# OPTIMIZED TRANSIT ROUTES
## LOS ANGELES COUNTY

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## PROBLEM + OBJECTIVE

**Problem**: LA County in California is one of the largest metropolitan areas in the world. It also happens to have a notoriously limited Metro service, particularly where light rail is concerned. Combine this with the fact that in 2014 over 40% of California's greenhouse gas emissions came from transportation and the problem becomes pretty clear: LA County needs more public transit services to push it to a greener future and building new light rail stations is as good a place as any to begin.

**Objective**: Our objective was to plan out a new light rail route that Metro can offer alongside its existing routes. Our criteria for choosing a route were to make sure that its terminus served as many people as possible by leading to an as-yet underserved and population dense area, that the new route is economically viable, that it does not pass through natural disaster-prone areas, and that its construction is feasible given the geography of LA County. To make sure we could meet these objectives, we used network analysis, TIN modelling and suitability analysis.
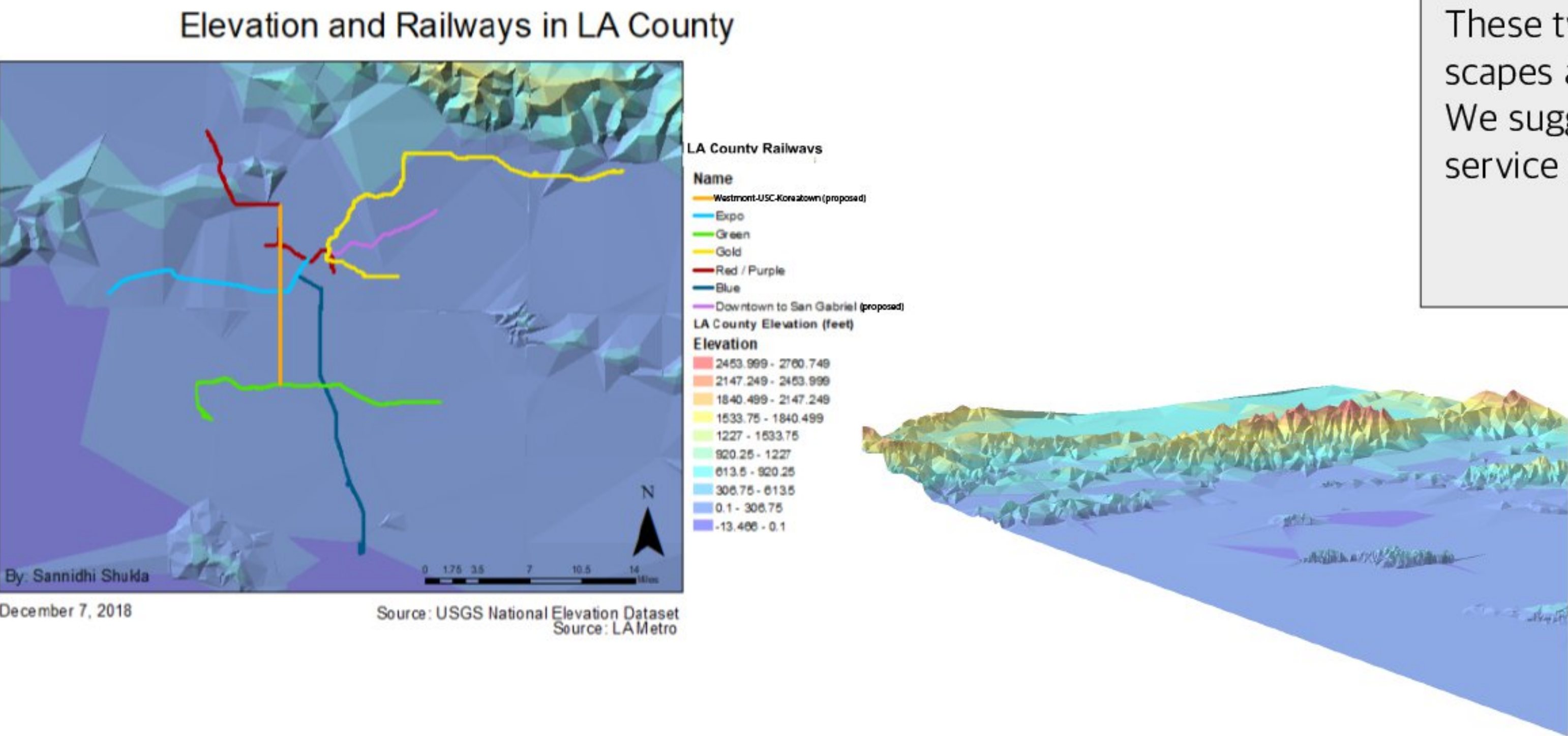
## SUITABILITY ANALYSIS

In our suitability analysis, we wanted to preference access to city parks and public services (schools, hospitals, senior services, museums, etc). We also recognize that density is critical to make rail cost effective. A UC Berkeley study by Robert Cervero and Erick Guerra (2011) is used as the basis of population densities by census block as opportunity weights. Additionally, we targeted bus routes (except for BRT) as ideal sites for rail. We used this suitability analysis to figure out where to route our proposed transit lines.
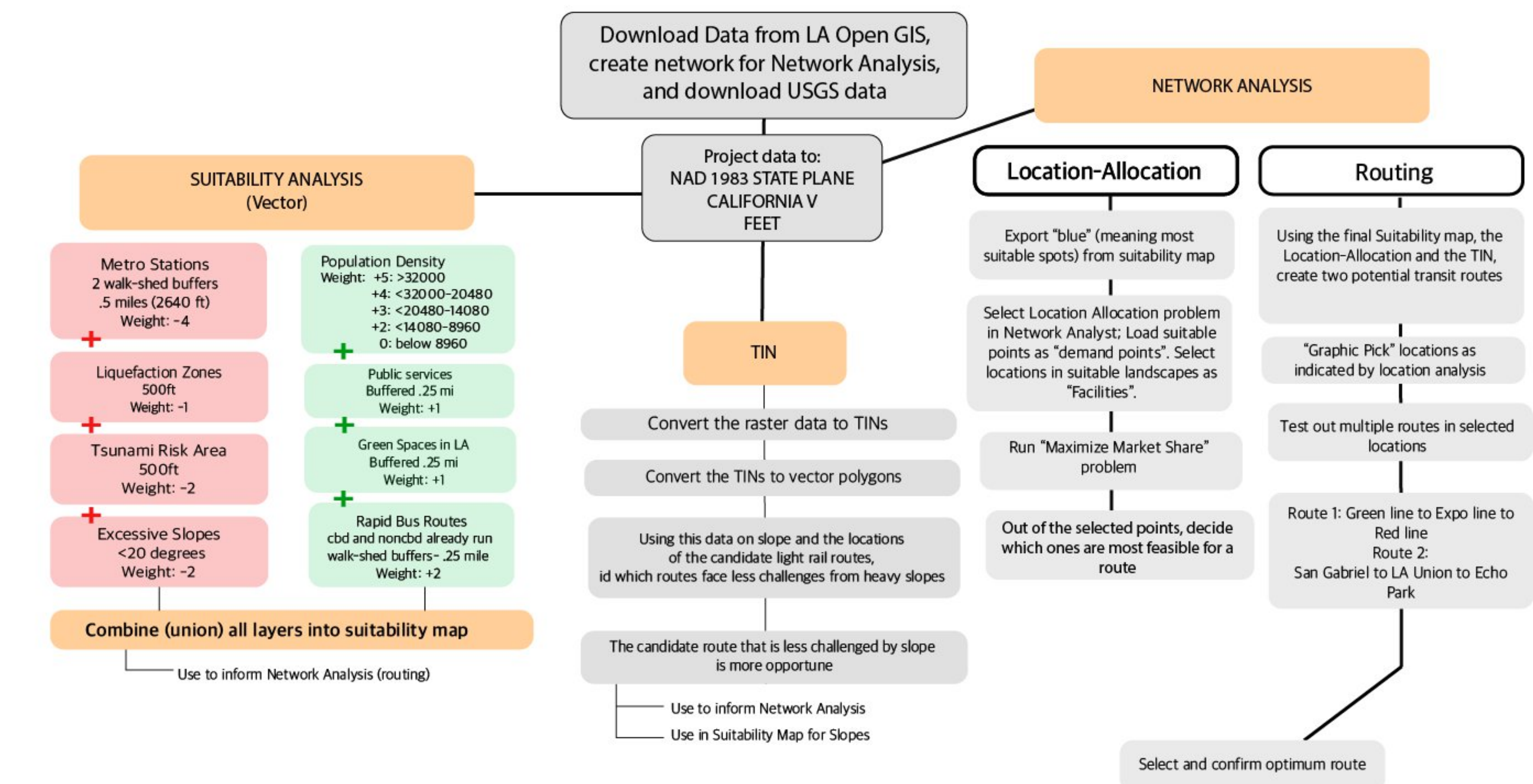
### OPPORTUNITIES



### CONSTRAINTS



### FINAL SUITABILITY MAP
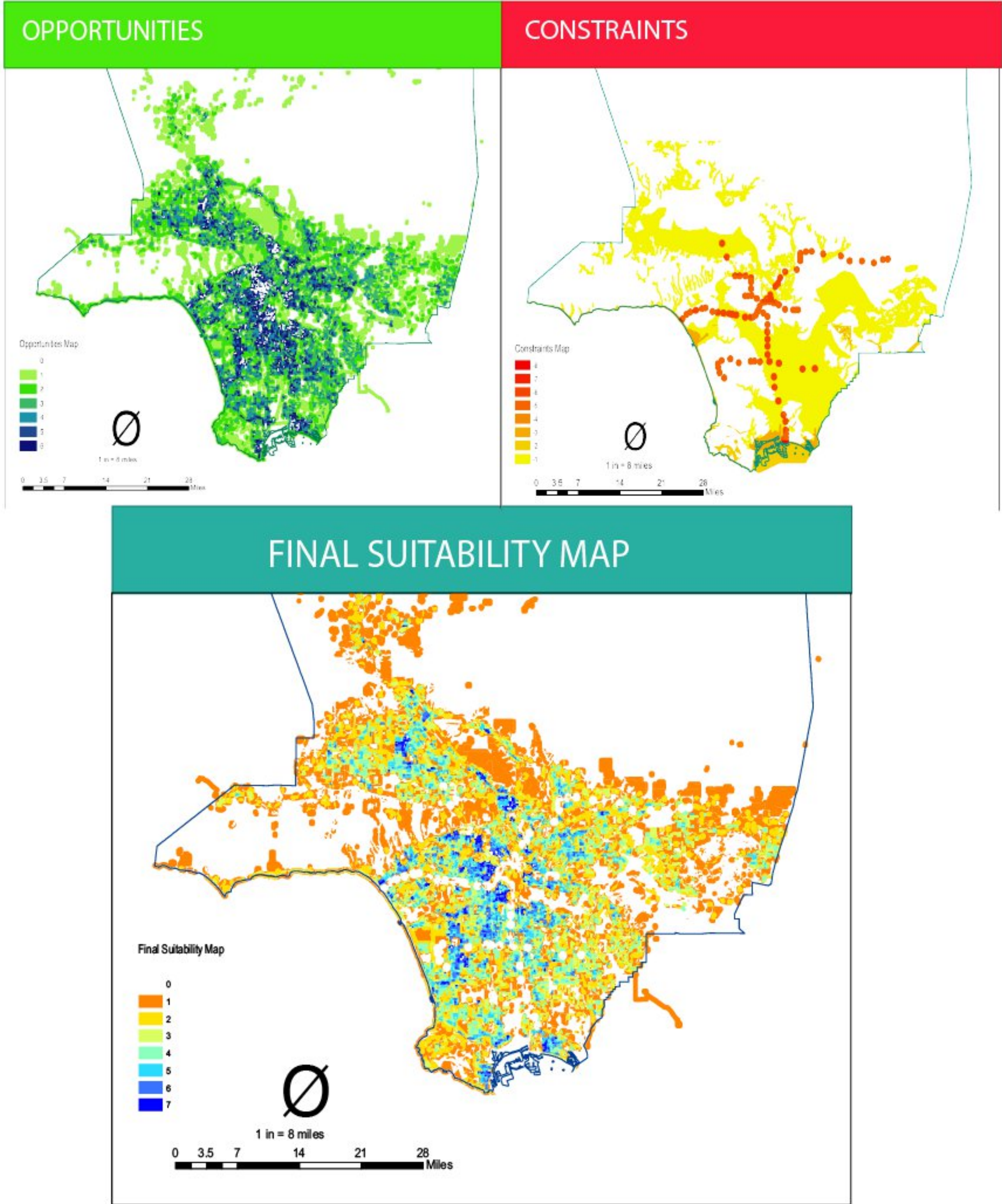


## TIN

By adding a TIN to our analysis we are better able to visualize the real-world layout of the new light-rail route and understand the ways in which slope and elevation would affect the lines. The TIN will help guide the Network Analysis, particularly in creating a transit route. Below is the TIN overlayed with the final transit route options.

### Elevation and Railways in LA County



By: Sannidhi Shukla
December 7, 2018
Source: USGS National Elevation Dataset
Source: LAMetro

## METHODS



Download Data from LA Open GIS, create network for Network Analysis, and download USGS data

Project data to: NAD 1983 STATE PLANE CALIFORNIA V FEET

**SUITABILITY ANALYSIS (Vector)**

Metro Stations 2 walk-shed buffers .5 miles (2640 ft) Weight: -4

Liquefaction Zones 500ft Weight: -1

Tsunami Risk Area 500ft Weight: -2

Excessive Slopes <20 degrees Weight: -2

Population Density Weight: +5: >32000 +4: <32000-20480 +3: <20480-14080 +2: <14080-8960 0: below 8960

Public services Buffered .25 mi Weight: +1

Green Spaces in LA Buffered .25 mi Weight: +1

Rapid Bus Routes cbd and noncbd already run walk-shed buffers-.25 mile Weight: +2

Combine (union) all layers into suitability map

Use to inform Network Analysis (routing)

**TIN**

Convert the raster data to TINs

Convert the TINs to vector polygons

Using this data on slope and the locations of the candidate light rail routes, id which routes face less challenges from heavy slopes

The candidate route that is less challenged by slope is more opportune

Use to inform Network Analysis
Use in Suitability Map for Slopes

**NETWORK ANALYSIS**

**Location-Allocation**

Export "blue" (meaning most suitable spots) from suitability map

Select Location Allocation problem in Network Analyst; Load suitable points as "demand points". Select locations in suitable landscapes as "Facilities".

Run "Maximize Market Share" problem

Out of the selected points, decide which ones are most feasible for a route

**Routing**

Using the final Suitability map, the Location-Allocation and the TIN, create two potential transit routes

"Graphic Pick" locations as indicated by location analysis

Test out multiple routes in selected locations

Route 1: Green line to Expo line to Red line
Route 2: San Gabriel to LA Union to Echo Park

Select and confirm optimum route

## NETWORK ANALYSIS

We selected the "blue" attributes on the suitability map and exported them, reloading just those "opportune" attributes to the Network Analysis map. We colored these "green" and made a new, simpler suitability scale. First, we ran the Location-Allocation function is run with the suitability attributes as the "demand points". We selected for points within those opportune landscapes as "facilities". We then ran the analysis with "Maximize Market Share", selecting for 5 optimal facilities. This helps us select for locations within optimal places that are MOST optimal. After visualizing the 5 optimal points, we decided to connect them by intuitively deciding what would be most feasible line (**considerations**: connect to existing lines, connect to LA union, pass through "suitable" areas). Eventually, we created three routes. We later condensed two of the routes into one, resulting in two final routes: route 1 + route 2, San Gabriel-LA Union-Echo Park, and route 3, Westmont-USC-Koreatown.

### Location-Allocation: Maximizing Market Share (LA County)



### Routing (LA County)
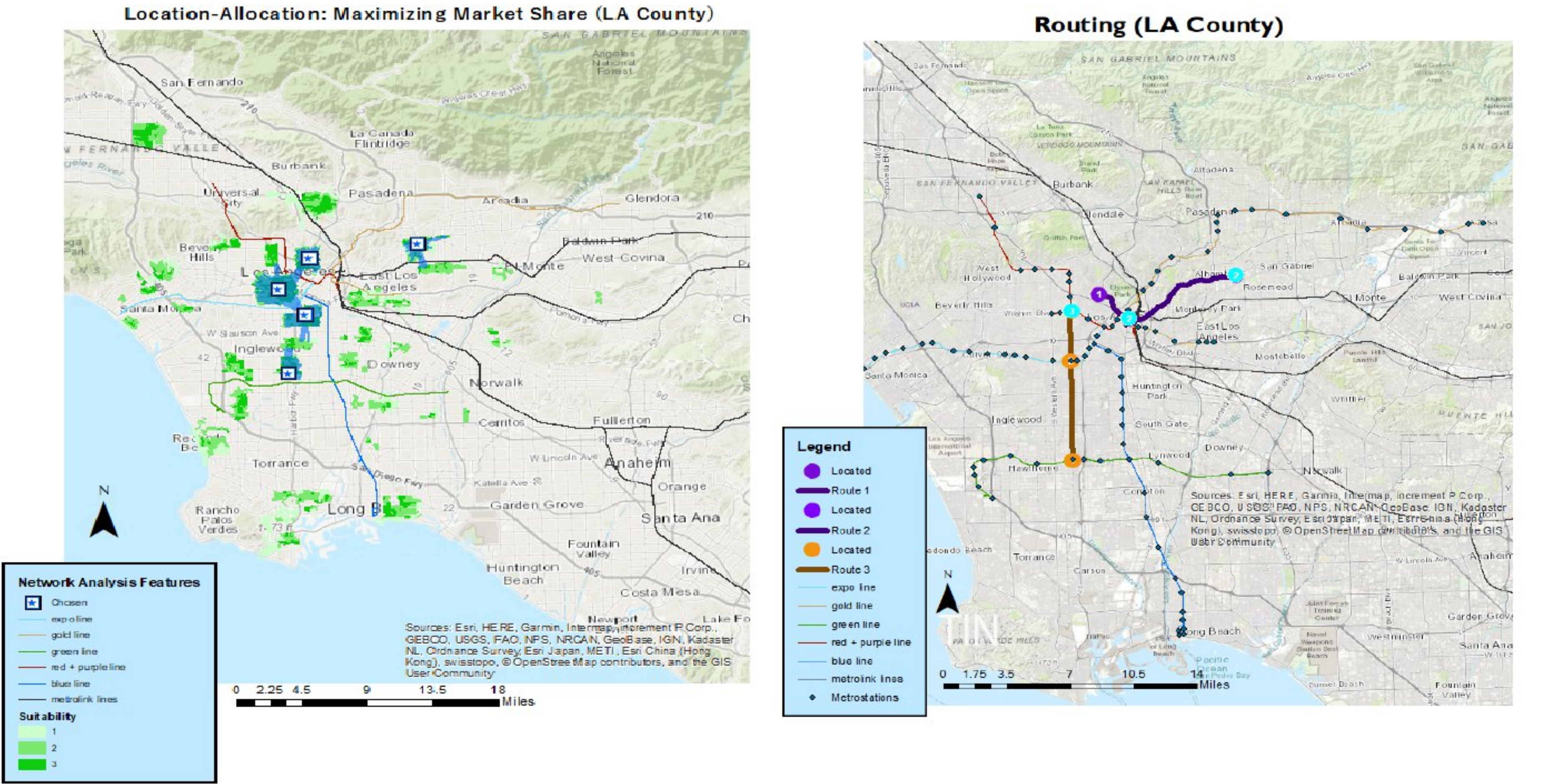


## CONCLUSION

Using the Suitability Analysis, the Network Analysis, and the TIN, we developed three transit routes for LA county. The first route (orange) connects the green line from Westmont to the expo line at USC to the red line at Koreatown. This is an important line because it connects three lines and spans through many important and opportune neighborhoods. The second line (the Magenta line) begins in San Gabriel. It travels through an area that is well-suited for a line, eventually landing at Los Angeles Union Station, a major transit hub. It makes a final stretch out to Echo Park, a location that was indicated as suitable for a rail line.

These two lines extend through suitable landscapes and provide service to underserved areas. We suggest that LA County prioritizes expanding service to these neighborhoods.

### LA COUNTY FINAL TRANSIT MAP



**New Lines**
— Westmont to USC to Ktown
— San Gabriel to Echo Park

**Existing Lines**
— Gold Line
— Expo Line
— Green Line
— Red + Purple Line
— Blue Line

## SOURCES

USGS
LA County OpenData
United States Census
(ACS 5- year, 2007-2011)