Appendices

Appendix C: Evacuation Scenario Analysis

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Appendix C: Evacuation Scenario Analysis

This appendix provides supplemental evacuation analysis in support of the Palmdale General Plan 2045. This study is intended to provide the City with a broad planning level assessment of the capacity of the transportation system during a citywide evacuation event. It identifies residential developments with a single entrance and exit road and evaluates the efficacy of existing evacuation routes under various hazard scenarios in compliance with the following two statutes:

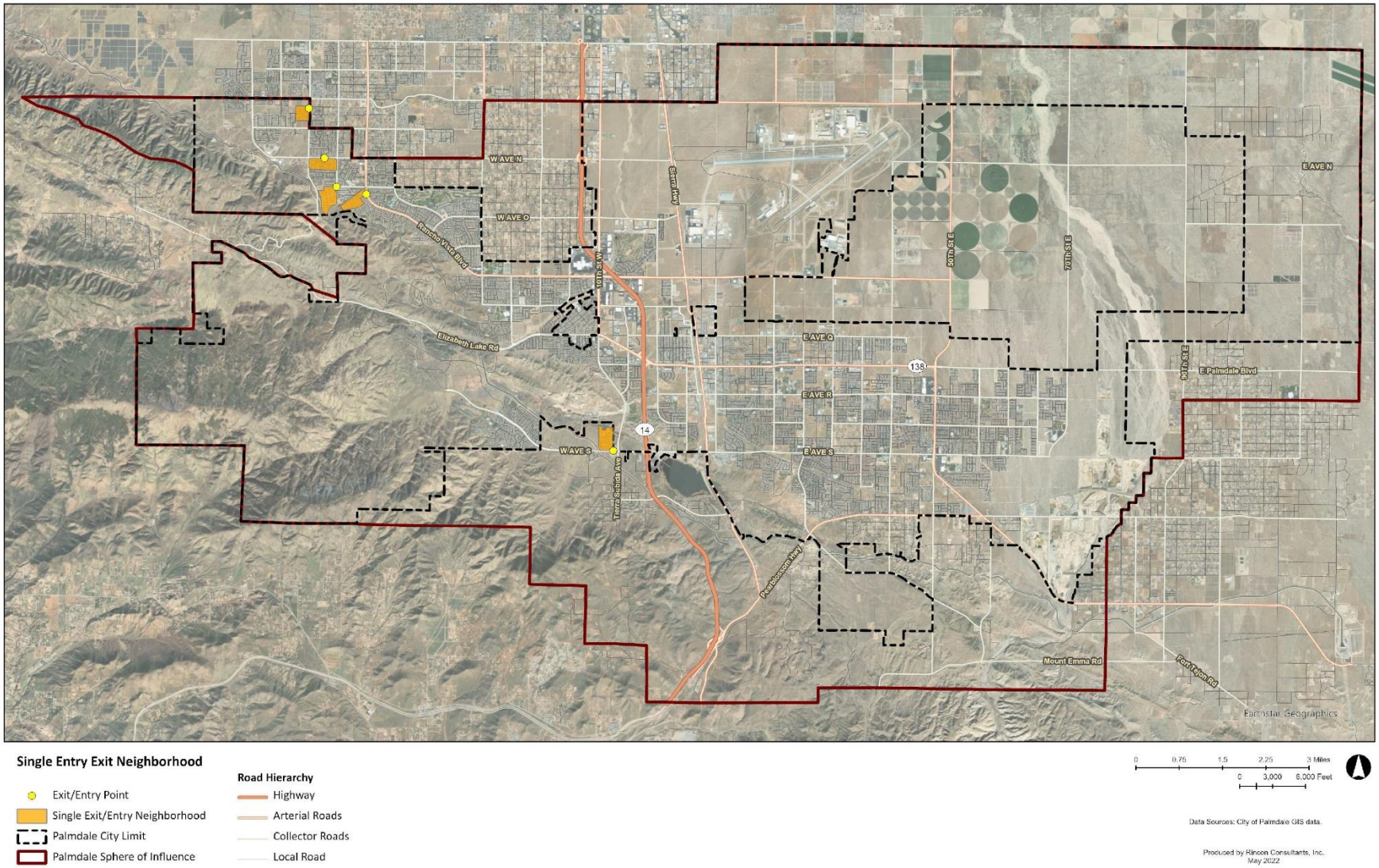
Senate Bill 99 requires that the Safety Element of the General Plan identify any residential developments in any hazard area that does not have at least two evacuation routes. This is a requirement for all safety element updates included upon the revision of the housing element on or after January 1, 2020.

Assembly Bill 747 requires that the Safety Element be reviewed and updated to identify evacuation routes and their capacity, safety, and viability under a range of emergency scenarios. This will be a requirement for all safety elements or updates to a hazard mitigation plan completed after January of 2022. As this requirement has recently gone into effect, there is no established standard methodology.

SB 99 Analysis – Single Entrance/Exit Neighborhoods

Per SB 99, the Safety Element of the General Plan is required to identify neighborhoods in any hazard area that does not have at least two evacuation routes. For this analysis, a neighborhood is defined as 30 or more dwelling units that only have a single route to access a collector or arterial road. There were five Single Entry/Exit Neighborhoods identified in the city that have a single entry or exit point (Figure 1). Four of the five neighborhoods are located in the northern portion of the city, in the northwest portion of the City. The remaining neighborhood is located northwest of Lake Palmdale within Palmdale's Sphere of Influence (SOI). In the case of an evacuation event, these single entry/exit neighborhoods would likely utilize the southern-most and northern most roads of the city to evacuate. The northwest portion of the City may also use roads to the west. However, in the case of a wildfire to the west of the city, the northwest portion of the City would not be able to utilize the western roads and would likely opt to use the northern roads instead.

Figure 1 Single Entry/Exit Neighborhood



AB 747 Analysis – Evacuation Scenarios

In accordance with AB 747, the following analyses and results outline the potential outcomes of a variety of hazard events requiring emergency evacuation.

Evacuation Assessment Methodology

Hazards Scenarios

In accordance with AB 747, a variety of potential hazard scenarios have been presented in this evacuation analysis. The locations of where natural hazards or disasters occur, highly effects how evacuation would occur within a city. There are two reservoirs and dams located on the southern border of the city, Lake Palmdale Dam and Little Rock Reservoir Dam. Thus, evacuation scenarios included in this analysis evaluate the potential effects these dam failures would have on evacuation and the associated flooding they would cause in the city. The city also has moderate and high wildfire severity risk areas to the south and west. Angeles National Forest borders the western and southern edge of the city, which are both within the city's borders and sphere of influence (SOI). Both areas have low rainfall, dry summers, and dense vegetation that make the forests prone to wildfire threats, especially under drought conditions. Therefore, this analysis evaluates the effects that potential wildfires occurring in the southern and western portion of city would have on evacuation. A total of four hazard scenarios, in addition to a baseline scenario, are considered in this analysis:

1. Baseline – A general emergency requiring full city evacuation under normal environmental conditions
2. Wildfire from the South
3. Wildfire from the West
4. Lake Palmdale Dam Break from the South
5. Little Rock Reservoir Dam Break from the South

Each of these hazard scenarios are described below in detail in the Evacuation Assessment Results section.

Data Sources and Data Processing

Transportation Network

The transportation network was extracted from Open Street Maps using a Python package called OSMnx. The Open Street Maps data provides topology linking all features, bridge attribution, speed limits, and road hierarchy. The network features were edited to add Z levels for bridges, complete speed limit coverage, traffic lights, and emergency/disaster area intersections. These edits allowed for a range of different factors that could affect the estimated time evacuation of out of Palmdale's Sphere of Influence (SOI).

Parcel Data

The parcel layer used in the model includes parcels that allow residential, industrial, and commercial land uses from Palmdale's zoning code. The parcel polygons were converted into point features that retained the attribution of the original parcel polygon for use in the routing models.

Road Hierarchy

A road hierarchy was also incorporated into the network model. The roads were classified into highways, highway ramps, arterial, collector, tertiary, and local roads. The road classification slightly differs from the City of Palmdale road classification in the Circulation Element of the 1993 General Plan and is instead based on the Open Street Map classification. Highway segments were designed to have the least travel time in the network as possible. Segments that had low travel times because of high speeds along the segments were given the highest priority in the hierarchy.

Evacuation Routing

Evacuation routing was developed using Esri's Closest Facility tool included in their Network Analyst extension. There were 24 city exit points that were placed outside of Palmdale's SOI. The Closest Facility tool was modeled along the network from each of the 45,042 parcels to find the closest city exit point. The fire scenarios removed exit points from the network, and the flood scenarios added time penalties to the network solver for traversing road segments that intersected the dam inundation area.

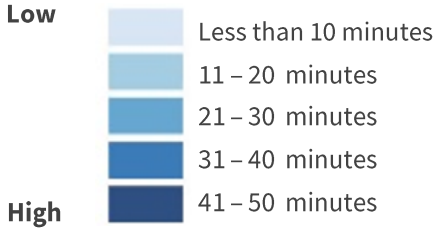
Travel time attribution was created by calculating the time it would take to travel each road segment based on the road segments speed limit. The travel time of each segment that was traveled from the parcel to the exit point was added up to give a final travel time score. For the dam failure scenarios, roads that intersected the dam inundation area were attributed and each segment affected by potential dam inundation added five minutes of travel time to the total travel time score. [1]

This analysis utilizes all major roads and arterials that would typically be used during an evacuation as evacuation routes and does not prioritize or designate any roadway as an emergency evacuation route compared to another roadway. For the purpose of this analysis, all developed roadways are considered emergency evacuation roadways.

[1] Department of Water Resources (DWR), Division of Safety of Dams (DSOD). 2022. Dam Breach Inundation Map Web Publisher. https://fmds.water.ca.gov/webgis/?appid=dam_prototype_v2 (Accessed June 2022)

Vulnerability Scoring

Vulnerability scores were determined based on the estimated travel times from a parcel to the nearest exit point.



Parcels with travel times below 20 minutes are considered to have low vulnerability. Parcels with travel times at 21 minutes to 40 minutes are considered to have moderate vulnerability. Parcels with travel times at 41 minutes or more are considered to have high vulnerability.

For each hazard-related evacuation scenario, parcels with differing evacuation route vulnerability, either an increased or decreased vulnerability score from the baseline, were identified.

The resulting scores are an estimation of the travel time it would take for each parcel to evacuate Palmdale. The network model is not a dynamic traffic model of the City's road network. The model does not account for traffic volumes that would be experienced in a real hazard-related evacuation scenario. The analysis highlights areas in Palmdale where evacuation routes would be most impacted by each hazard-related evacuation scenario.

Evacuation Assessment Results

Baseline

The baseline scenario evaluates the evacuation route vulnerability of residential parcels absent of a hazard-related evacuation scenario. In the baseline scenario, all outbound roads are available to residents for evacuation. Highways and arterial roads within the city boundary are labeled on Figure 2. For each scenario, key intersections (where arterials connect) have been determined. These intersections are necessary to efficiently route residents to outbound roads that connect to the nearest exit points, marked using green points. Residential parcels with the highest evacuation route vulnerability score are highlighted in dark blue. Assuming all evacuation routes and exit points are viable, vulnerability of the City's evacuation network is low.

Fire from the South

This scenario assumes a wildfire south of the city. Outbound roads leading to the south are not viable, including Tierra Subida Avenue, Pearblossom Highway, and the southern portion of State Route 14. Figure 3A shows the extent of the proposed south wildfire area and the exit points that were assumed not to be viable. Evacuation route vulnerability scores were recalculated to account for the increased distance to the next closest, viable outbound road. Figure 3B shows a slight increase in the evacuation route vulnerability scores due to the closure of the three southernmost evacuation points. In this scenario, it is likely that the most utilized routes will be 50th Street East and Sierra Highway, because westbound roads lead to other high fire risk areas. Consequently, the following intersections would be critical to maintain this scenario: 10th Street West/Sierra Highway, 50th Street East/State Route 138, and 50th Street East/Pearblossom Highway. Evacuation responders could consider activating

evacuation traffic management at these intersections and as contra-flow lane reversal on the highway to allow both lanes to be used for northbound evacuation.

Fire from the West

This scenario assumes a wildfire west of the city. Outbound roads leading west are not viable, including Elizabeth Lake Road. Figure 4A shows the extent of the proposed western wildfire area and the exit points that were assumed not to be viable. Evacuation vulnerability scores are re-calculated to account for increased distance to the next closest viable outbound road. Figure 4B shows that compared to the baseline scenario, there would be no increase in the vulnerability of parcels in this scenario. There is one exit point to the west of the city along Elizabeth Lake Road that would no longer be viable. Exit points to the north, south and east would likely be utilized in the case of an evacuation event. Both directions of State Route 14 (North/South) are likely to be viable under this scenario, which allows for high evacuation capacity. The critical intersections to maintain in this scenario are likely to be as follows: Sierra Highway/State Route 138 and50th Street East/State Route 138.

Lake Palmdale Dam Break from the South

This scenario assumes people will evacuate away from the flood zone. In the case of a Lake Palmdale Dam break, the water would move north and inundate the Pearland area of the city. Figure 5A shows the extent of the modeled Lake Palmdale inundation zone. Figure 5B shows an increase in vulnerability where the water is projected to flow in this scenario. People to the east of this area will have access to exit points to the east of the city. It is possible that people on the eastern side of the flood my utilize 50th Street East to exit using a northern or southern exit point. However, this would require evacuees to travel around the flooded area and may increase travel times. Those to the west of the flooded area would have access to the northern exit points or to the western exit points. Evacuees to the west of the flooded area may utilize State Route 14 to access the southern exit points. However, this may increase travel times for some residents.

In this scenario, when the dam breaks the flow of water is likely to split, going around some southern neighborhoods and converge again in the Pearland area leading toward the United States Airforce Plant 42 Airport. Those in the southern portion may have trouble evacuating due to being surrounded by water. Proximity to the dam breakage could mean that the depth of that surrounding water would be slightly higher than in other areas, making it challenging for vehicles to transverse the covered areas. Residents evacuating from the west or east of the flood site should be directed away from the flooded areas in order to decrease traffic around this area and allow for first responders to assist evacuees. The critical intersections to maintain in this scenario are likely to be as follows: Sierra Highway/W Avenue S, Sierra Highway/State Route 138, and 50th Street East/State Route 138. Evacuation responders should consider activating evacuation traffic management at these intersections and as contra-flow lane reversal on the highway to allow both lanes to be used for northbound evacuation.

Little Rock Reservoir Dam Break from the South

This scenario assumes people will evacuate away from the flood zone. In the case of a dam break, the water from the dam would enter the city from the south. The flow may split and water may inundate the Pearland area. Figure 6A shows the extent of the modeled Little Rock Reservoir Dam inundation

zone. Figure 6B shows an increase in vulnerability where the water is projected to flow in this scenario. There would likely be an area north of the Pearland area where evacuees may utilize collector roads to connect to larger arterials such as 50th Street East to reach the northern exit points. Exit points to the west, south or east would not be viable for residents surrounded by water in the northern Pearland area. Residents to the east of the flood would utilize the two exit points on the eastern side of the city. Those two exit points can be reached by taking collector roads in the western portion of the city. It is unlikely that residents would utilize exit points in the northern or southern portions of the city since the water from the dam breakage would interrupt connectivity to those points.

Evacuees near the Barrel Springs area of the city would also be inundated by water. This area of the city is also closer in proximity to the Little Rock Reservoir. This may make evacuation for those in this area challenging. However, exit points to the east and south of this area may be viable depending on the time of evacuation. If water has reached this area before residents are able to evacuate, first responders would likely need to assist the remaining evacuees.

Residents to the west of the flooded area would be able to utilize the northern, southern, and western exit points. Critical intersections to maintain in this scenario would be as follows: 50th Street East/East Avenue S, 50th Street East/State Route 138, Sierra Highway/State Route 138, and W Avenue S/State Route 138. These intersections are all near areas that have high scores for evacuation route vulnerability.

Conclusion

The City of Palmdale has a very large evacuation network allowing residents to evacuate in the case of a hazard-related disaster. However, there are key takeaways that should be kept in mind depending on the nature of such events. In the case of a large wildfire, State Route 14 may be vulnerable. In the dam inundation scenarios, the central portion of the city contains the highest vulnerability score. In addition to considering evacuation route vulnerability, the vulnerability of residents should be considered in determining which areas may need to be prioritized by first responders during an evacuation. Areas within the city with a greater percentage of elderly people, disabled people, households that do not own vehicles (i.e., transit dependent populations), and institutionalized populations require a greater amount of support during an evacuation. Other vulnerable groups should be evaluated relative to evacuation route vulnerability.

Figure 2 Baseline Vulnerability Score

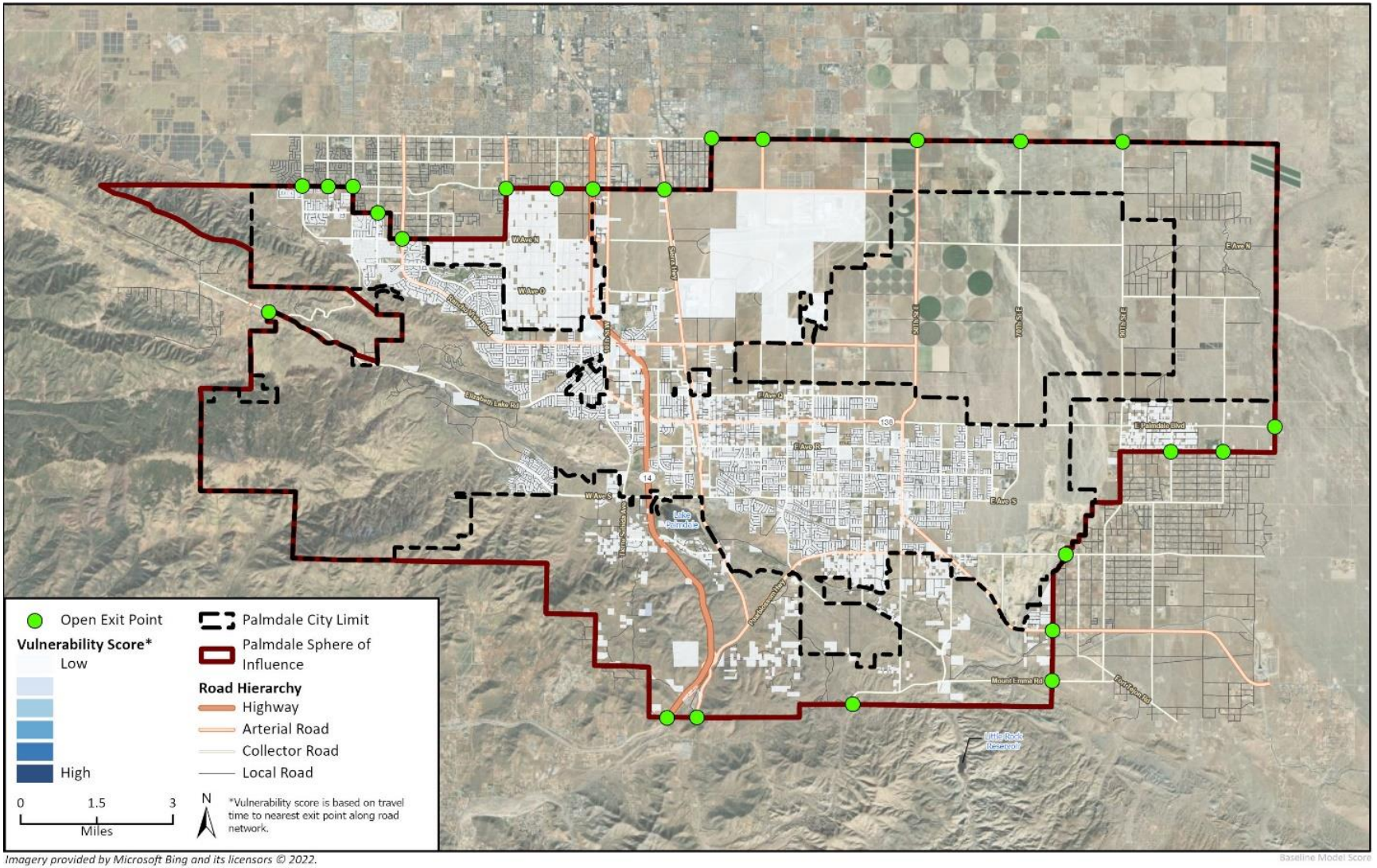


Figure 3A Fire from the South Extent

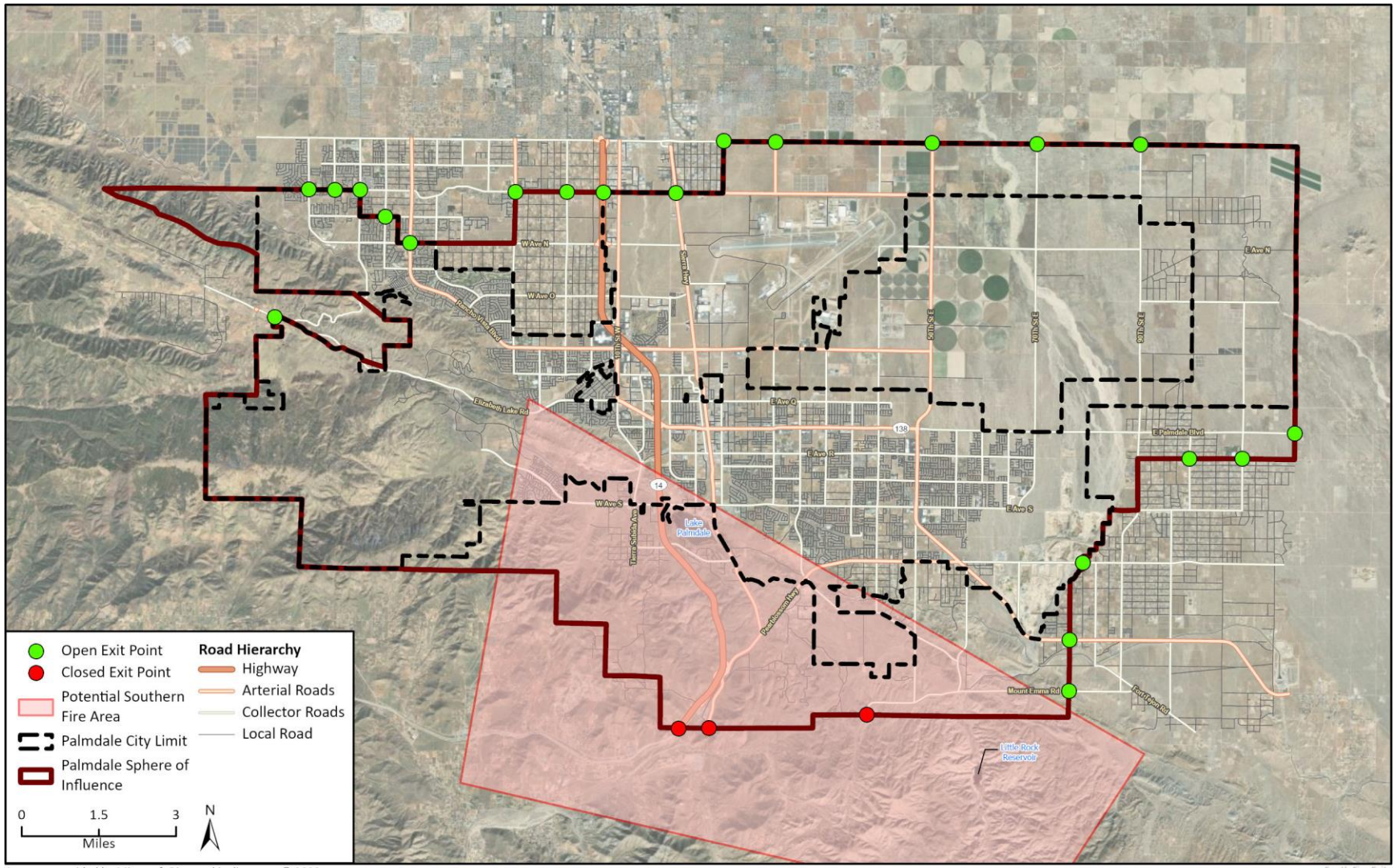


Figure 3B Fire from the South Vulnerability Score

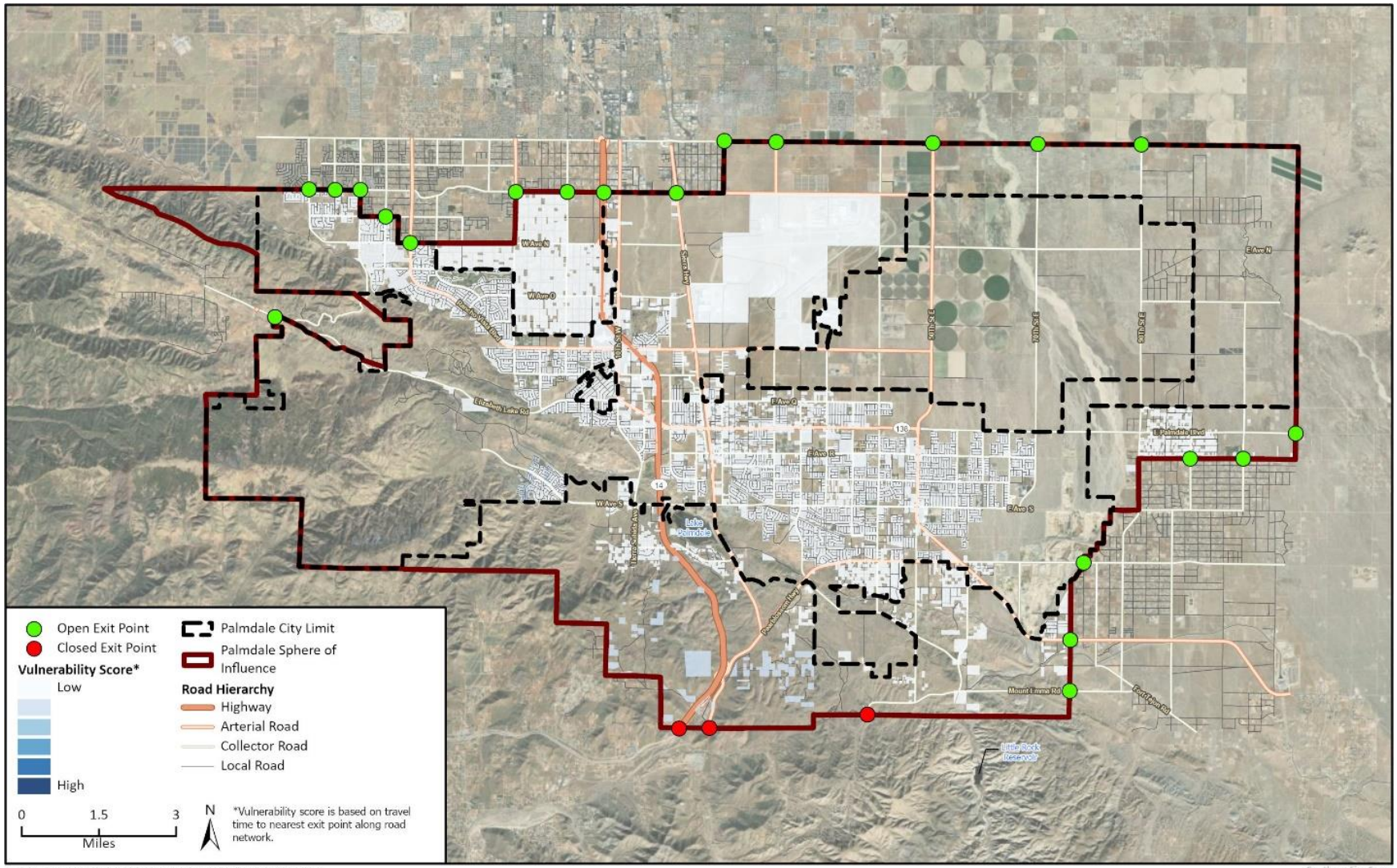


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Figure 4A Fire from the West Extent

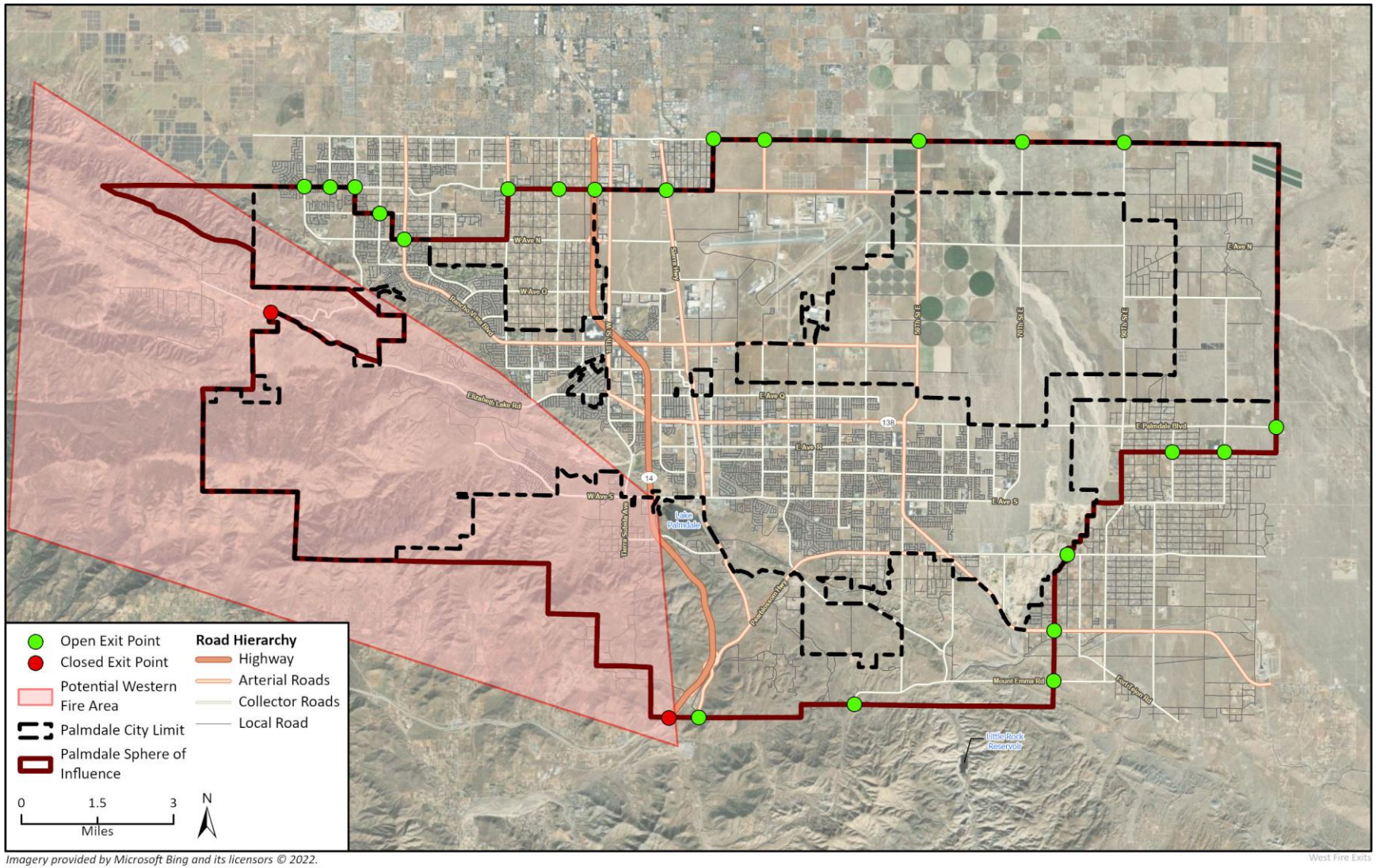

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Figure 4B Fire from the West Vulnerability Score

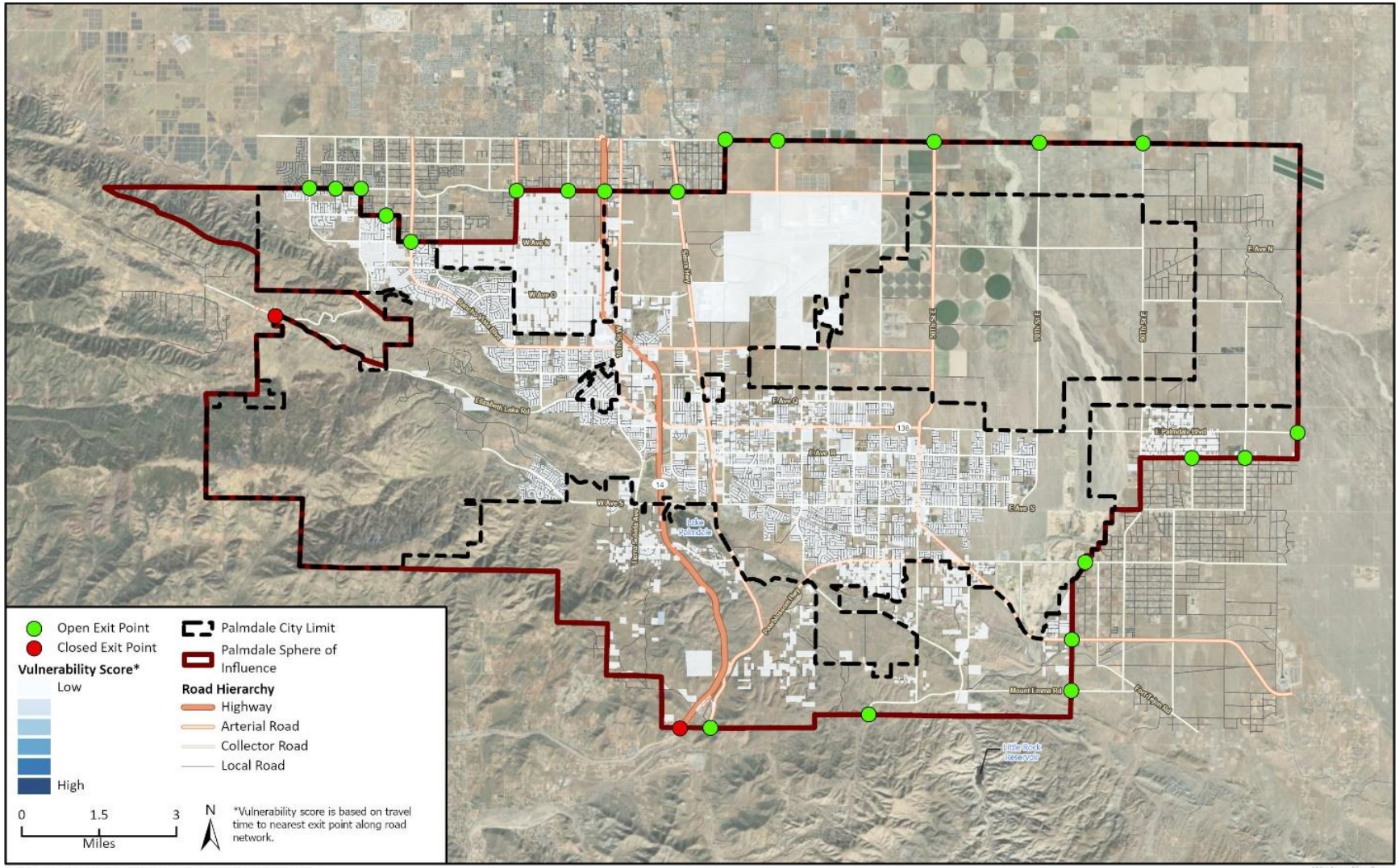

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Figure 5A Lake Palmdale Dam Break Inundation Extent

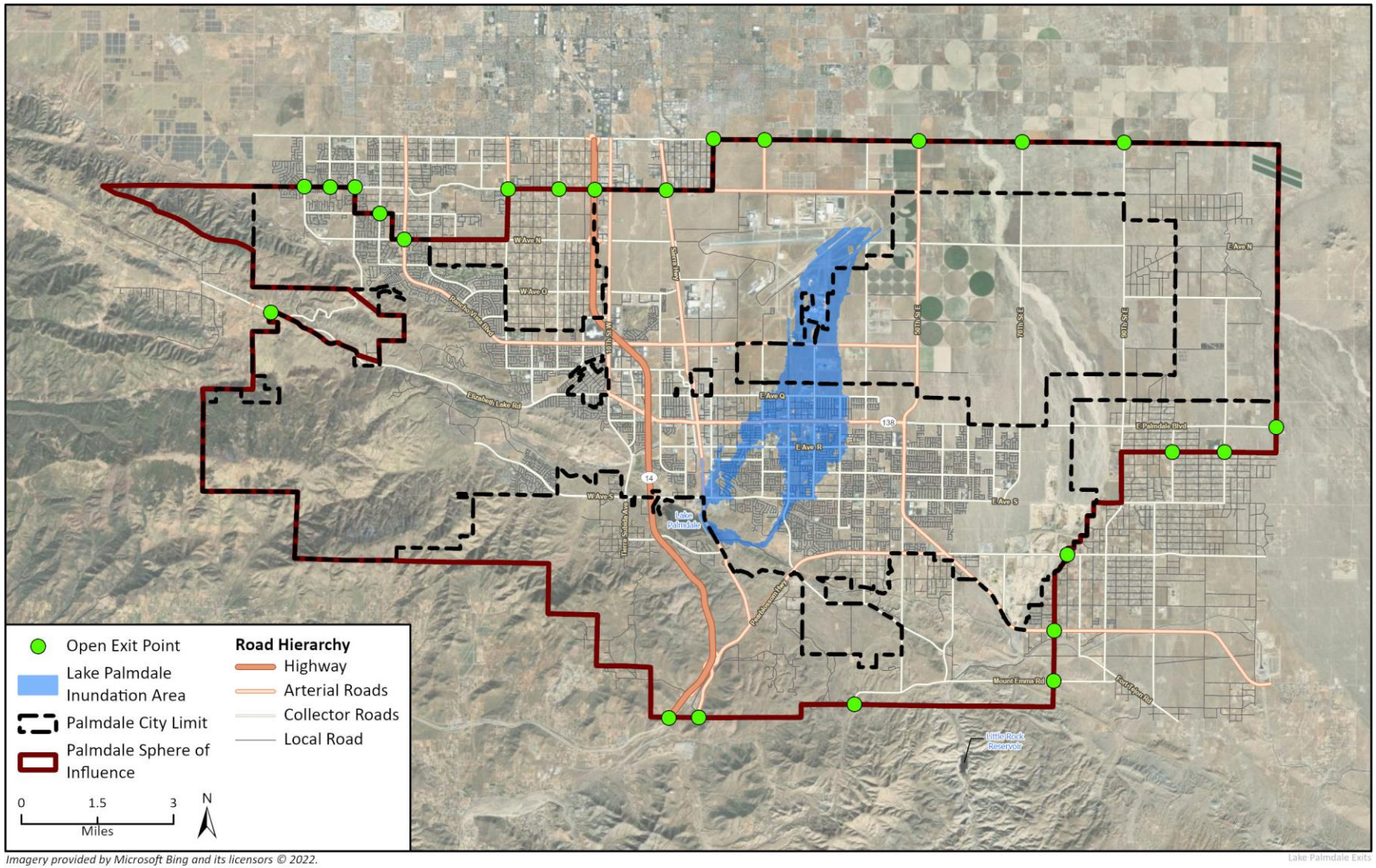

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Figure 5B Lake Palmdale Dam Break Vulnerability Score

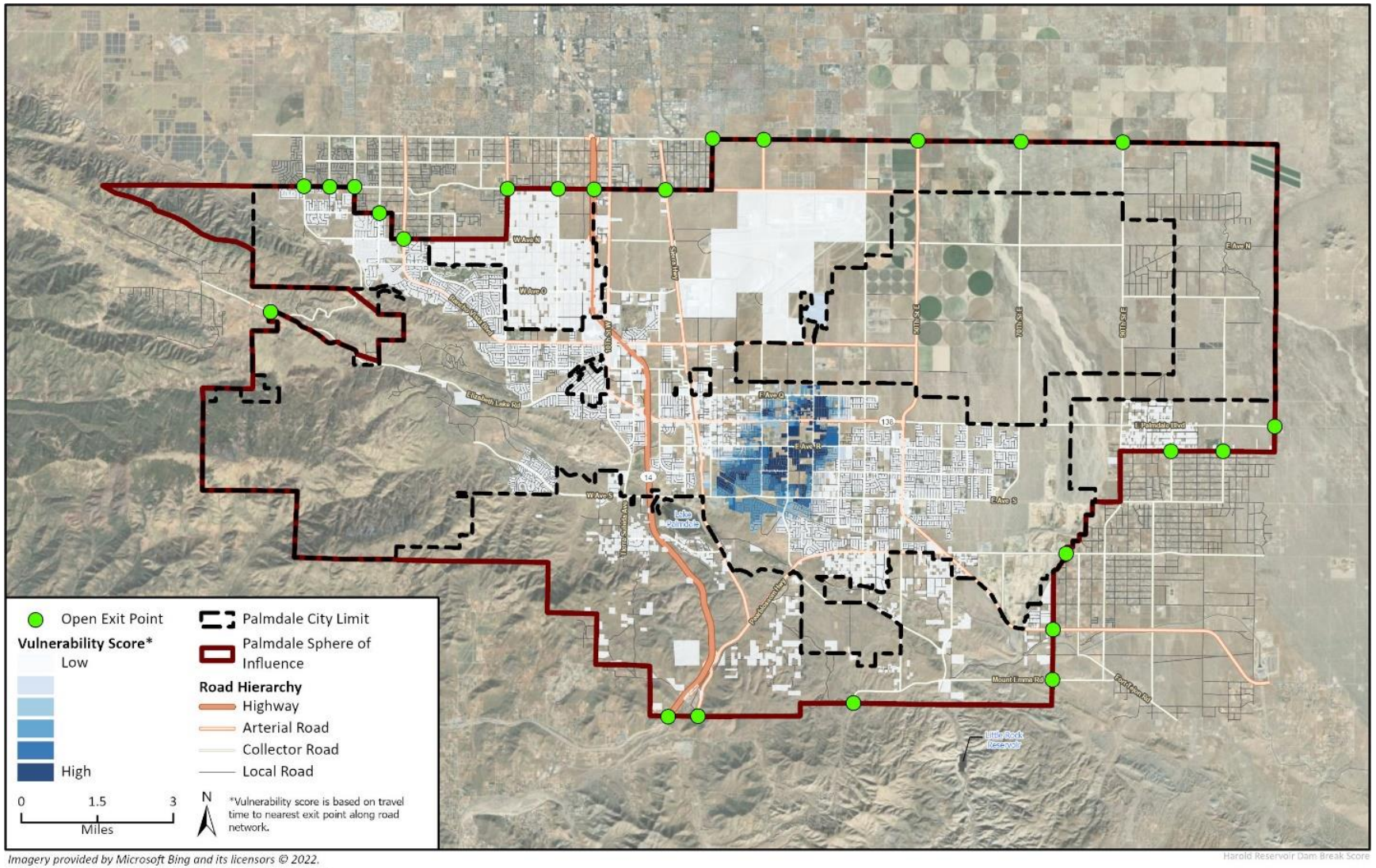

Figure 6A Little Rock Reservoir Dam Break Inundation Extent

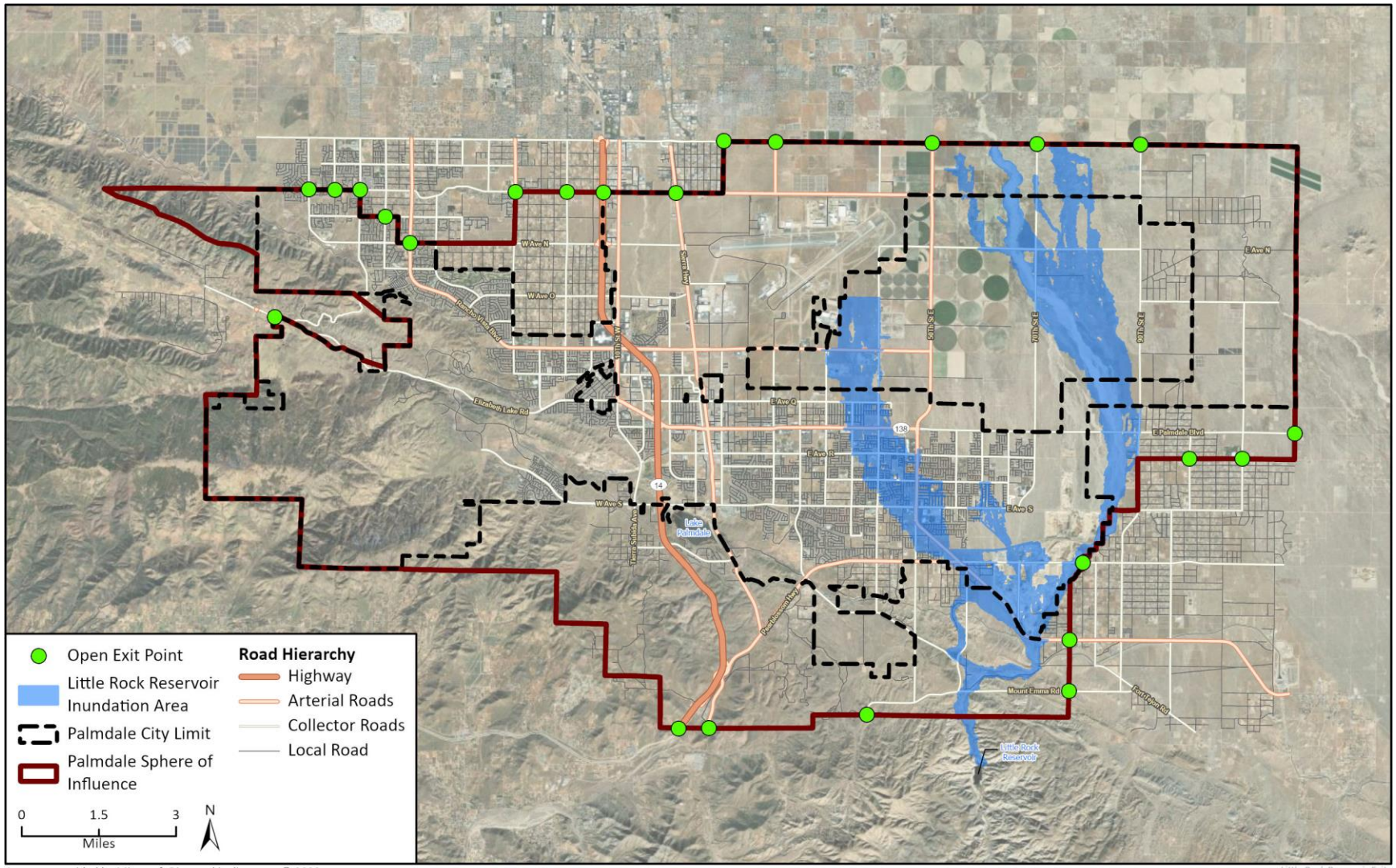

Figure 6B Little Rock Reservoir Dam Break Vulnerability Score