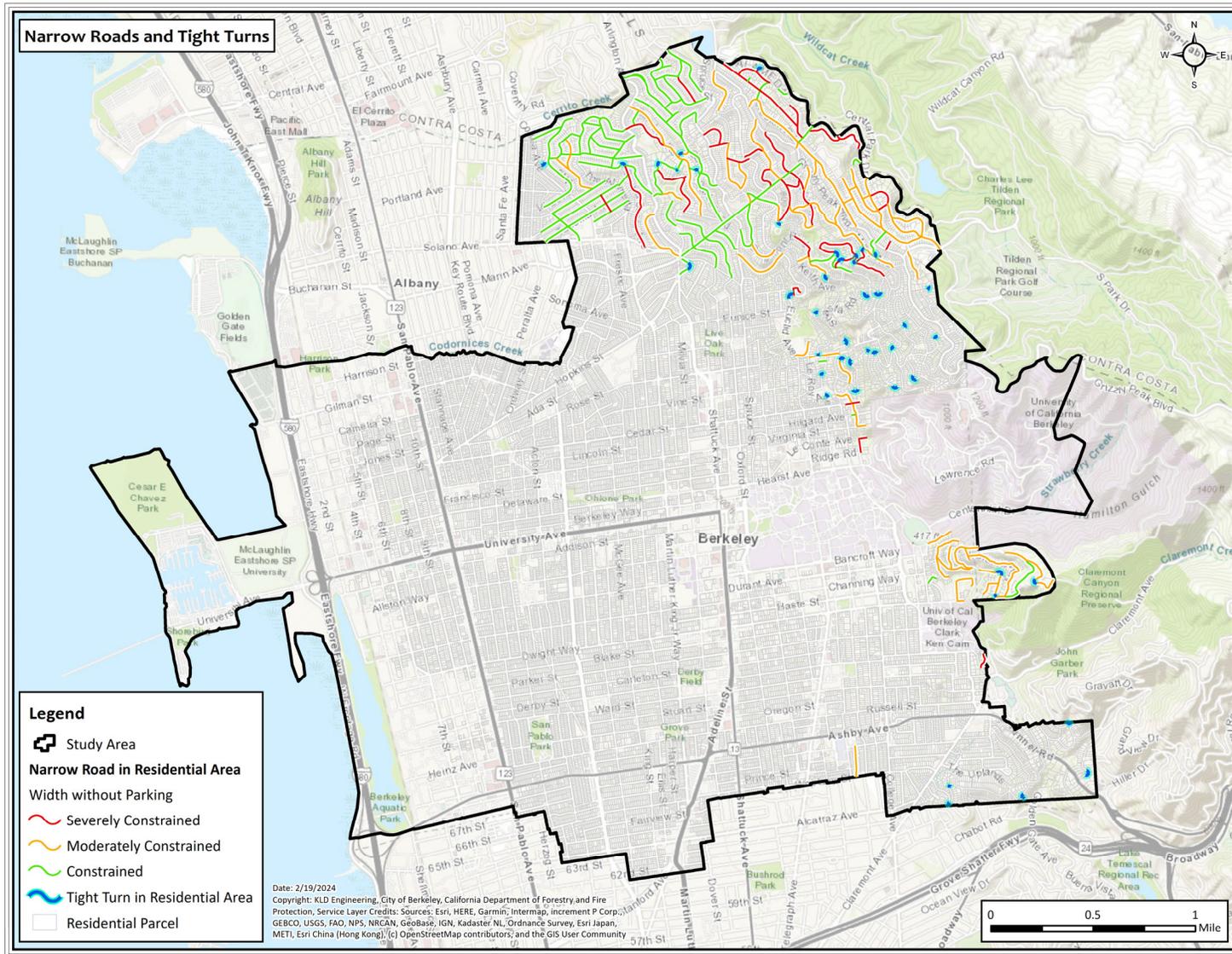


Figure 6. Narrow and Winding Roads

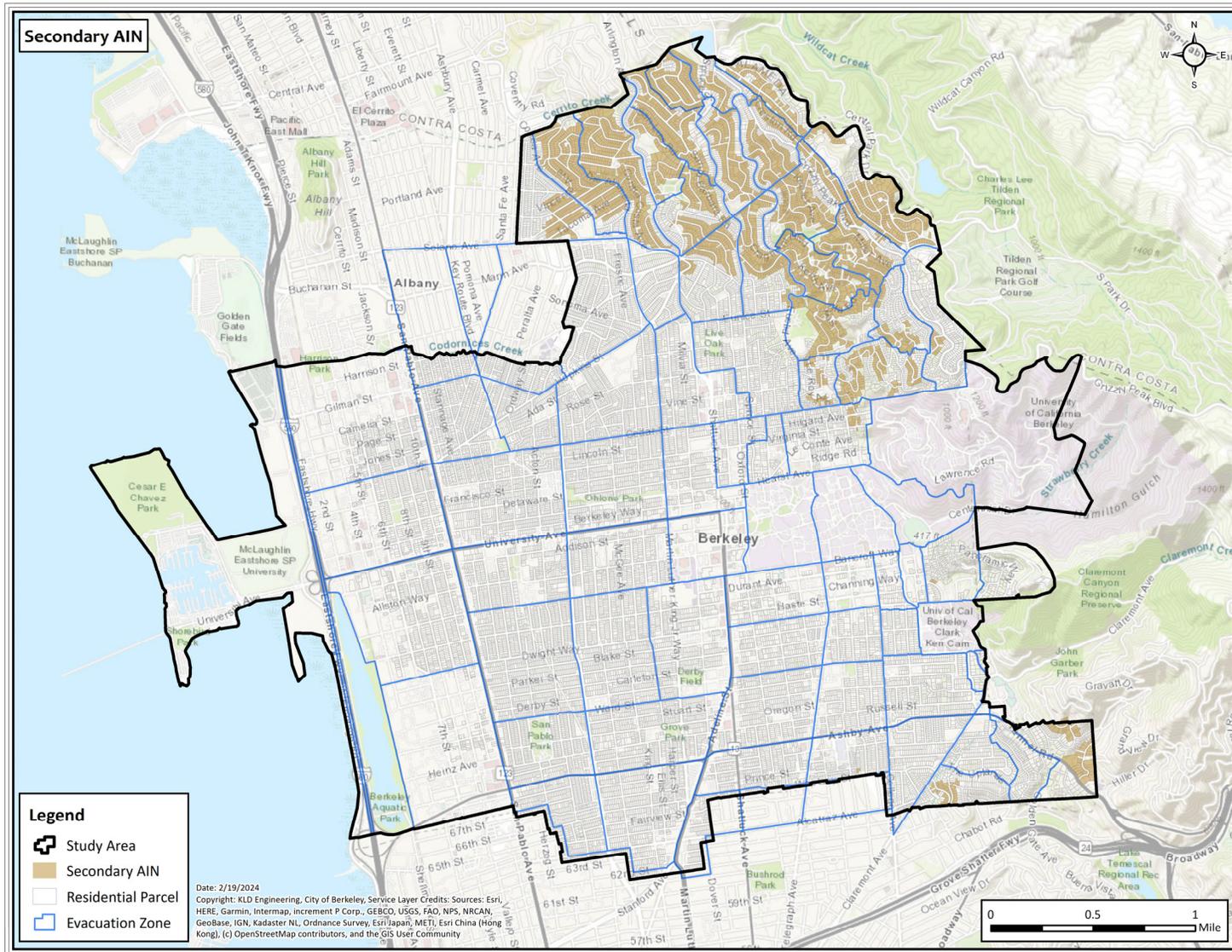


Figure 7. Secondary Access Impaired Neighborhoods

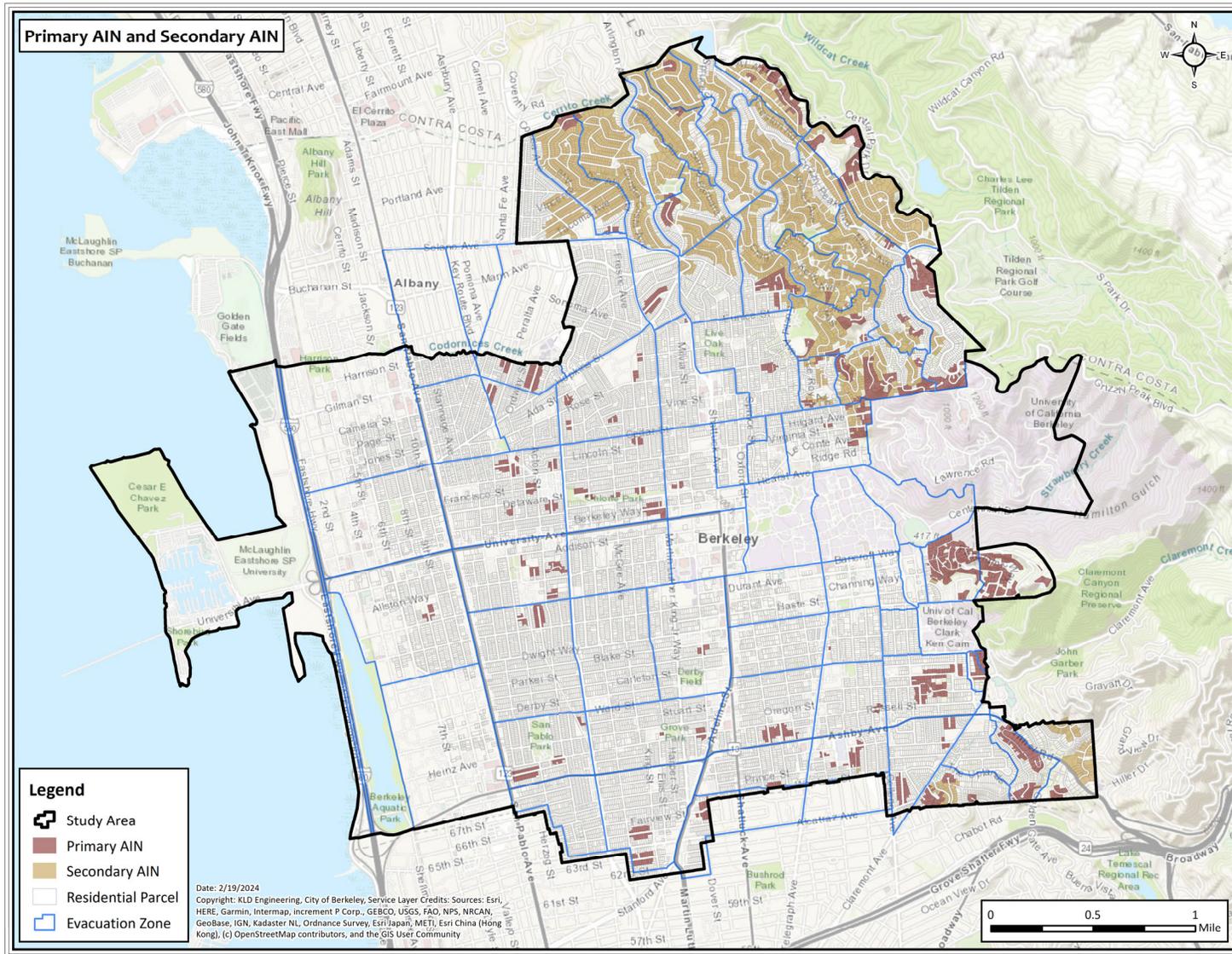


Figure 8. Primary and Secondary Access Impaired Neighborhoods