Stormwater Infiltration Projects in L.A. County

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Table of Contents

Table of Figures

Executive Summary

Water supply is a major concern in Los Angeles County. Increasing population levels and climate change effects threaten the supply of usable water. Stormwater infiltration projects are a crucial tool to create more sustainable cities. This report locates possible areas to develop new stormwater infiltration projects. A set of scores was created considering the percentage of people below the poverty level in the city, park needs, and existing project locations. Areas like Long Beach, Carson, and Inglewood are among the possible new sites.

Introduction & Motivation

This report aims to select a site suitable for the development of a stormwater infiltration project. This project will bring multiple benefits to the L.A. County population and would create more sustainable cities. The proposed project consists of an underground infiltration system that will secure and infiltrate stormwater. The project allows to collect, treat, and store that water underground for later use. The first element is a concrete box with an edge that will redirect the stormwater toward the infiltration system. Then, the water would be pass by a pretreatment system and collected in a series of infiltration wells connected by pipes. Once finished, there will be no impact to transit because all the changes will be underground. Figure 1 shows an animation of previous and similar projects.[1]

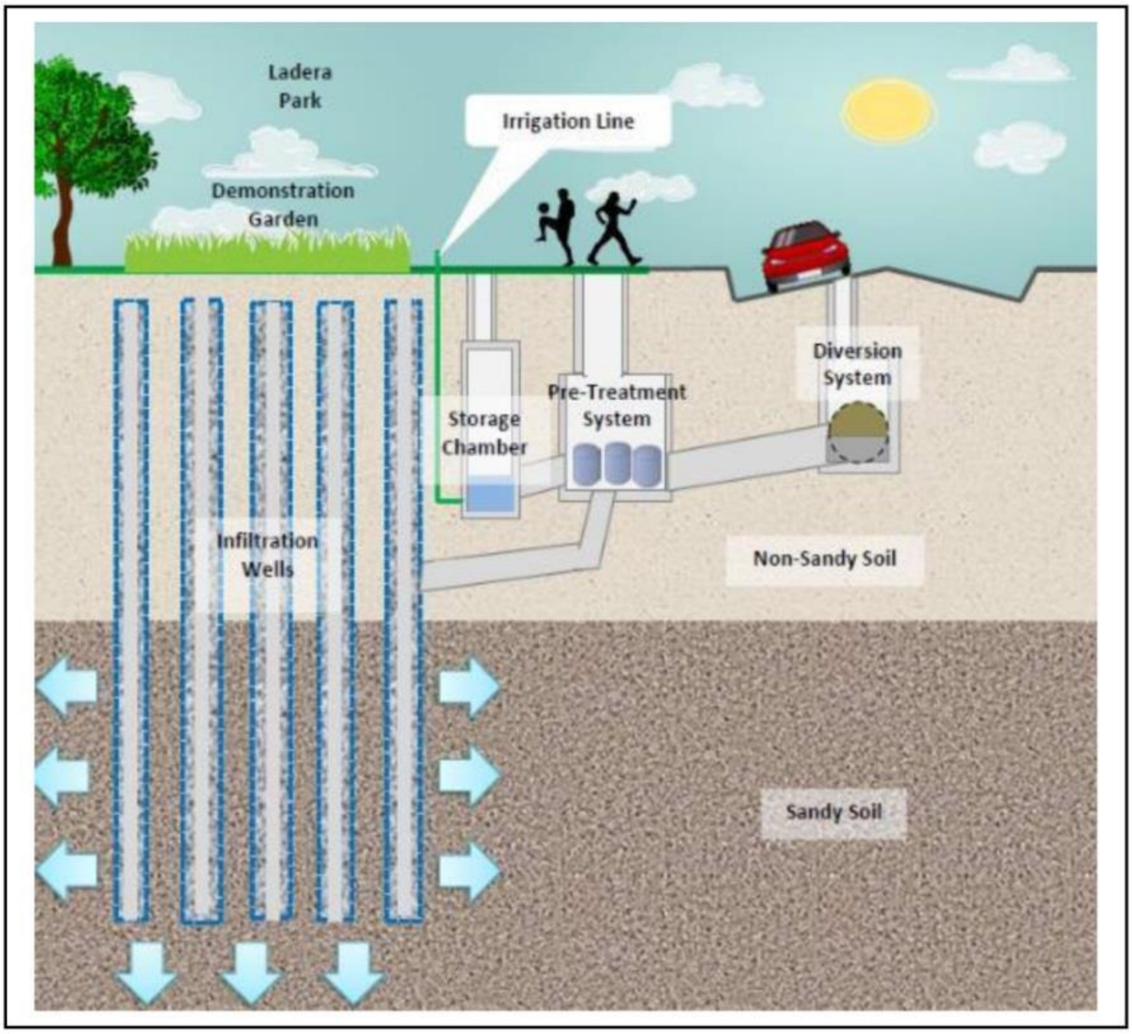

Figure 1. Example of diversion, infiltration, treatment, and storage project.

Los Angeles County (L.A. County) has a population estimate of more than 10 million (U.S. Census Bureau, 2018), being the most populated county in the United States. The population size of L.A. County demands complex public service systems. The 88 cities that compose L.A. County are served by approximately 200 different water agencies (DPW, 2017). There are three primary sources of water: the Owens River, Northern California and the Colorado River, and groundwater (Blanco et al., 2016). Groundwater "is the water found underground in the cracks and spaces in soil, sand, and rock"

[1] Source: Alva, P; Hamamoto, B; and D' Angelo, A. (2019). Ladera Park Stomwater Improvements Project. ASCE. International Conference of Sustainable Infrastructure 2019.

(Groundwater Foundation, n/d). Groundwater accounts for approximately 30% of the water supply in L.A. County (Blanco et al., 2016).

Specialists have foreseen an increase in population, hotter weather, with an increment on wildfires, and a decrease of snowpack that maintain the external water sources (Federico, Youngdahl, Subramanian, Rauser, & Gold, 2019; DPW, 2017). The effects of climate change need to be addressed immediately, as L.A. authorities know. In 2015, the L.A. County Board of Supervisors certified the Enhanced Watershed Management Programs Draft Program Environmental Impact Report on behalf of the Los Angeles County Flood Control District. Since then, many Best Management Practices have been adopted for wastewater treatment. Currently, only 10% of the groundwater goes for residential use (Blanco et al., 2016).

Rainwater is one of the primary sources of groundwater. According to the National Weather Service, Southern California has experienced unusually high levels of precipitation during the beginning of 2019, see Figure 2[2] (Fry, 2019). Stormwater collection and treatment provides multiple beneficial uses, such as flooding control, pollution reduction, increasing the sustainability of the local water supply, real states value, quality of life, and increase or improve recreational areas (Read, Hogue, Edgley, Mika, and Gold, 2019; DPW 2014).

[2] Source: Los Angeles Times, through March 6, 2019, in downtown Los Angeles (National Weather Service)

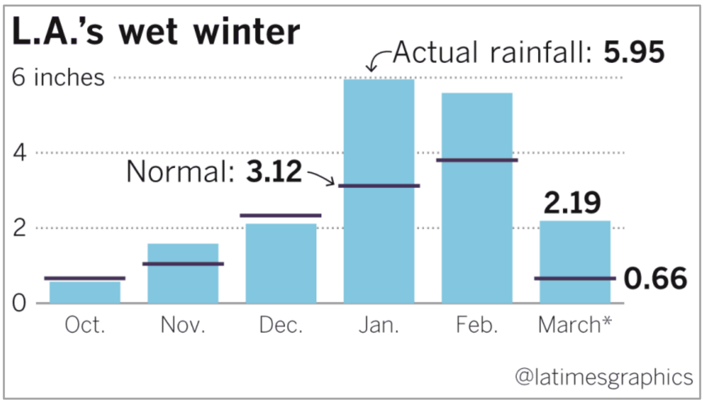

Figure 2. L.A. City Rainfall levels.

Existing and Proposed Stormwater Projects

The L.A. County Department of Public Works, with the support of the L.A. County Board of Supervisors, has planned nine multi-benefit projects that include stormwater collection and treatment. These projects are distributed along L.A. County but mostly concentrated in L.A. City.

Stormwater projects feasibility analysis should include but is not limited to, existing projects, topography, existing stormwater infrastructure (like catch basins, natural drainages, pump stations, among others), population density, poverty level, and park needs. One of the benefits of these projects is the possibility of creating new green spaces. But most projects are located within existing parks because it is where most stormwater infrastructure is located. For this project, the park needs were prioritized over the existing infrastructure.

Data

The 2017 percentage of all people below the poverty level for data was obtained from the U.S. Census Bureau, 2013-2017 American Community Survey 5-Year Estimates. The Los Angeles County City boundaries and annexations shapefile was collected from the L.A. County GIS Data Portal (2013). The L.A. County storm drain system shapefile was also retrieved from the L.A. County GIS Portal, obtained from the Department of Public Works in 2013. From the same Portal, the Countywide Parks and Open Space shapefile was gathered. The list of existing stormwater projects was obtained from the Department of Public Works website, and their coordinates were calculated using Google Maps.

Methodology

The maps for this project were created using ArcGIS. The first step of the analysis was to join the poverty level data to the County shapefile to create a thematic map. As shown in Figure 3[3], the highest the percentage of people below the poverty level, the darker the color. Low-income communities are more in need of the benefits that this type of project brings.

The second step was to map the existing stormwater projects using a table of latitude and longitude coordinates. The location of those projects is also shown in Figure 3. To cover

[3] A full-size map is available in Appendix A.

a wider area of the County, it is fundamental to locate the existing projects. The last step to finalize the map for the analysis was to include the parks shapefile.

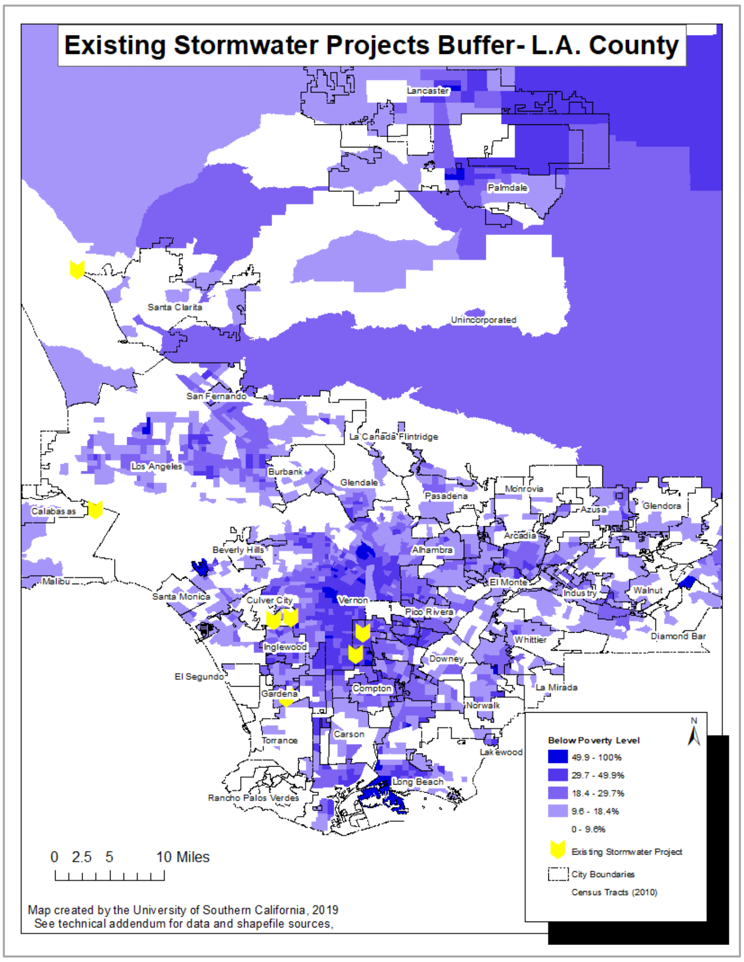

Figure 3. Existing Stormwater Projects & Percentage of People Below Poverty Level

The actual analysis was done using a scoring system based on background research. Table 1 shows the possible scores for each variable. The higher the score for each variable, the more suitable the area for the location of a new stormwater project.

Table 1. Possible Score per Variable

Variable	*% Poverty Level*	*Existing Projects*	*Parks*
Score Range	1 to 5	0 or 1	0 or 1

Each percentage range of people below the poverty level was assigned a score. This score was added to the joined table for later calculations. As shown in Figure 4[4], a 2 mile buffer

[4] A full-size map is available in Appendix A.

was created for each existing project. The 2 miles radio is based on an approximate estimate of the area that the project could cover. Those areas inside the buffer received a score of 0 and those outside the buffer a score of one.

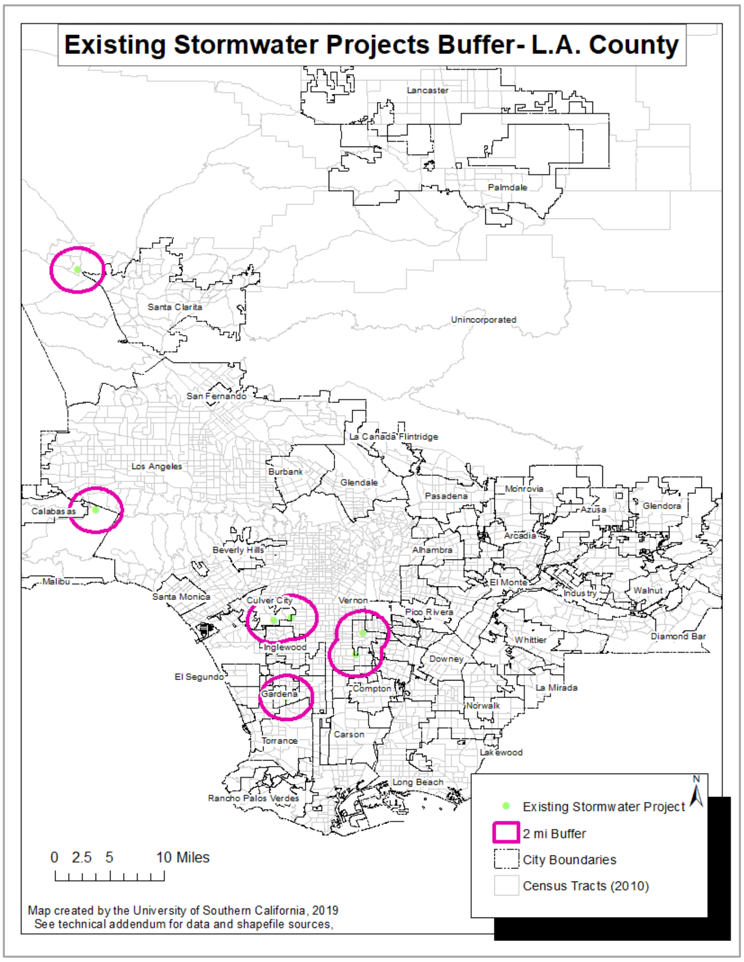

Figure 4. Existing Stormwater Projects- 2 mi Buffer

Following the same logic, a 0.25 miles buffer was created for each park (see Figure 5[5]). As previously explained, one of the benefits of stormwater projects is that they can improve the existing Park area or create new ones. Thus, those areas inside the buffer received a score of 0 and those outside the buffer a score of one.

Once all the scores were determined, they were added to create a final score. The minimum possible score was 0 and the maximum was 7. Then, the values were mapped, but only those with a score of 6 or 7 were shown.

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[5] A full-size map is available in Appendix A.

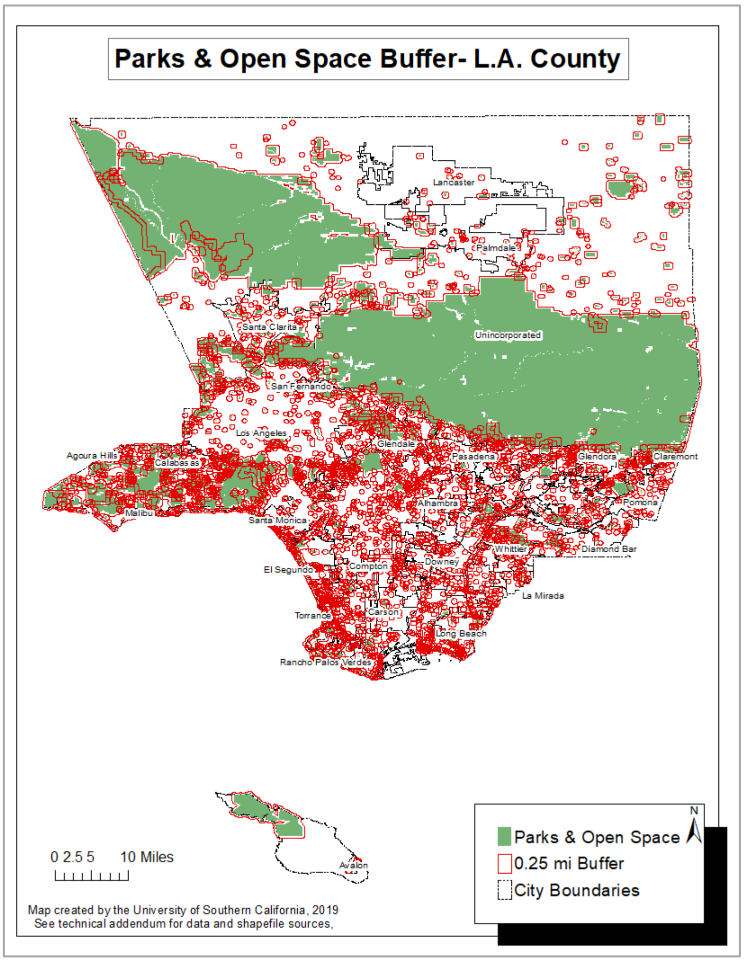

Figure 5. Parks & Open Space- 0.25 mi Buffer

Results

Figure 6[6] shows the final results of the analysis. Based on the variables used in this project, the next stormwater project should be developed in Inglewood and/or Carson, Long Beach, Palmdale, or Lancaster.

[6] A full-size map is available in Appendix A.

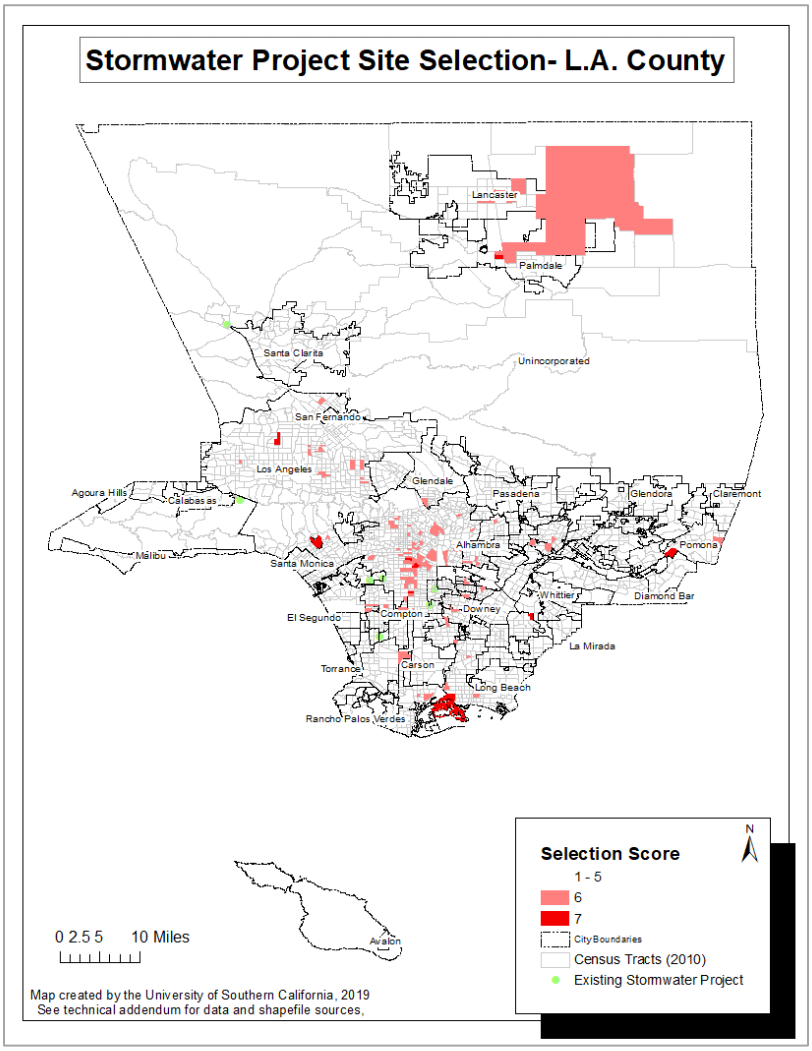

Figure 6. Final Stormwater Site Selection

The catch basins were included to locate the areas that had existing infrastructure that will lower the cost and time of the project. As shown in Figure 7[7], the distribution of catch basins along L.A. County was not a useful parameter. Nevertheless, Lancaster and Palmdale cities could be eliminated since they have a score of 6, and not many catch basins are in the area.

[7] A full-size map is available in Appendix A.

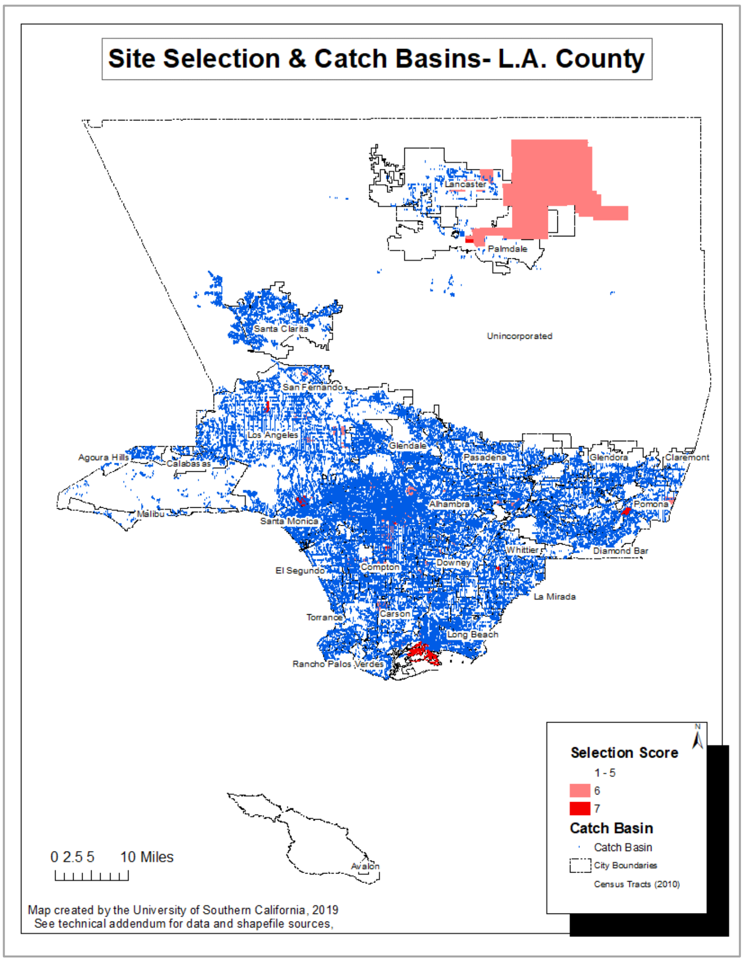

Figure 7. Site Selection & Catch Basins

Limitations

Stormwater feasibility analyses include more variables that help determine the location of new projects. Most of these variables were not included due to a lack of data compatible with ArcGIS. For example, another infrastructure requirement are active infiltration dry wells. The L.A. County Department of Public Works provides its own interactive and live map of the wells (see Figure 8[8]), but I was unable to download the data to include it in my figures.

[8] Source: L.A. County Department of Public Works. Retrieve from https://dpw.lacounty.gov/general/wells/

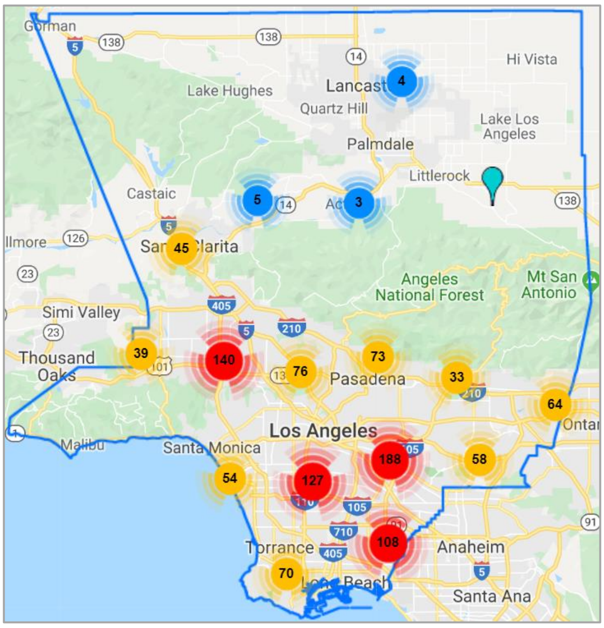

Figure 8. Active Infiltration Dry Wells

Other essential variables for this analysis are flooding areas, elevation contours, and watersheds. Although the data was available, the complexity of those mapping techniques was beyond the scope of this project.

Regarding the variables used for the project, the L.A. County Department of Parks and Recreation completed a park need assessment in 2016. The report located the areas that required more parks in connection with the population density. This data would be more accruable for this study than doing a buffer for existing parks. The shapefile was available, but it was not possible to join the data to the map and calculate a score like it was done with other variables. Figure 9[9] shows a combination of the obtained results and the actual need assessment layer.

[9] A full-size map is available in Appendix A.

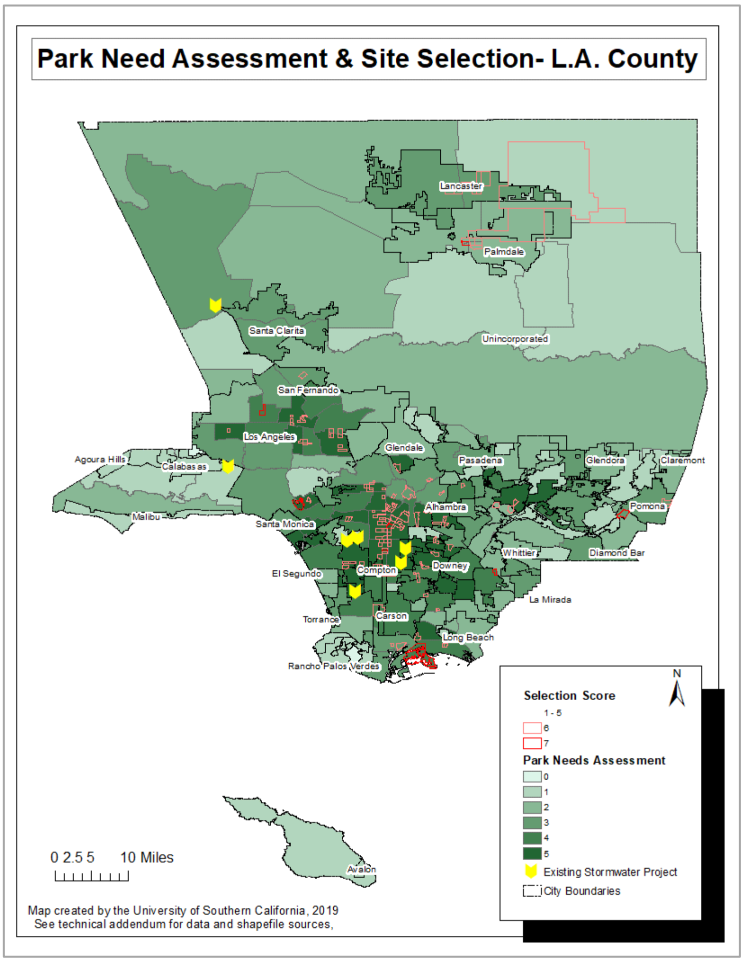

Figure 9. Park Need Assessment & Site Selection

In addition, infiltration projects are typically designed in areas where shallow highly permeable soils can be engaged by the wells. Permeable soils allow more infiltration and minimize the cost of the project because it is not necessary to use so many wells. Soil permeability of 1.5 in/ hour (1x10E-3 cm/s) or higher corresponds to areas sandy soils that are suitable for the project. The Conservation Biology Institute created a soil-permeability rate dataset[10]. The dataset could not be joined with the map to calculate the score, but Figure 10[11] shows the obtained results combined with the soil permeability layer. Most of the possible locations are located in areas with an average soil permeability between 1.14 and 3.33 in/hr. Also, the areas of Lancaster and Palmdale have an average

[10] For more information visit: https://databasin.org/datasets/b2cf6ffe382347efa13920eed3f5add0

[11] A full-size map is available in Appendix A.

soil permeability between 5.09 and 6.15. Figure 10 gives confidence on the obtained results.

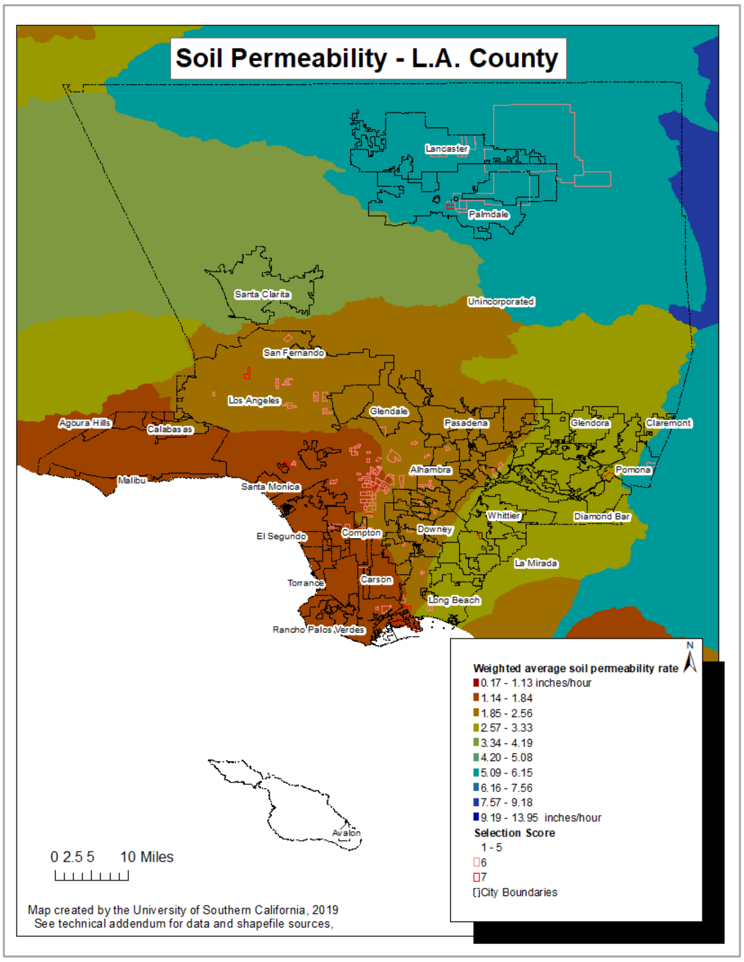

Figure 10. Soil Permeability

A final point that should be acknowledged is that the existing stormwater project locations are approximate. In addition, I was unable to locate one of the proposed projects.

Conclusion

L.A. County must switch into a more sustainable water system. Changes have been made in this direction, but more is needed as the population continues to grow, and the effect of climate change threaten the water supply. Stormwater infiltration projects are crucial for this endeavor.

This report shows that there is still room for developing more of this project along L.A. County, that will bring multiple benefits to the community. Figure 6 shows that Long

Beach, East L.A., Lancaster, and Palmdale are potential locations for new projects. Nevertheless, the catch basins distribution shown in Figure 7 may suggest that Long Beach, Inglewood, or Carson may be more appropriate locations.

Although the Department of Parks and Recreations' Park Need Assessment was not used to score the locations, Figure 9 provides certain assurance. As shown in Figure 9, most of the areas that were identified as possible locations by this report match the areas with a higher need for parks and open spaces.

Further research and assessment of other relevant variables are needed to complement this report. Especially, soil conditions, topography, and infrastructure assessment need to be combined with these findings. Without including additional variables to the analysis, we fail to provide an exact location. However, this report provides a good first step towards that goal.

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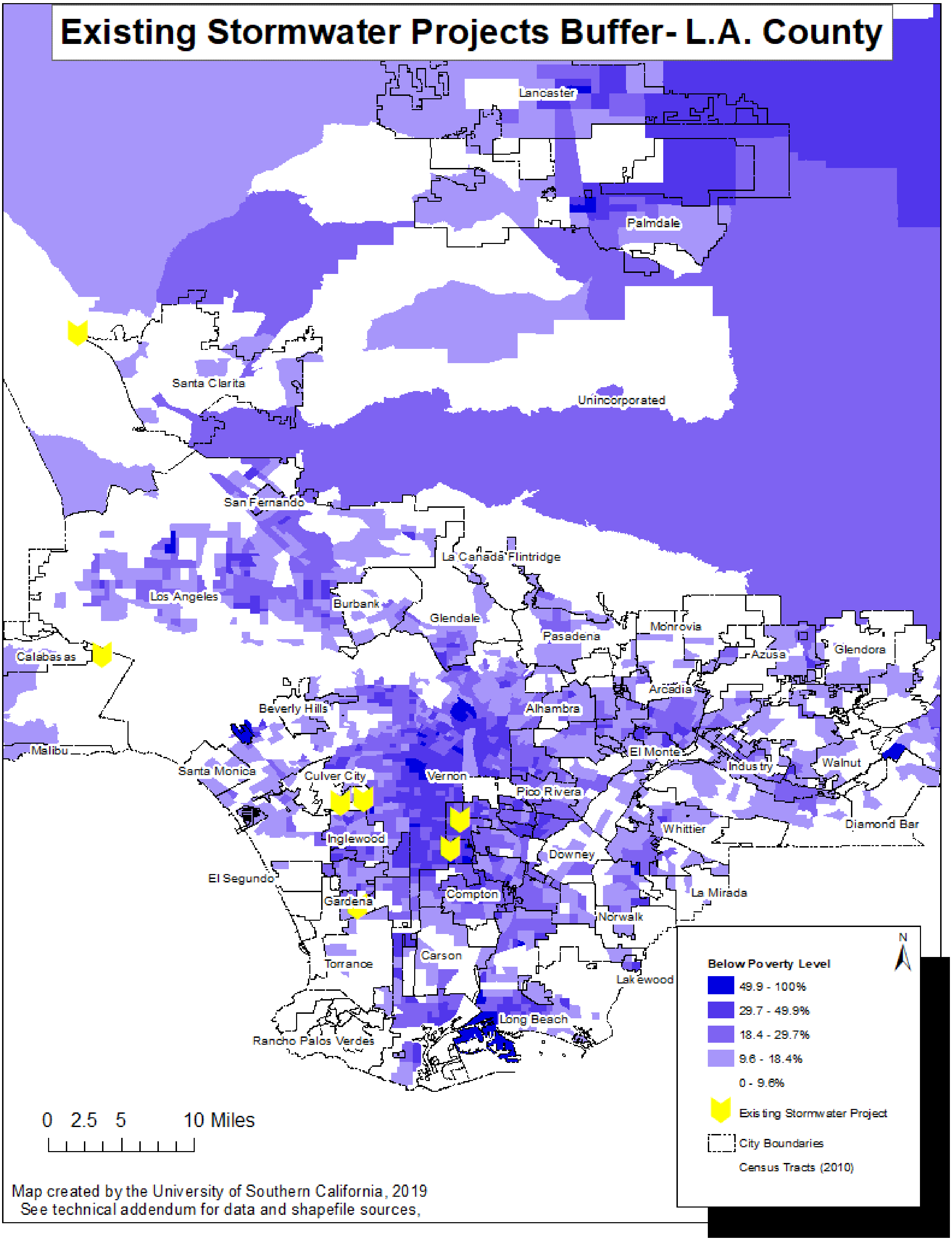
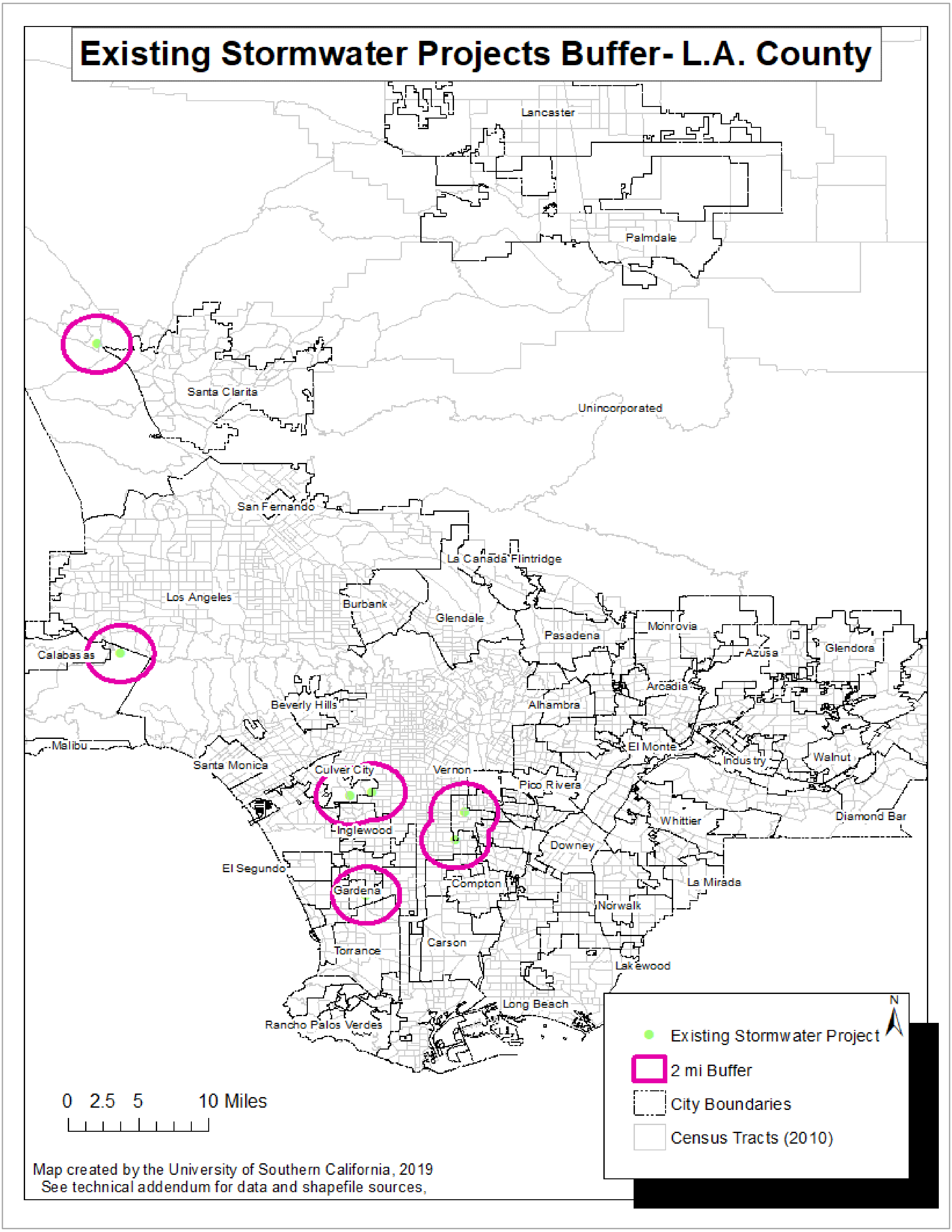

Existing Stormwater Projects Buffer- L.A. County
Lancaster
Palmdale
Santa Clarita
Unincorporated
San Fernando
La Cañada Flintridge
Los Angeles
Burbank
Glendale
Pasadena
Monrovia
Azusa
Glendora
Calabasas
Arcadia
Beverly Hills
Alhambra
Malibu
El Monte
Walnut
Santa Monica
Culver City
Vernon
Industry
Pico Rivera
Diamond Bar
Inglewood
Whittier
Downey
El Segundo
La Mirada
Compton
Gardena
Norwalk
Torrance
Carson
Lakewood
Long Beach
Rancho Palos Verdes
N
Below Poverty Level
49.9 - 100%
29.7 - 49.9%
18.4 - 29.7%
9.6 - 18.4%
0 - 9.6%
Existing Stormwater Project
City Boundaries
Census Tracts (2010)
0 2.5 5 10 Miles
Map created by the University of Southern California, 2019
See technical addendum for data and shapefile sources,


Existing Stormwater Projects Buffer- L.A. County
Lancaster
Palmdale
Santa Clarita
Unincorporated
San Fernando
La Canada Flintridge
Los Angeles
Burbank
Glendale
Pasadena
Monrovia
Azusa
Glendora
Calabasas
Arcadia
Beverly Hills
Alhambra
Malibu
El Monte
Industry
Walnut
Santa Monica
Culver City
Vernon
Pico Rivera
Diamond Bar
Whittier
Inglewood
Downey
El Segundo
La Mirada
Gardena
Compton
Norwalk
Carson
Torrance
Lakewood
Long Beach
Rancho Palos Verdes
N
Existing Stormwater Project
2 mi Buffer
City Boundaries
Census Tracts (2010)
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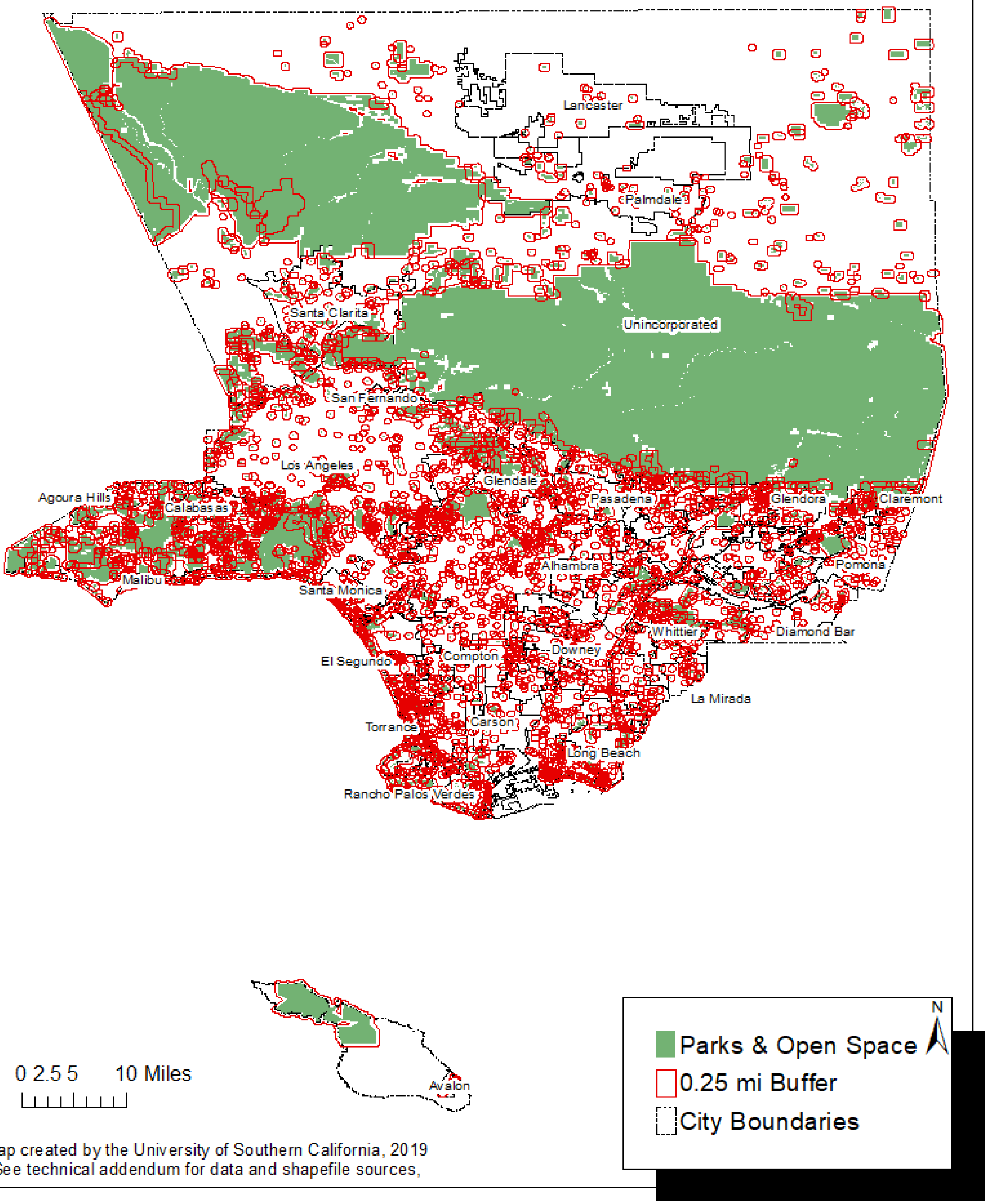
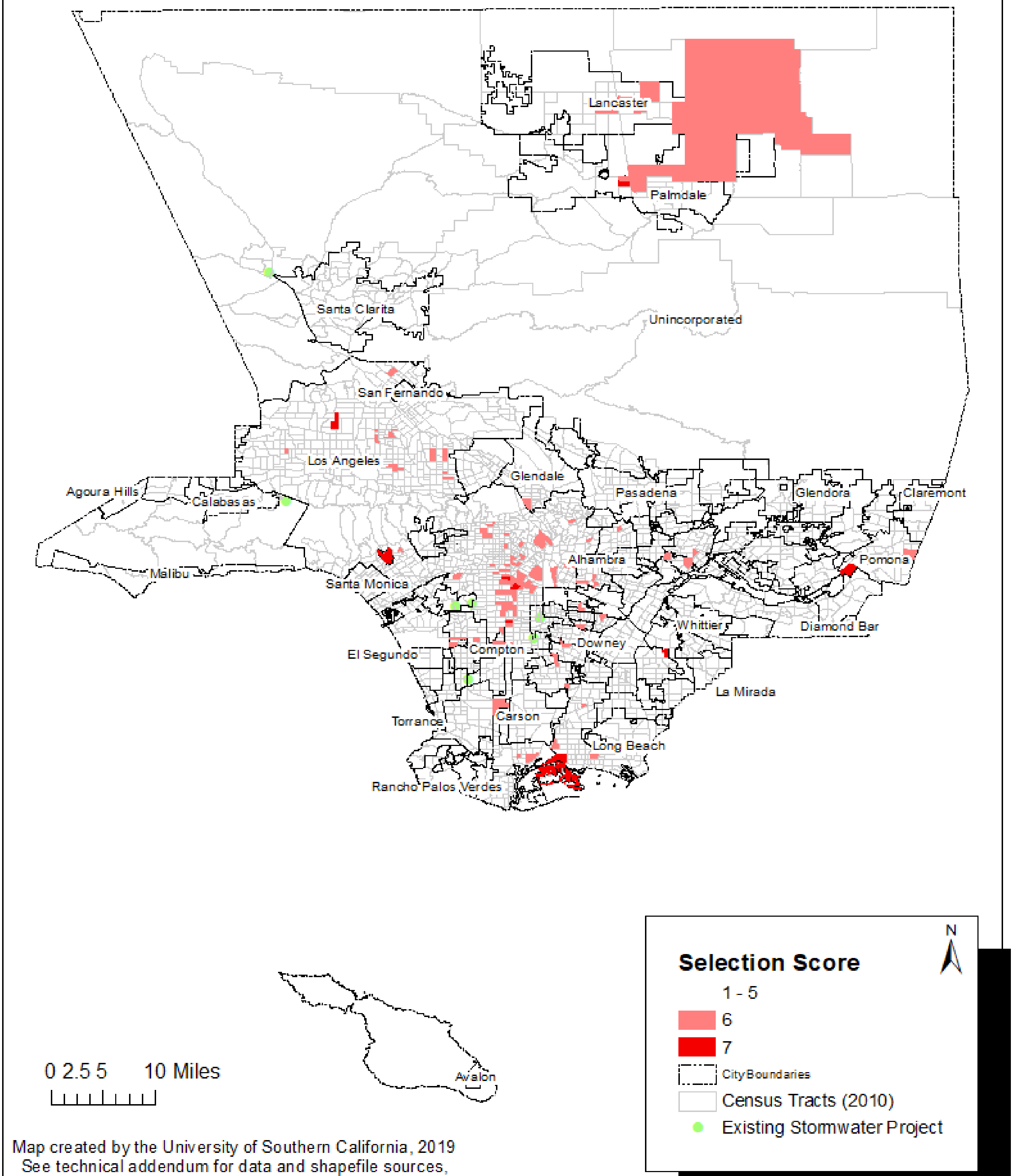
Map created by the University of Southern California, 2019
See technical addendum for data and shapefile sources,

Parks & Open Space Buffer- L.A. County



Stormwater Project Site Selection- L.A. County



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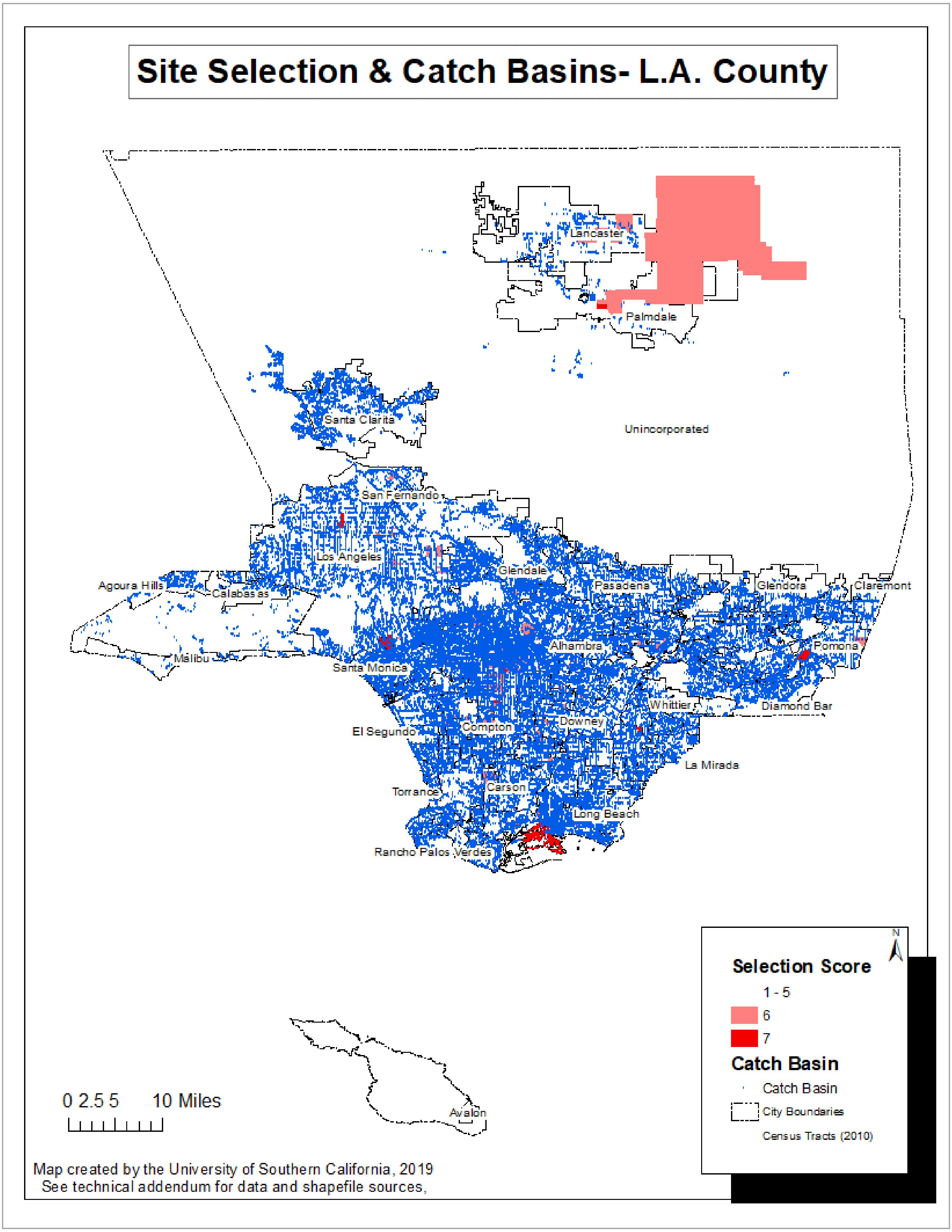
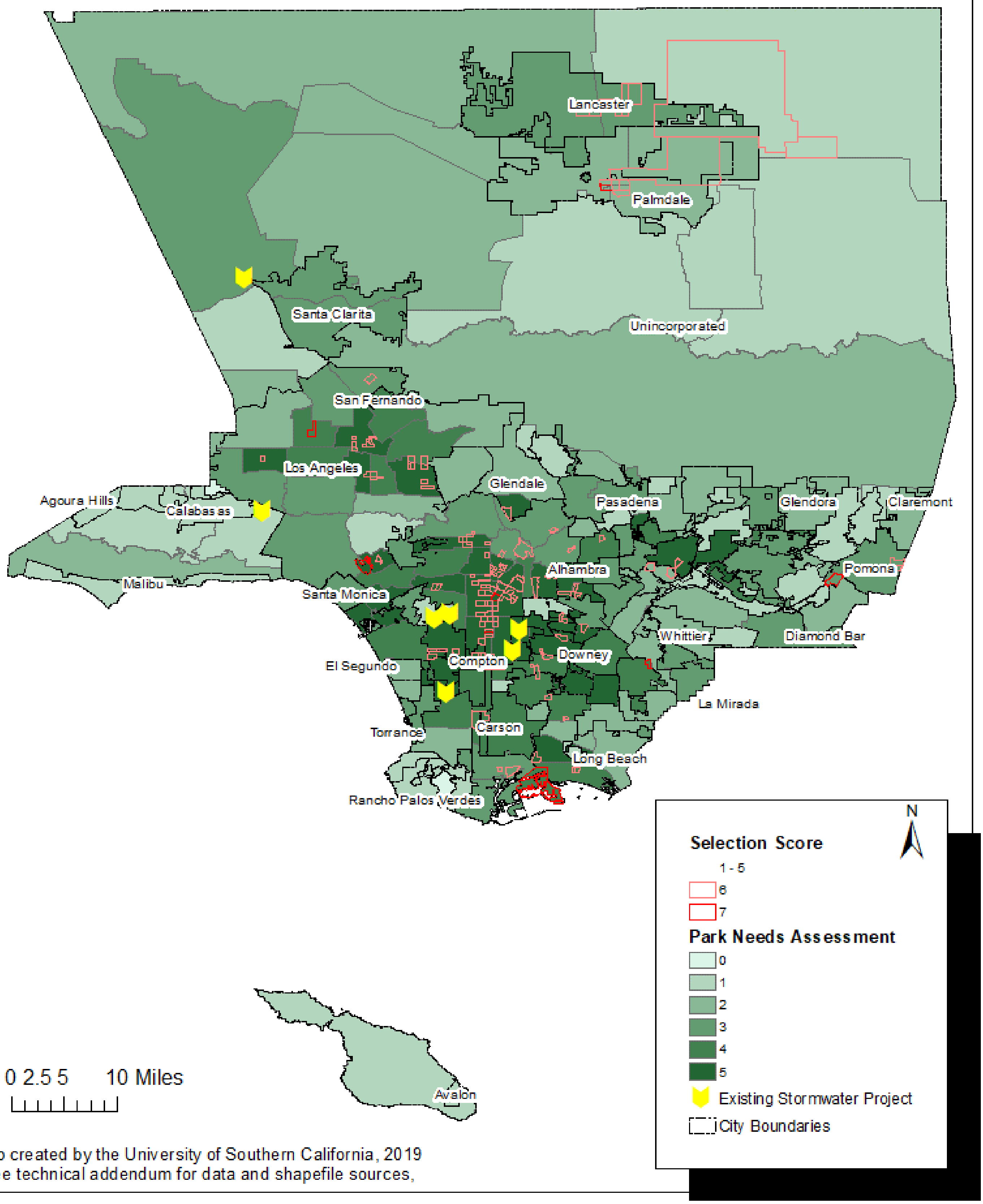


Site Selection & Catch Basins- L.A. County
Lancaster
Palmdale
Santa Clarita
Unincorporated
San Fernando
Los Angeles
Glendale
Agoura Hills
Calabasas
Pasadena
Glendora
Claremont
Alhambra
Pomona
Malibu
Santa Monica
Whittier
Diamond Bar
Downey
El Segundo
Compton
La Mirada
Carson
Torrance
Long Beach
Rancho Palos Verdes
Avalon
0 2.5 5 10 Miles
Selection Score
1 - 5
6
7
Catch Basin
Catch Basin
City Boundaries
Census Tracts (2010)
N
Map created by the University of Southern California, 2019
See technical addendum for data and shapefile sources,

Park Need Assessment & Site Selection- L.A. County



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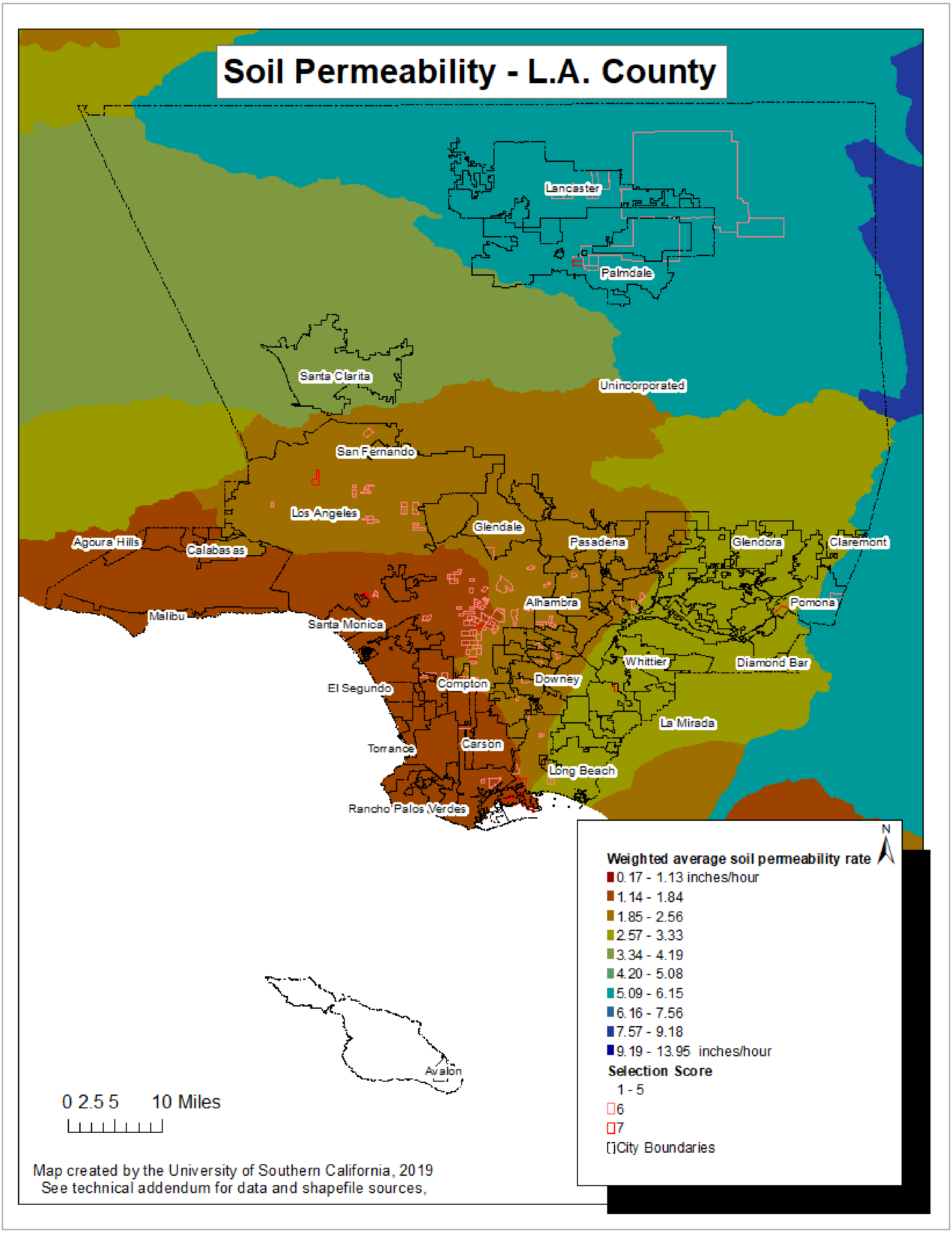
Soil Permeability - L.A. County
Lancaster
Palmdale
Santa Clarita
Unincorporated
San Fernando
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Pasadena
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Calabasas
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Diamond Bar
El Segundo
Compton
Downey
La Mirada
Torrance
Carson
Long Beach
Rancho Palos Verdes
Avalon
N
Weighted average soil permeability rate
0.17 - 1.13 inches/hour
1.14 - 1.84
1.85 - 2.56
2.57 - 3.33
3.34 - 4.19
4.20 - 5.08
5.09 - 6.15
6.16 - 7.56
7.57 - 9.18
9.19 - 13.95 inches/hour
Selection Score
1 - 5
6
7
City Boundaries
0 2.5 5 10 Miles
Map created by the University of Southern California, 2019
See technical addendum for data and shapefile sources,