San Joaquin Valley Regional Charging Station Siting Analysis

December 2013

SUBMITTED TO:

San Joaquin Valley Air Pollution Control District

SUBMITTED BY:

California Center for Sustainable Energy

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I. Introduction

The San Joaquin Valley Air Pollution Control District and the San Joaquin Valley Plug-in Electric Vehicle Coordinating Council (PEVCC) have identified optimal locations for public electric vehicle chargers in ten Valley cities and along the Highway 99 corridor. The analysis is based on regional transportation origin and destination data, industry expertise, and other demographic information.

The San Joaquin Valley PEVCC is a 28-member advisory group comprised of local Metropolitan Planning Organizations, cities, counties, utilities, the San Joaquin Valley Clean Cities Coalition, electric vehicle service providers, as well as local consultants and non-profit organizations. These stakeholders worked together to develop a methodology at the local level (i.e., census block, travel analysis zone) for identifying locations.

The report is divided into three sections: fast charging, public access charging and workplace charging. Each section provides an overview of the type of charging, how charging locations have been selected, the data sources used to conduct the siting analysis and, finally, maps of the optimal locations to place charging stations and infrastructure.

II. Fast Charging Infrastructure

As the number of plug-in electric vehicles (PEVs) increases in the San Joaquin Valley, DC fast charging or other fast charging infrastructure will be needed to complement Level 1 and Level 2 charging as a reliable option for drivers to extend their range. Recent studies have shown that PEV drivers want more fast chargers available to use and charge their vehicle. This type of charging equipment, which can provide an 80% charge for a light-duty PEV battery in as little as 30 minutes, will not only serve the needs of inter-regional and intra-regional travel, but also support a "safety net" charging network for drivers throughout the Valley.

a. Optimal Locations for Fast Charging in the San Joaquin Valley

For this analysis, DC fast chargers are sited along California State Route 99, or Highway 99. The 99 corridor was chosen because it travels through the most densely populated areas of the San Joaquin Valley; it also connects the major cities of the Valley to Sacramento.

In order for a site to be regarded as an optimal location for hosting fast chargers, it must be within half a mile of a highway exit, be easily accessible, well-lit, offer facilities and shelter for drivers while charging, and be a "destination" point. The types of destinations that were selected are supermarkets, department stores, shopping malls, restaurants, and airports (short-term parking). These locations meet the criteria; further, they likely have adequate power and transformer capacity to support fast chargers and parking availability.

Interstate 5 was excluded from this analysis because it predominately passes through relatively rural areas in the San Joaquin Valley. This implies that areas around the I-5 may not have the existing on-site electrical capacity required for DC fast charging infrastructure.

Type of Charging	*Power Levels (installed circuit rating)*	*Where to Install*
DC Fast Charging	440 or 480VAC	Public or commercial sites within ½ mile of highway exit
*Refer to vehicle specifications for exact ratings		
Source: Adapted from PEV Collaborative Multi-unit Dwelling Guidelines		

To site optimal fast charge locations, each highway exit along the Highway 99 was mapped and a half-mile buffer was created around each exit. Within each half-mile buffer, Google's Places Application Programming Interface (API) was used to locate the aforementioned destinations. Areas with a higher density of destinations are a darker shade of blue and have more potential to host fast chargers with adequate electrical capacity. Together, these variables help determine which proposed areas will potentially experience the most charging demand.

b. Data Sources

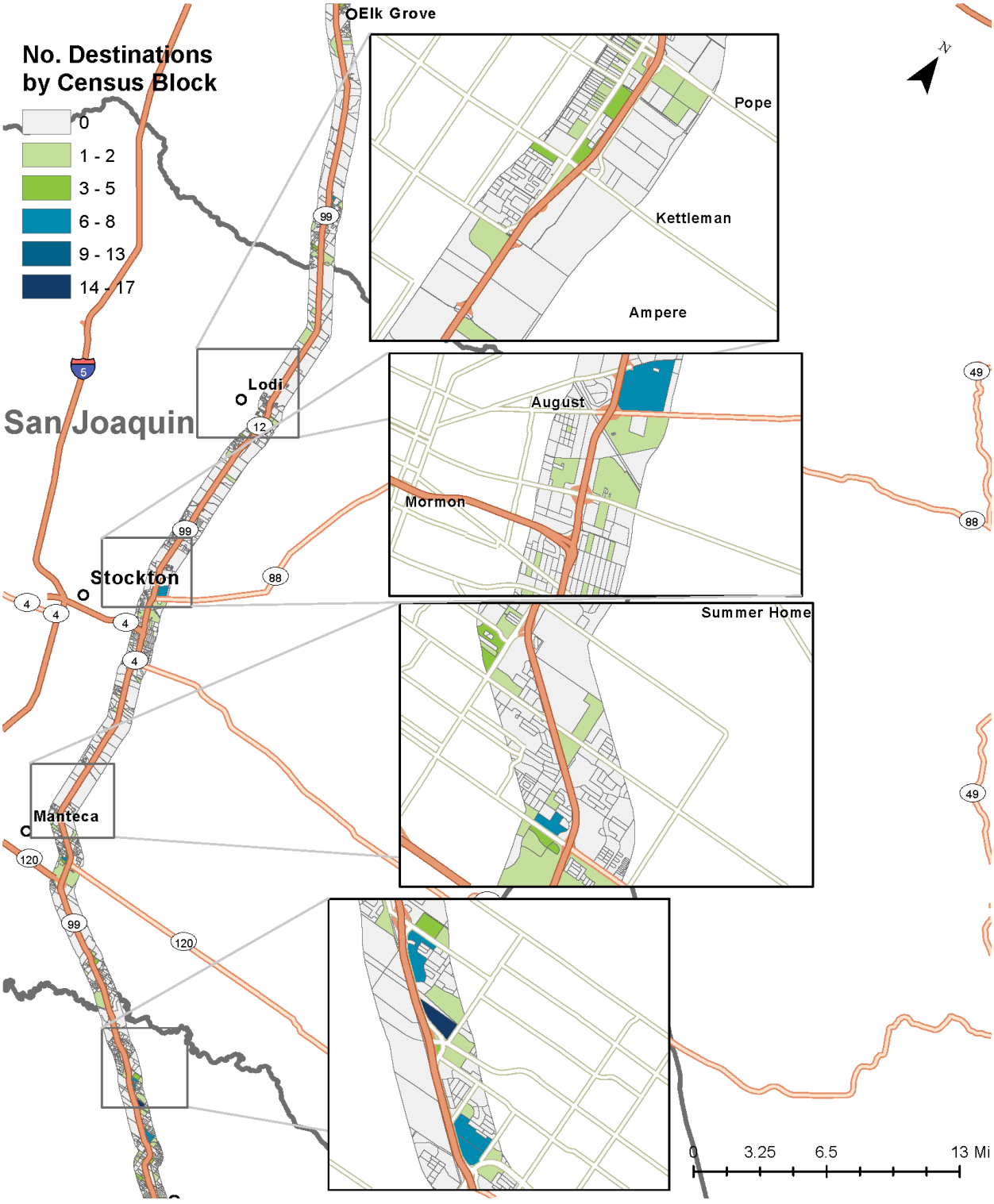
Data was obtained from the National Household Travel Survey, the California Department of Transportation's data on highway exits, an ESRI-developed layer for highway exits, Google Places API, which enables the downloading of Google data, and, finally, support from the UC Davis Plug-in Hybrid Electric Vehicle Research Center.

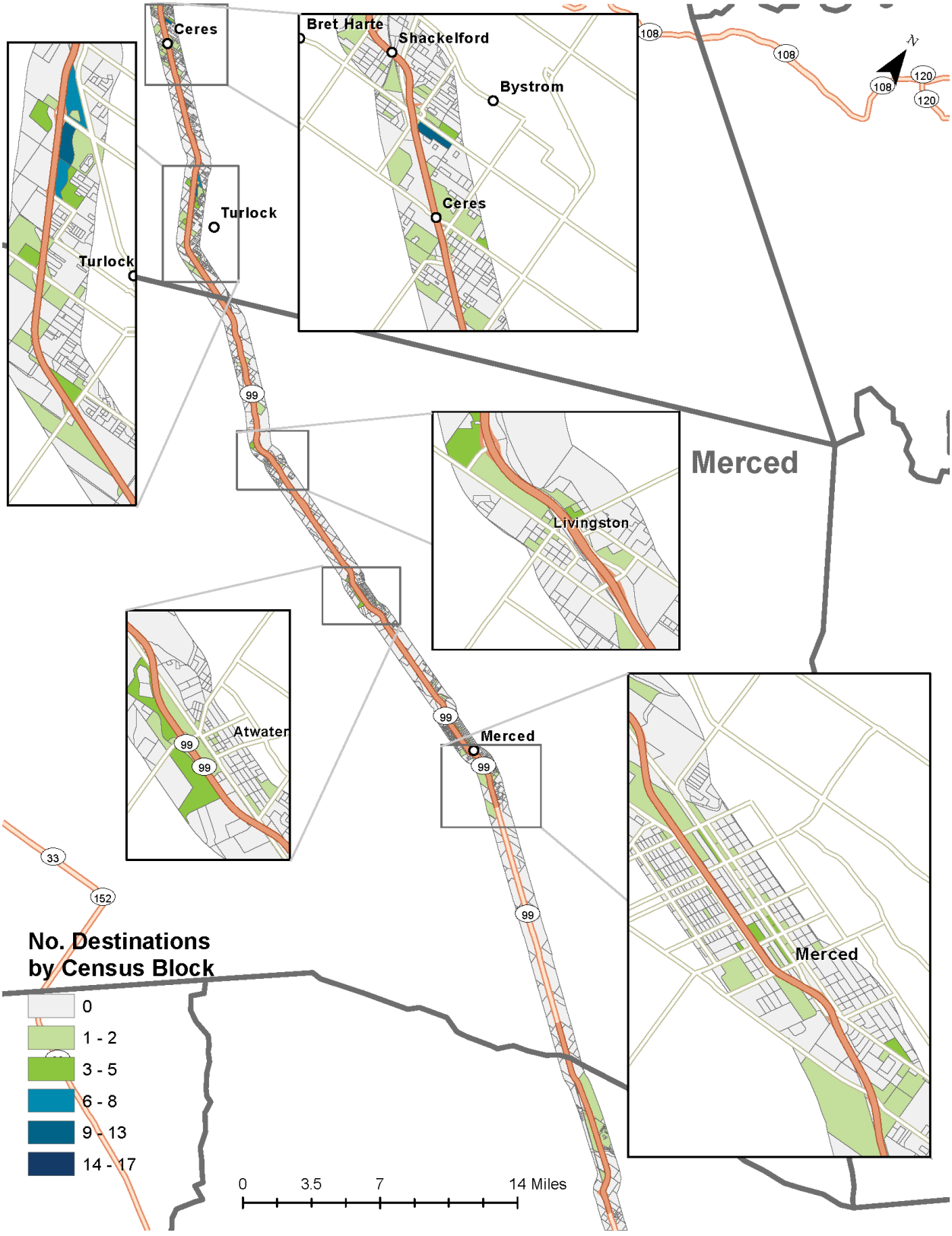
Python, a computer programming software, was used to collect data from the Google Places API. This involved writing code that allows the collection of geocoded coordinates of chosen destinations in cities. This is a powerful tool that removes the need to manually search for each destination online.

c. Maps

The following is a continuous map of the Highway 99 corridor from San Joaquin County to Kern County. Areas with a higher density of destinations are a darker shade of blue whereas areas with lower density of destinations are shades of green or grey.

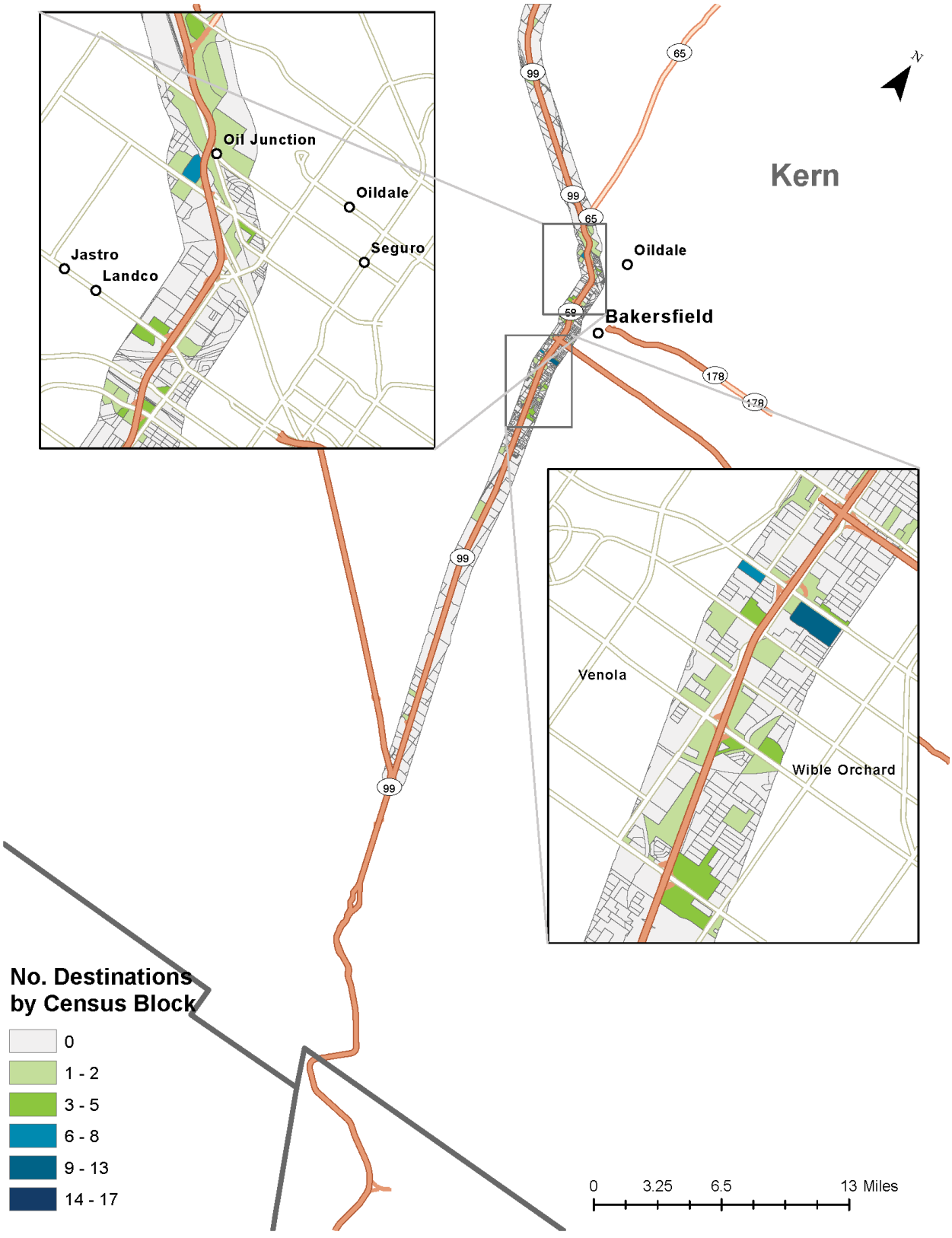
Optimal DC Fast Charging Locations




Ceres
Bret Harte
Shackelford
Bystrom
Ceres
Turlock
Turlock
Merced
Livingston
Atwater
Merced
Merced
108
108
120
120
99
99
99
99
99
99
33
152
No. Destinations
by Census Block
0
1 - 2
3 - 5
6 - 8
9 - 13
14 - 17
0
3.5
7
14 Miles


Madera
Fresno
Madera
Madera
Fresno
Selma
Kingsburg
Sierra St
Simpson St
10Th Ave
Stroud Ave
18Th Ave
Kern St
Draper St
No. Destinations
by Census Block
0
1 - 2
3 - 5
6 - 8
9 - 13
14 - 17
0
3.25
6.5
13 Miles


Kings
Hanford
Tulare
Tulare
Tulare
Delano
Delano
Cecil Ave
Fremont St
High St
S Lexington St
No. Destinations by Census Block
0
1 - 2
3 - 5
6 - 8
9 - 13
14 - 17
0 3.25 6.5 13 Miles
41
198
5
46
99
155
43
65


Oil Junction
Oildale
Jastro
Landco
Seguro
Kern
Oildale
Bakersfield
Venola
Wible Orchard
99
65
58
178
No. Destinations by Census Block
0
1 - 2
3 - 5
6 - 8
9 - 13
14 - 17
0
3.25
6.5
13 Miles

III. Public Access Charging

A robust network of publically-available Level 2 charging stations is needed to encourage more PEV purchases in the San Joaquin Valley. Destination charging sites should be located in urban areas and destinations where drivers will park their vehicle for more than one hour. This includes places that attract out-of-town visitors (i.e. art galleries, zoos, museums, and amusement parks) and places where community members frequent (such as libraries, universities, and parks).

a. City Level

Ten cities in the San Joaquin Valley have been used in the siting analysis for Level 2 chargers. A map has been created for each of the following cities.

- Bakersfield
- Clovis
- Fresno
- Hanford
- Madera
- Merced
- Modesto
- Stockton
- Tracy
- Visalia

These ten cities include top PEV adopting cities in the Valley (Bakersfield, Clovis, Fresno, and Tracy) and the county seats of each San Joaquin Valley county. Top PEV adopting cities have been chosen because local government officials would benefit from understanding what areas in their community would likely experience the most demand for public charging. The county seats have also been chosen because these areas tend to be more populated and it is a fair way to give representation to all counties in the Valley.

b. Best Locations for Public Access Charging

Data was obtained from the National Household Travel Survey to understand where drivers tend to be parked for longer periods of time. The following list places may attract drivers to travel "medium-to-long" distances from their home and tend to stay parked at these places for at least one hour, generally enough time to sufficiently charge their vehicle to complete the trip home using a Level 2 charging station.

- Airport
- Amusement park
- Aquarium
- Art gallery
- Campground
- Casino
- Department store
- Grocery store or supermarket
- Hospital
- Library
- Lodging
- Movie theater
- Museum
- Park
- Restaurant
- Shopping mall

- Stadium
- Train station
- University
- Zoo

c. How Local Government Officials can use the Maps

Each map displays the density of these "destinations" by census block. A census block is the smallest geographic unit used for tabulation by the United States Census Bureau. By mapping the destination points of a city within each census block, this will allow local transportation and city planners the ability to assess the relative number of EVSE hosting opportunities located in a block. From there, planners could assess the potential parking availability for charging stations within each high-density block and prioritize upcoming planning reforms. Finally, planners may be able to take inventory of the blocks with high density of "destinations" and identify the building types that offer cost effective charging opportunities.

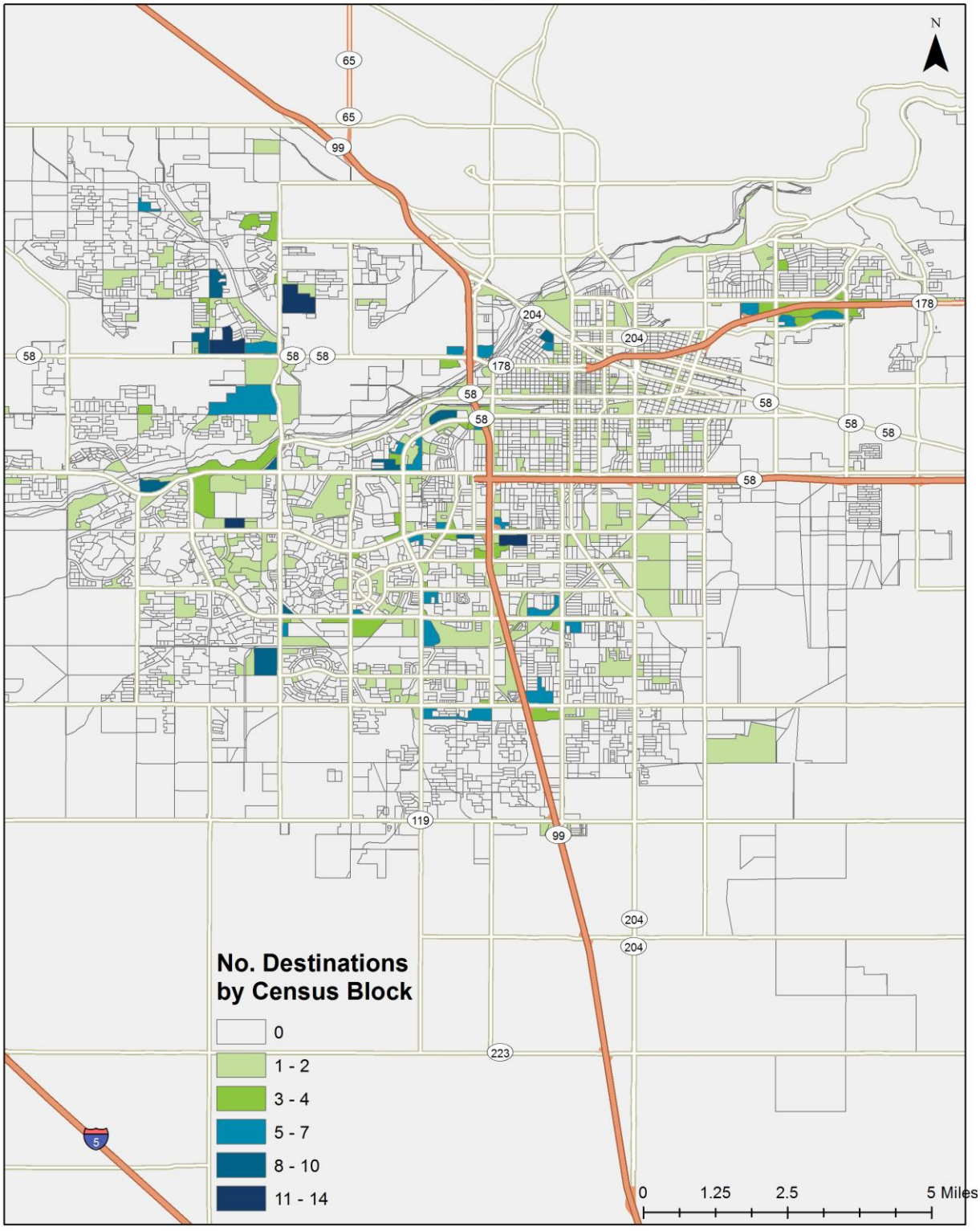
d. Data Sources

Data has been gathered from Google Places API using Python. The data for existing public charging stations was accessed from the Department of Energy's Alternative Fuels Data Center, as of October 2013.

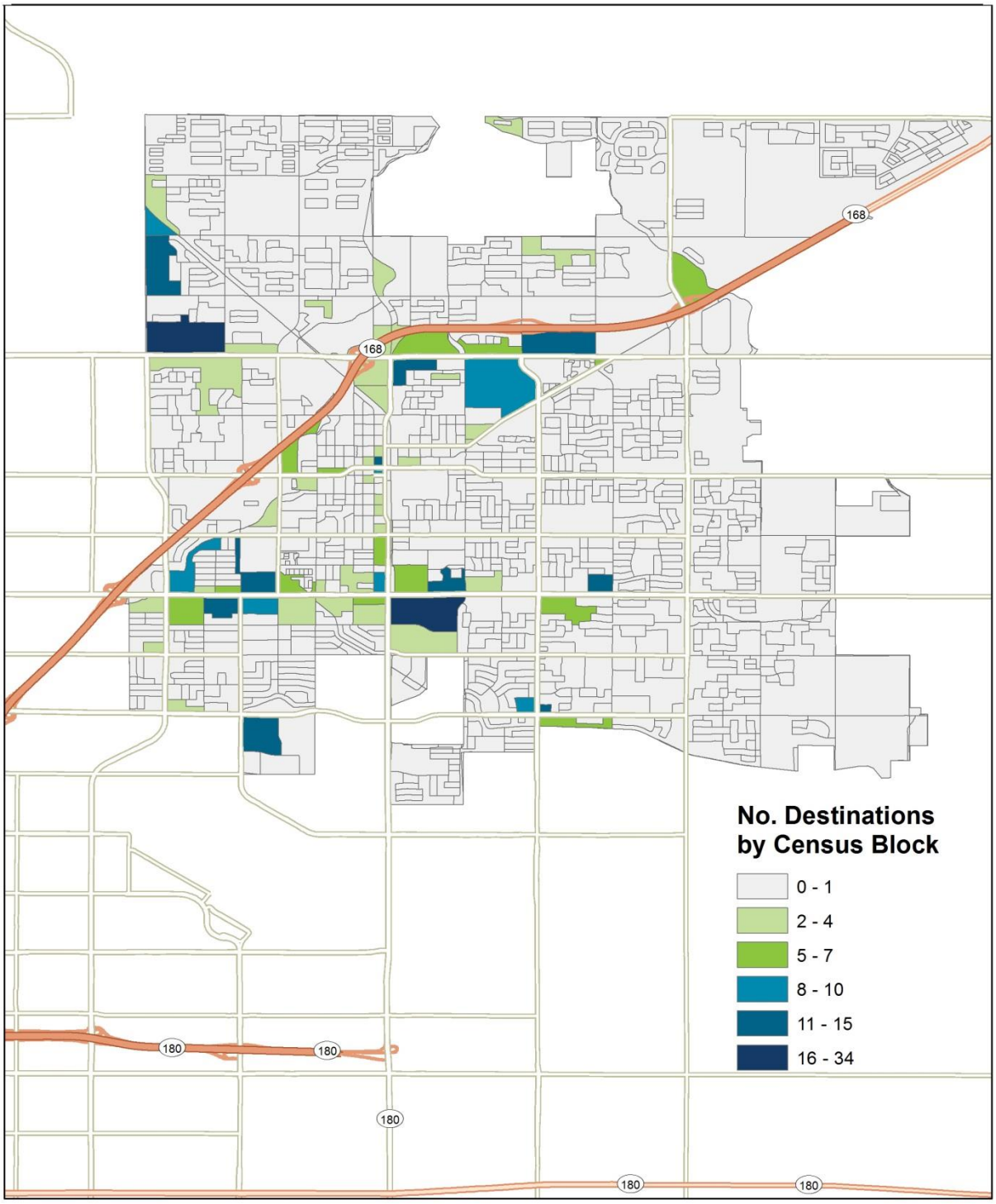
e. Maps

Each map identifies optimal locations for public access charging by census blocks. Census blocks with high density of the above "destinations" are dark blue, whereas those with low density are green and grey.

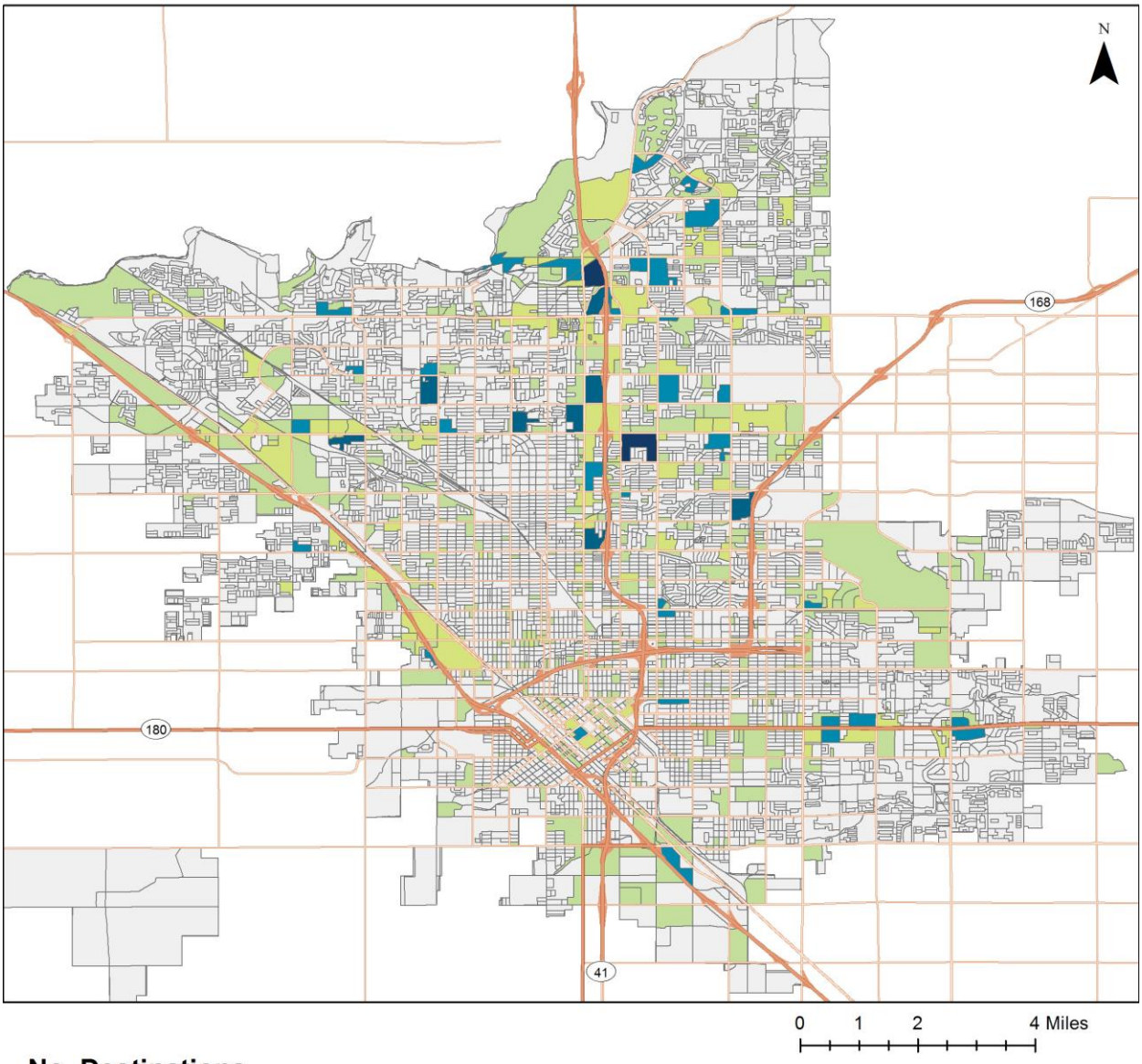
Optimal Public Access Charging Locations, Bakersfield



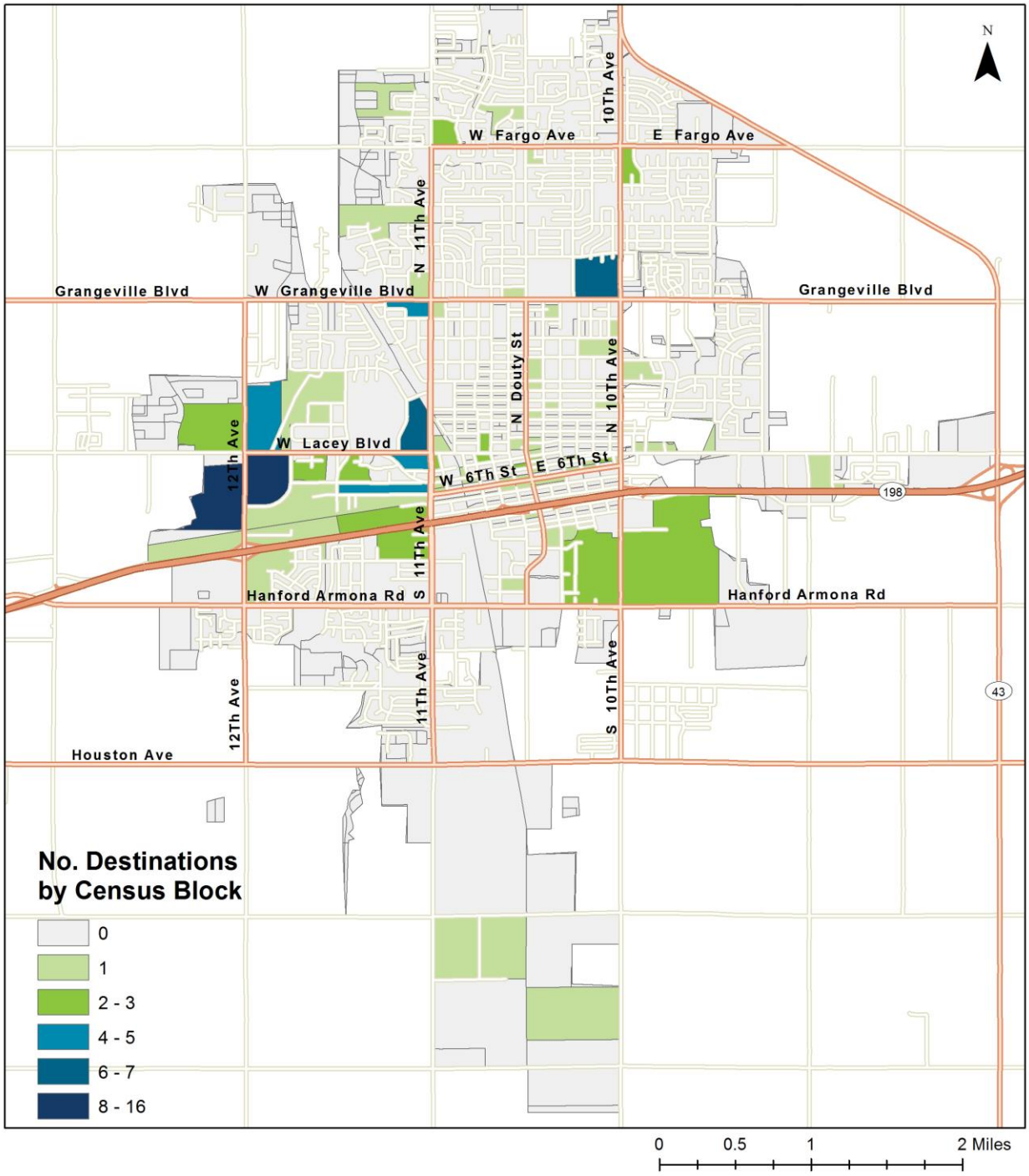
Optimal Public Access Charging Locations, Clovis



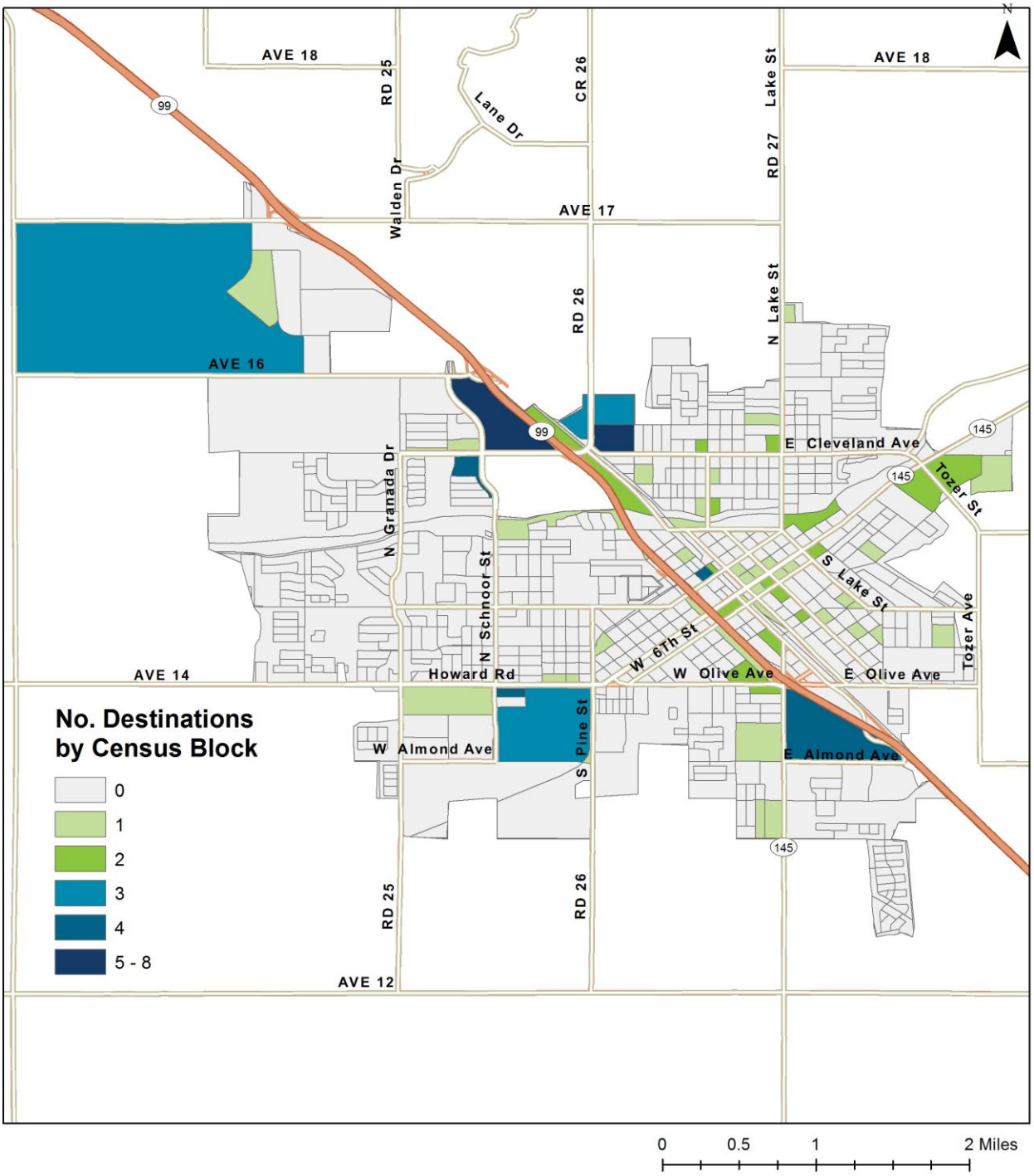
Optimal Public Access Charging Locations, Fresno



Optimal Public Access Charging Locations, Hanford

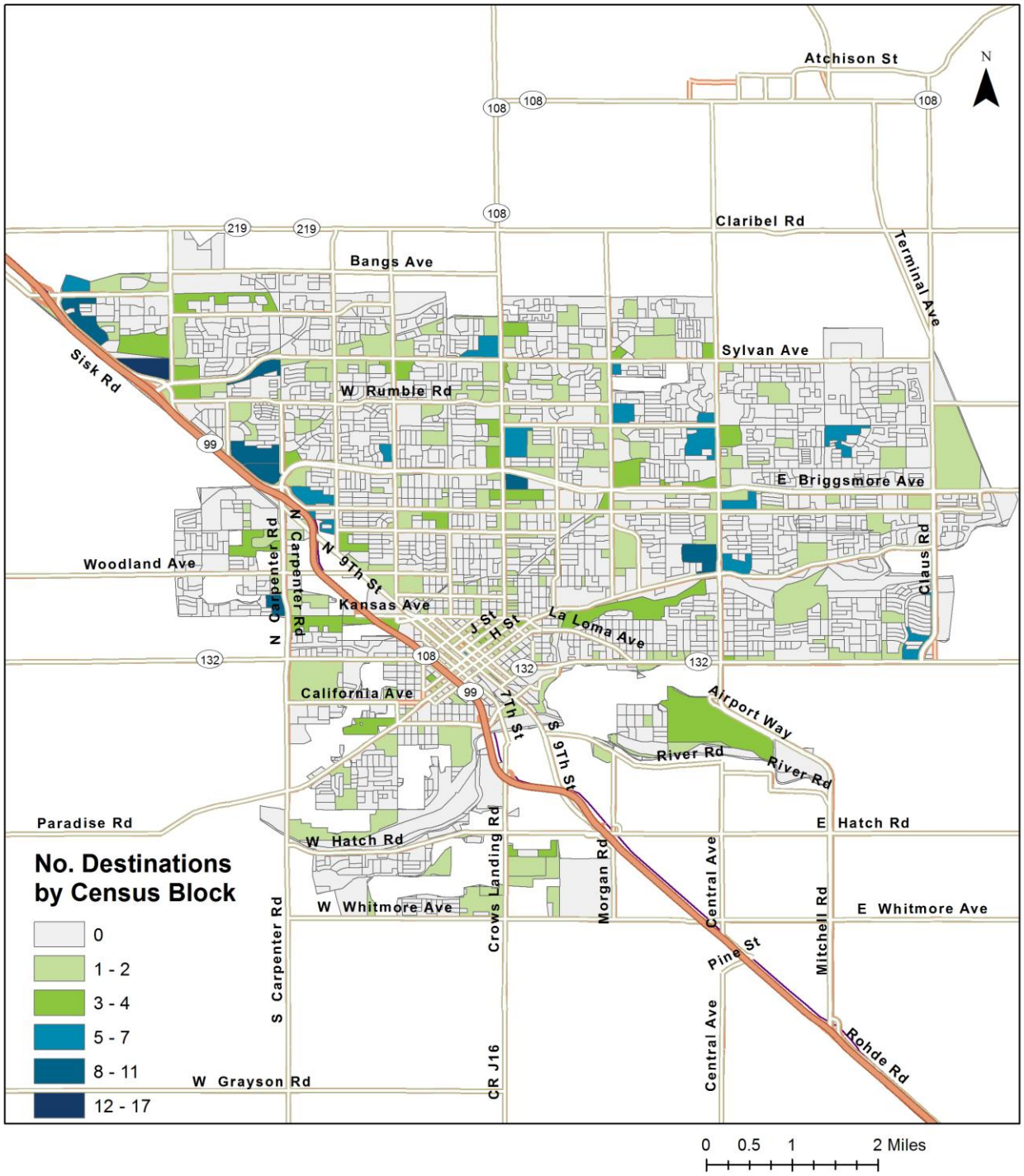


Optimal Public Access Charging Locations, Madera

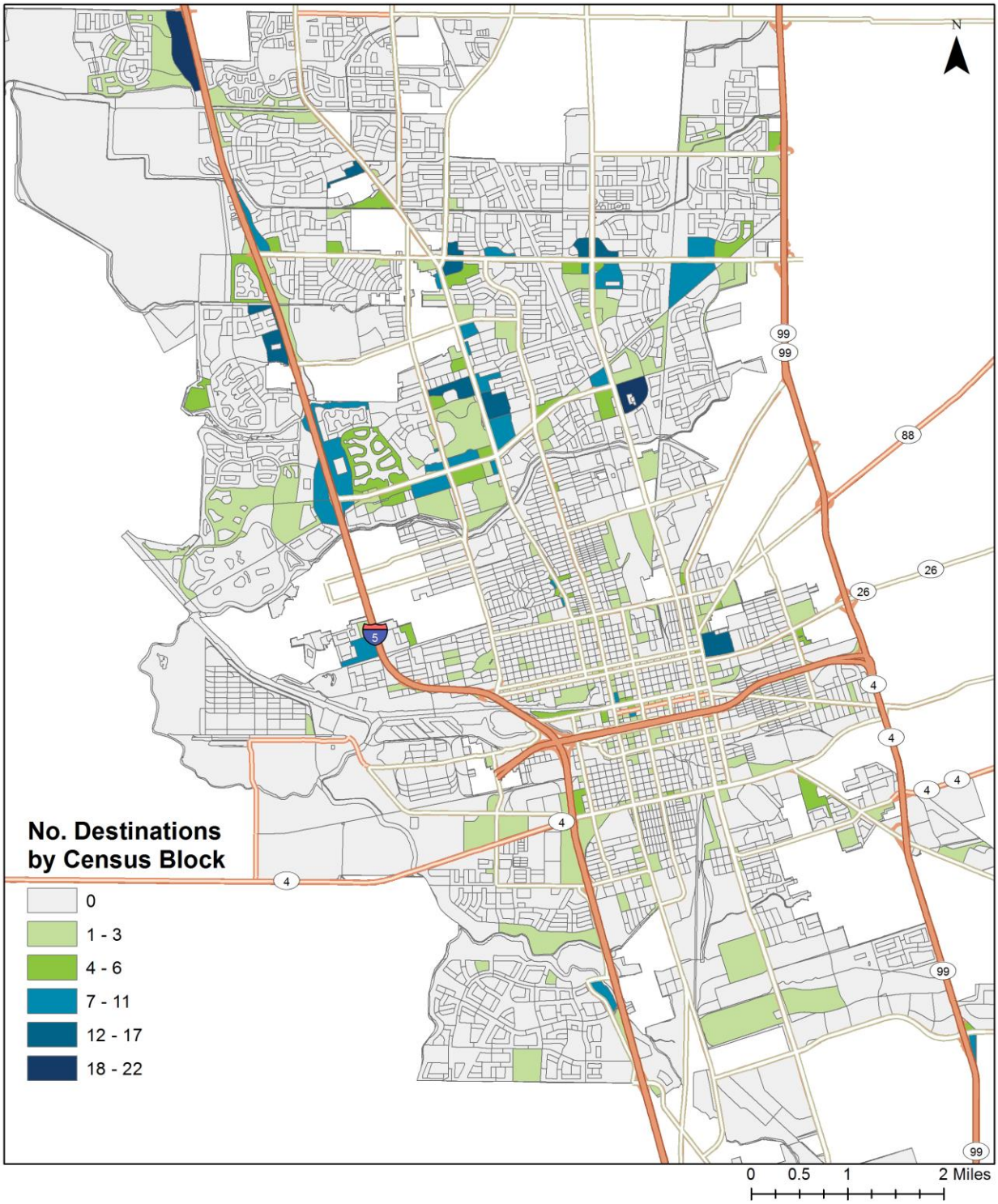


Optimal Public Access Charging Locations, Merced

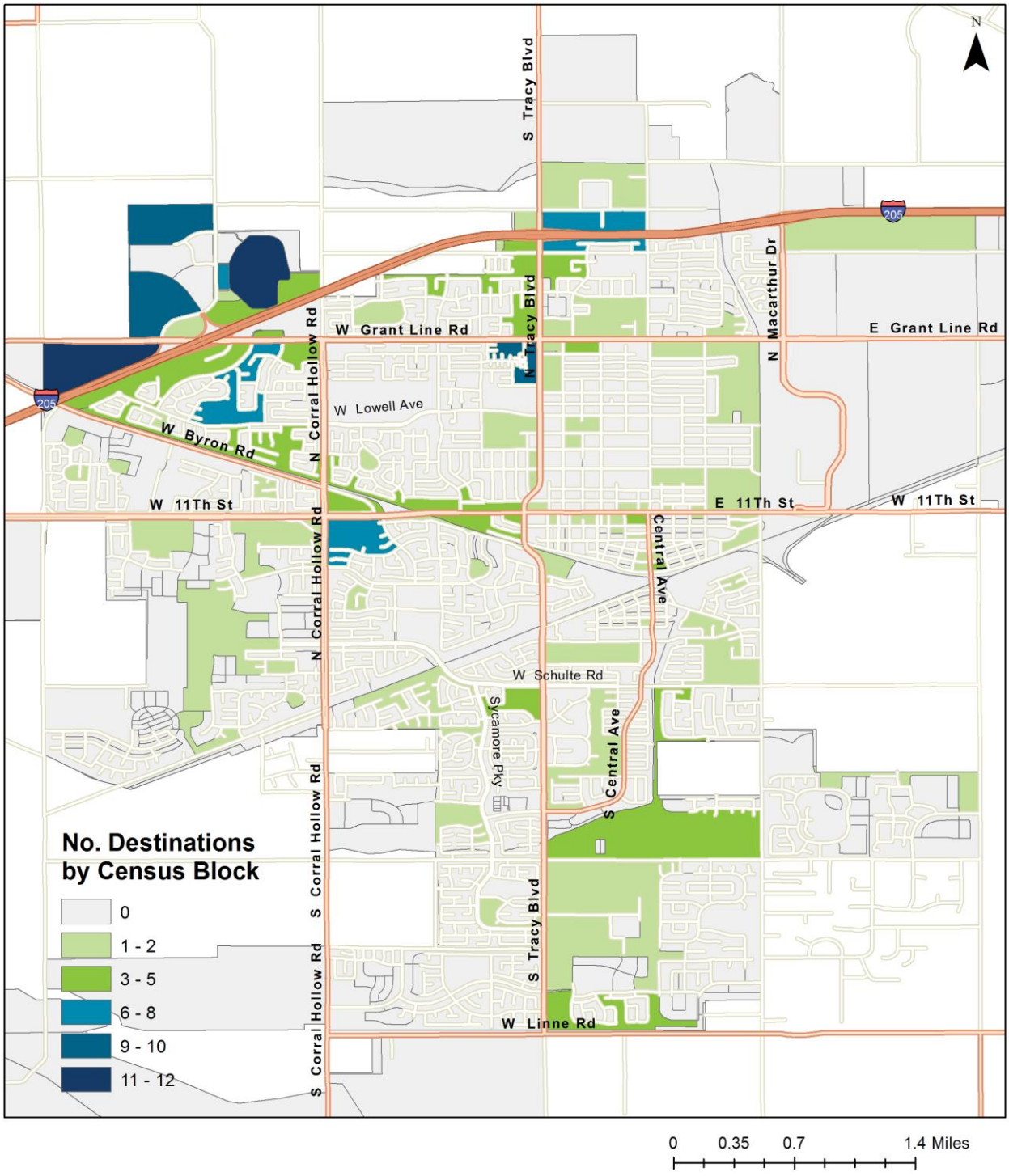
Optimal Public Access Charging Locations, Modesto



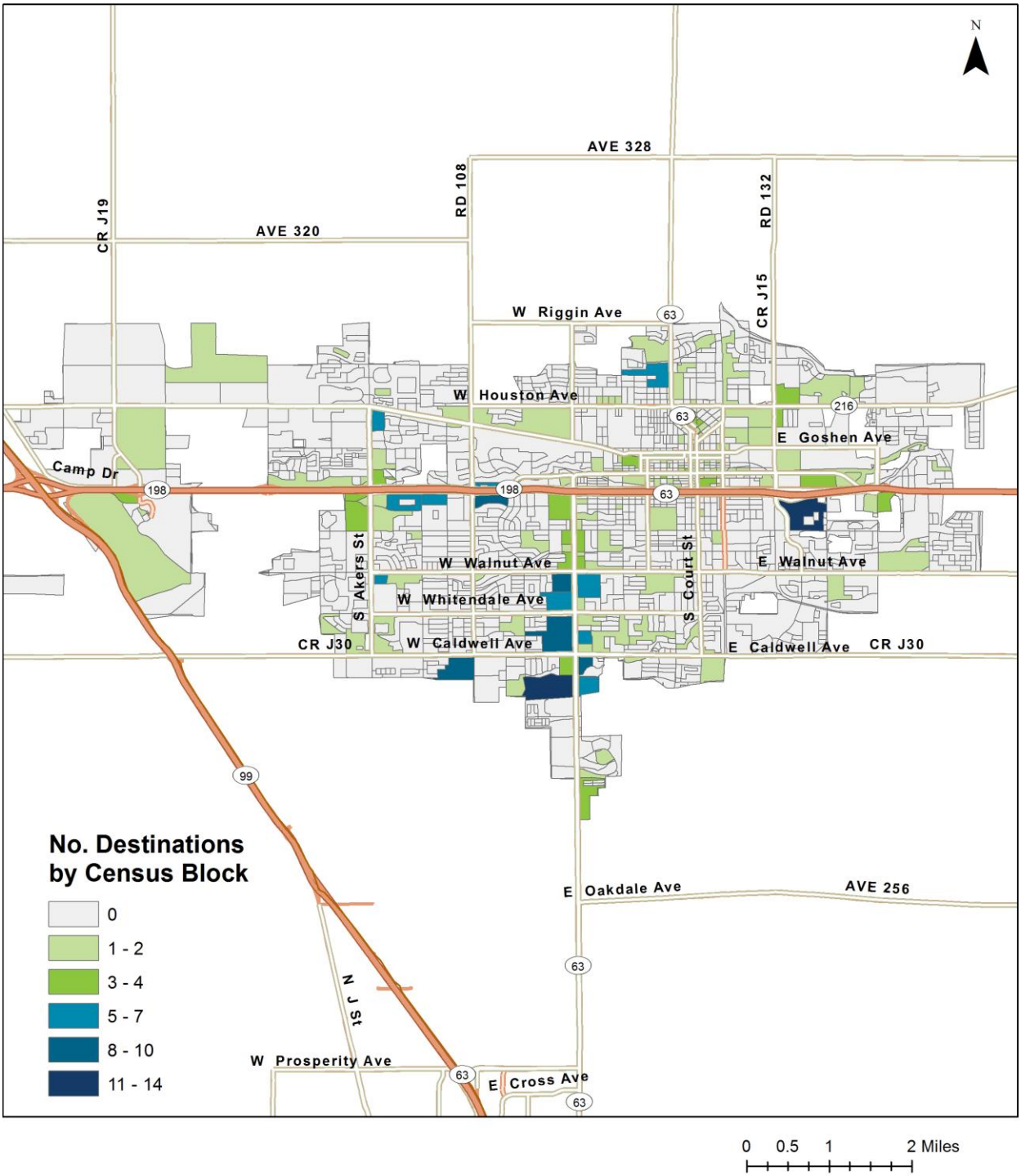
Optimal Public Access Charging Locations, Stockton



Optimal Public Access Charging Locations, Tracy



Optimal Public Access Charging Locations, Visalia



IV. Workplace Charging

According to the Electric Power Research Institute, the workplace is the second most frequented location for charging after a PEV driver's home. This is because vehicles tend to stay parked at a workplace on average 8 to 9 hours, providing sufficient time for drivers to "top off" and fully complete their commute or take side trips using electricity. Workplace charging is also an alternative to residential charging for drivers that may not have residential charging available.

a. Best Locations for Workplace Charging

To understand which locations would benefits from workplace charging, land use data was obtained to understand the total numbers of employees located in a travel analysis zone (TAZ), which is typically a small area in a neighborhood or community that serves as the smallest geographic basis for travel demand model forecasting systems. A TAZ may also be referred to as a travel analysis zone, transportation analysis zone, or a traffic analysis zone In addition to regional planning studies, a TAZ could also account for a variety of census data. For this project, TAZs provided data on employee numbers and land use.

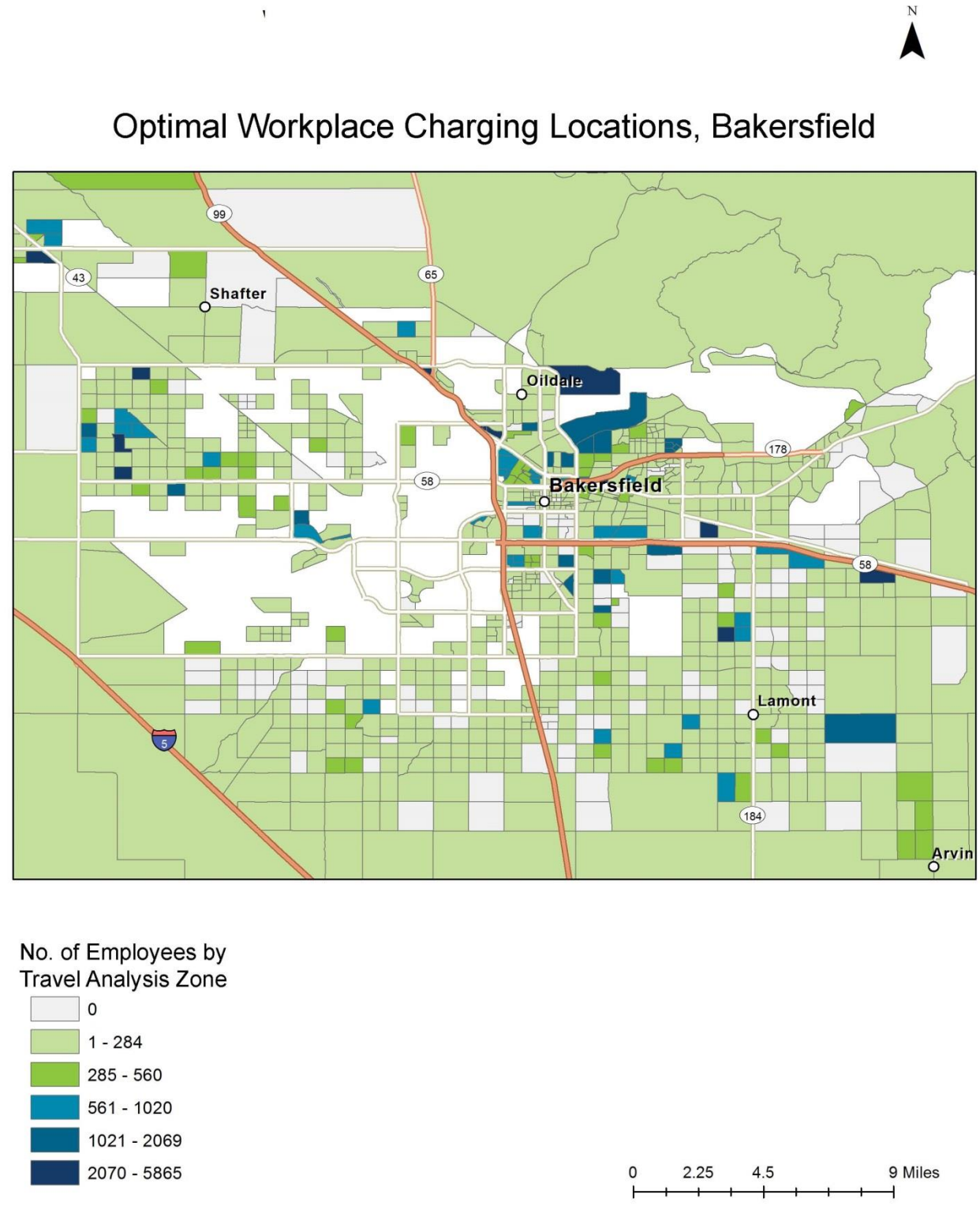
Employee data in each TAZ helped to located dense workplace zones, which may inform planners and business owners to focus workplace charging initiatives. The analysis assumes that zones with more employees will likely contain higher number of PEV drivers.

b. Data Sources

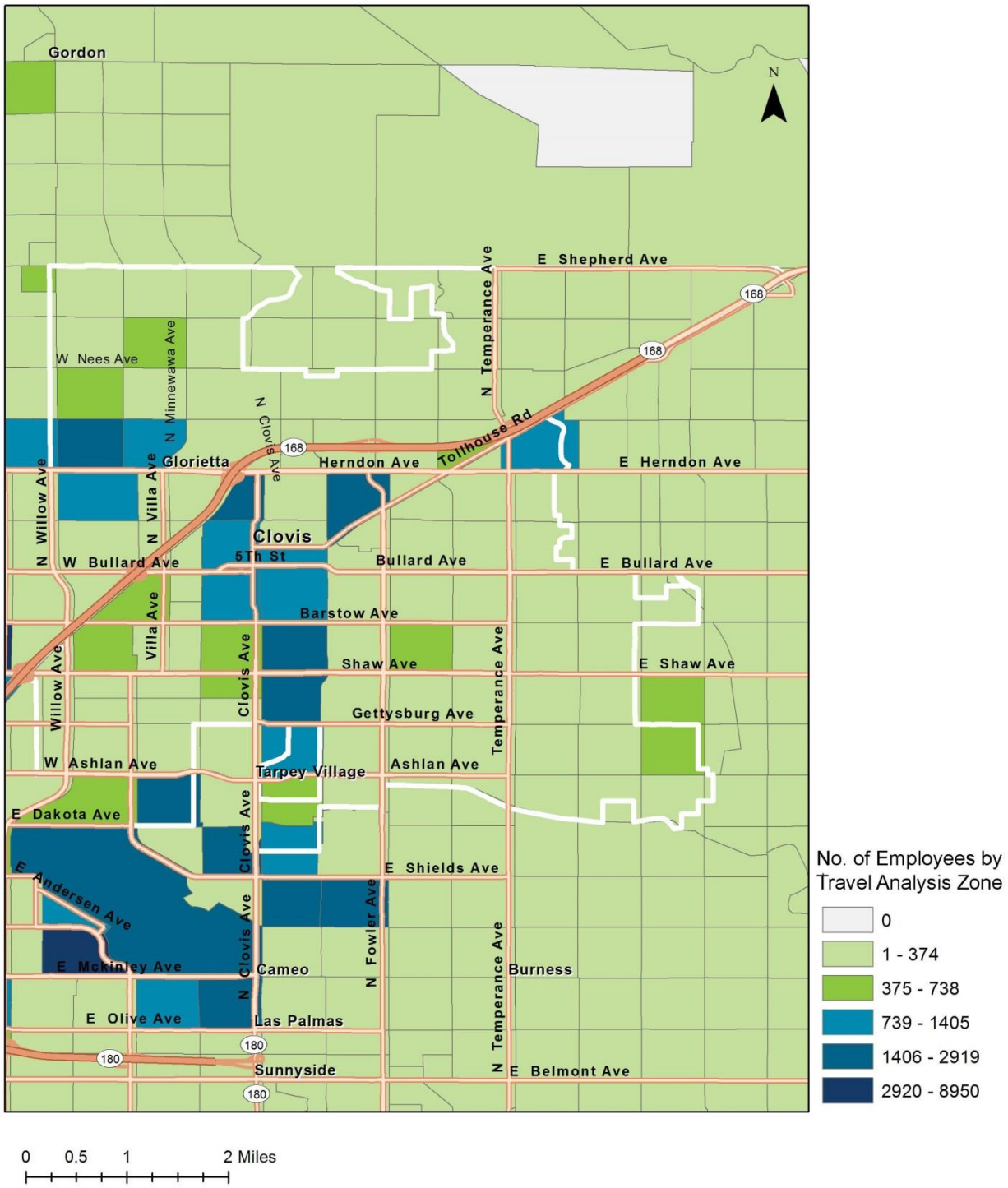
Some regional agencies were able to provide thorough land use data for the siting analysis. These include Madera County Transportation Commission, Fresno Council of Governments (COG), Kern COG, and Tulare COG. The data were given to the project as Geographic Information System shapefiles.

c. Maps

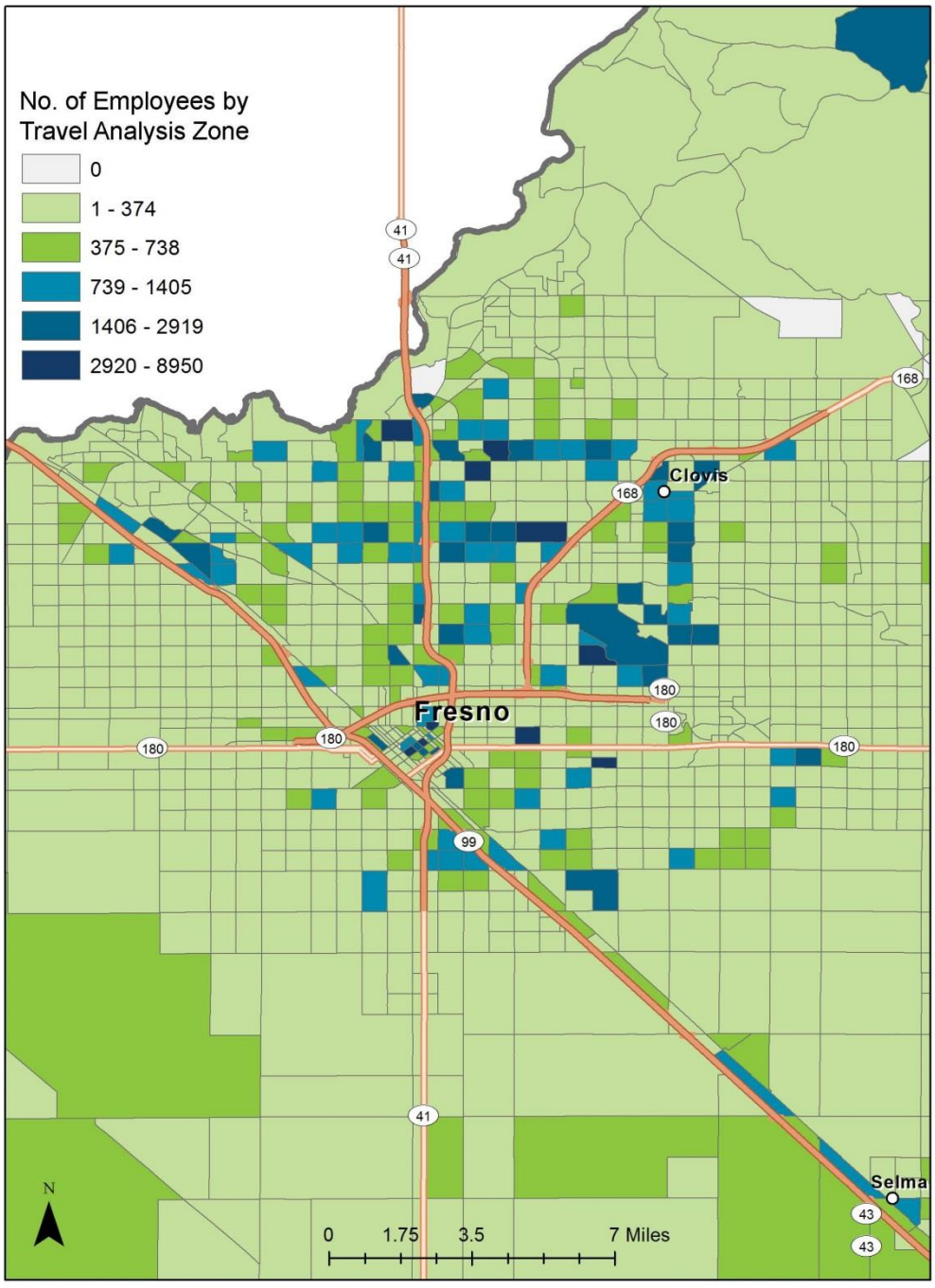
Employment density maps are provided for the cities of Bakersfield, Clovis, Fresno and Visalia and the counties of Fresno, Kern and Tulare. Areas with higher density of workplaces will be dark blue, whereas areas with low density of workplaces are light green or grey.


N
Optimal Workplace Charging Locations, Bakersfield
99
43
65
Shafter
Oildale
178
58
Bakersfield
58
Lamont
5
184
Arvin
No. of Employees by
Travel Analysis Zone
0
1 - 284
285 - 560
561 - 1020
1021 - 2069
2070 - 5865
0
2.25
4.5
9 Miles

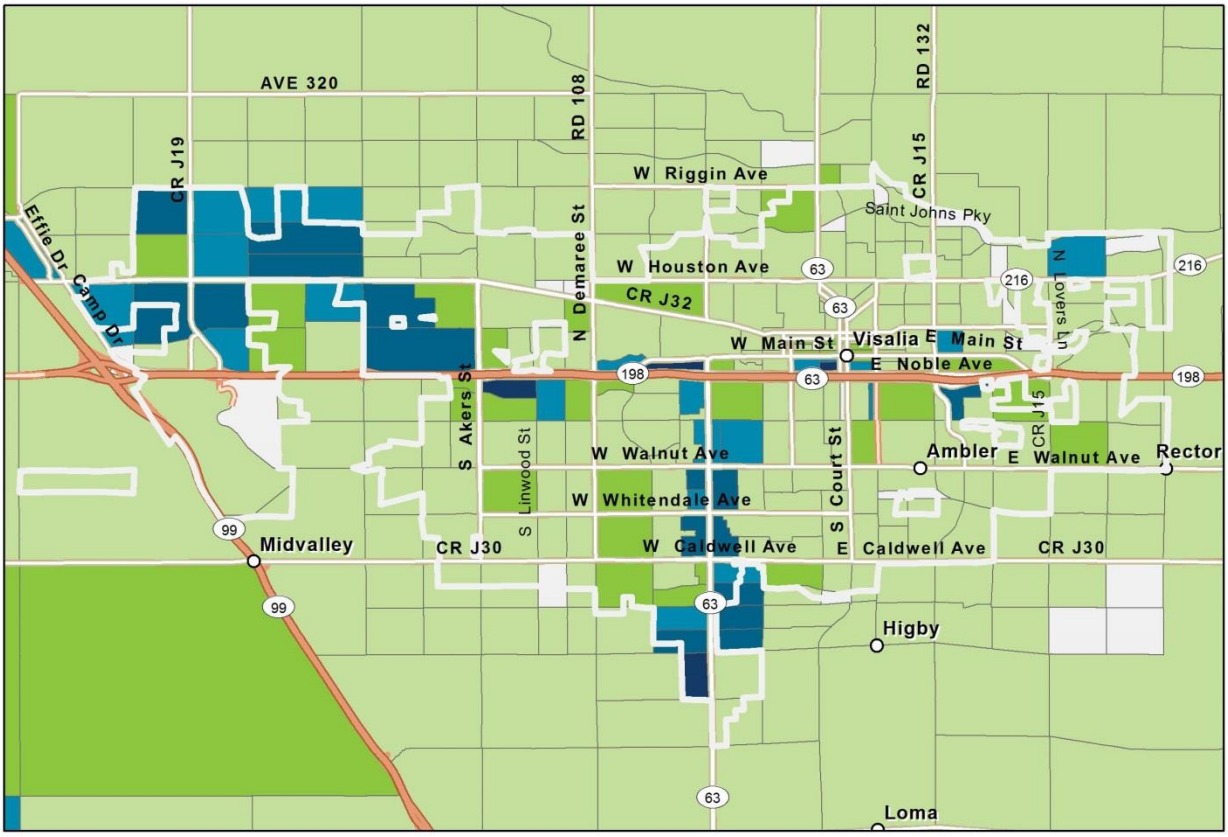
Optimal Workplace Charging Locations, Clovis



Optimal Workplace Charging Locations, Fresno



Optimal Workplace Charging Locations, Visalia

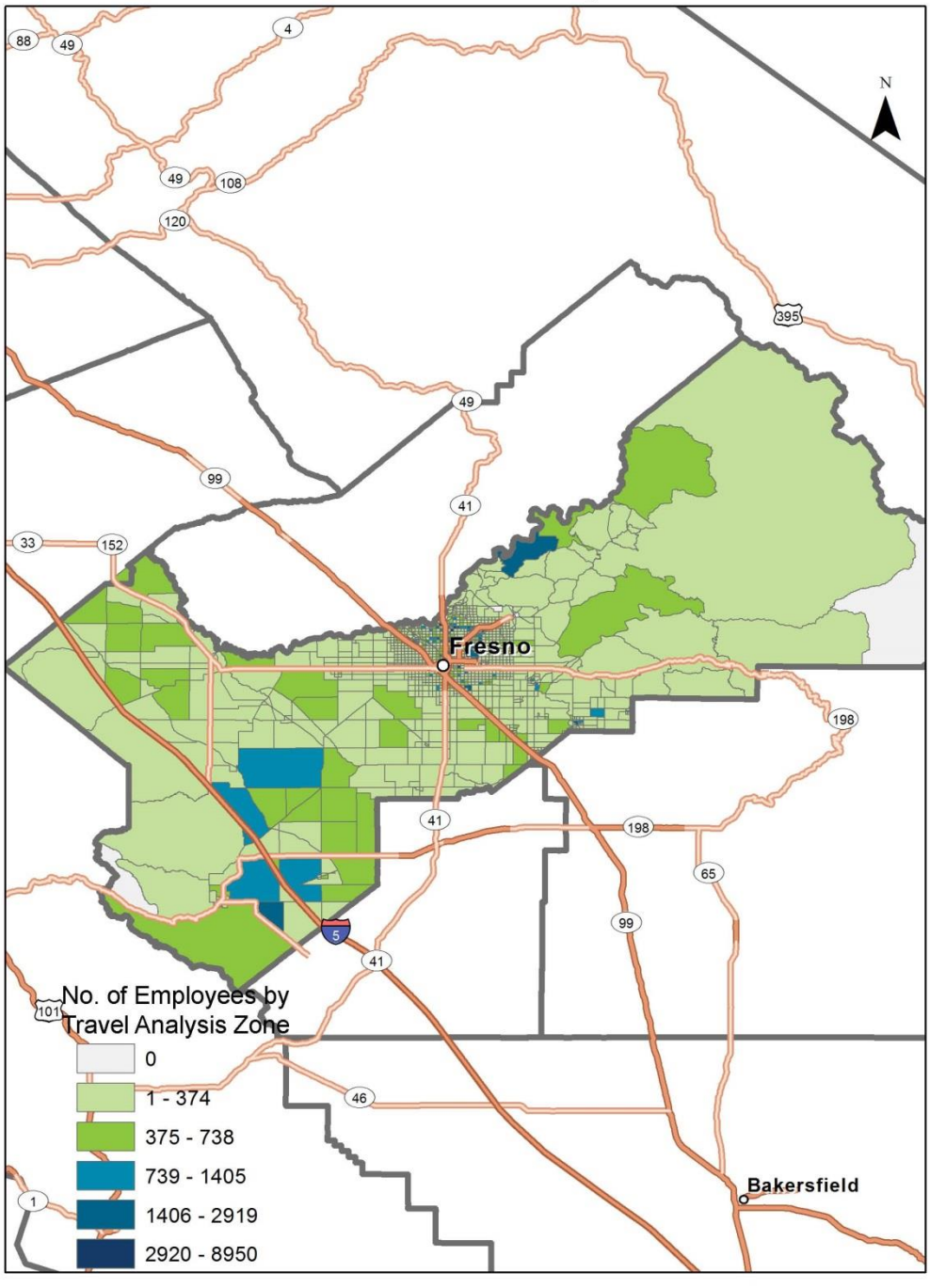


No. of Employees by Travel Analysis Zone

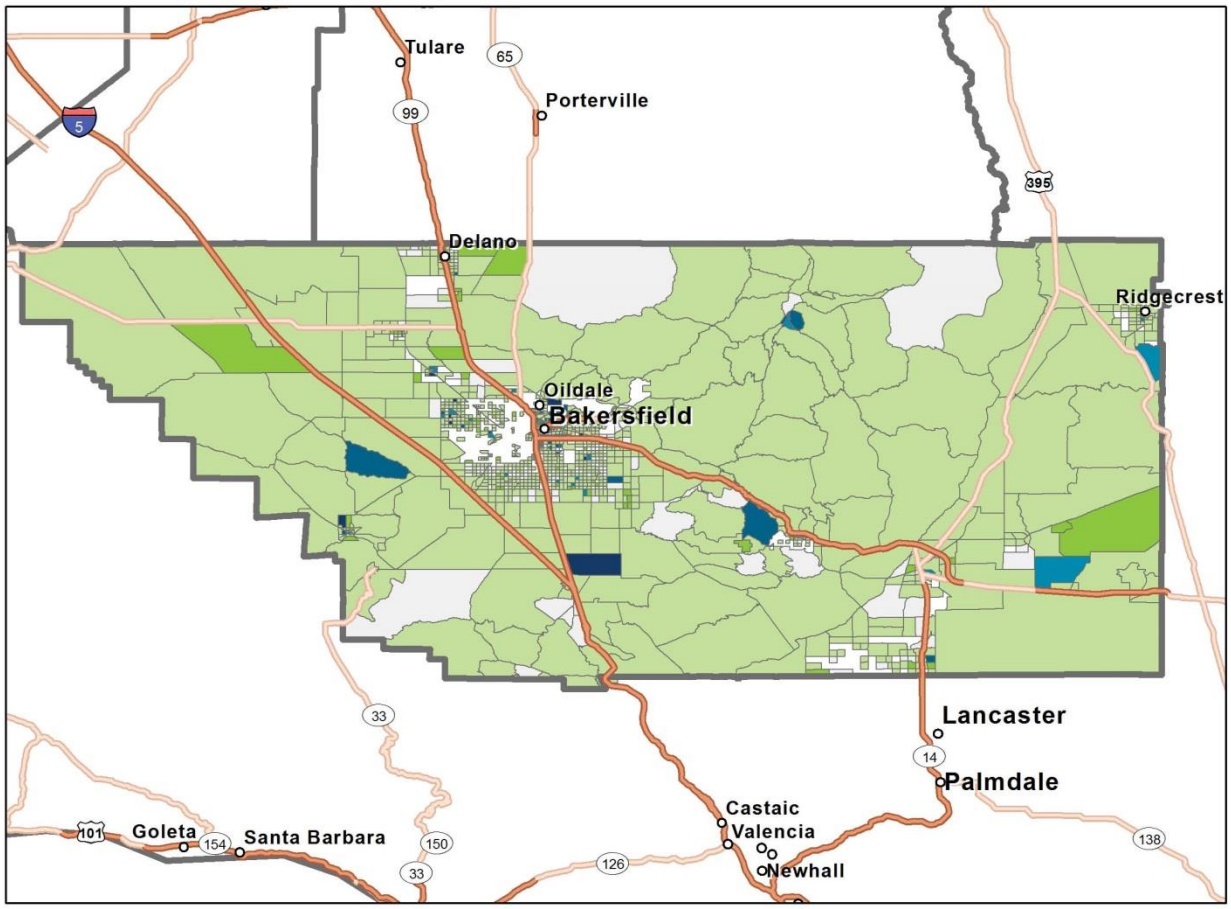
- 0
- 1 - 266
- 267 - 508
- 509 - 861
- 862 - 1576
- 1577 - 3136

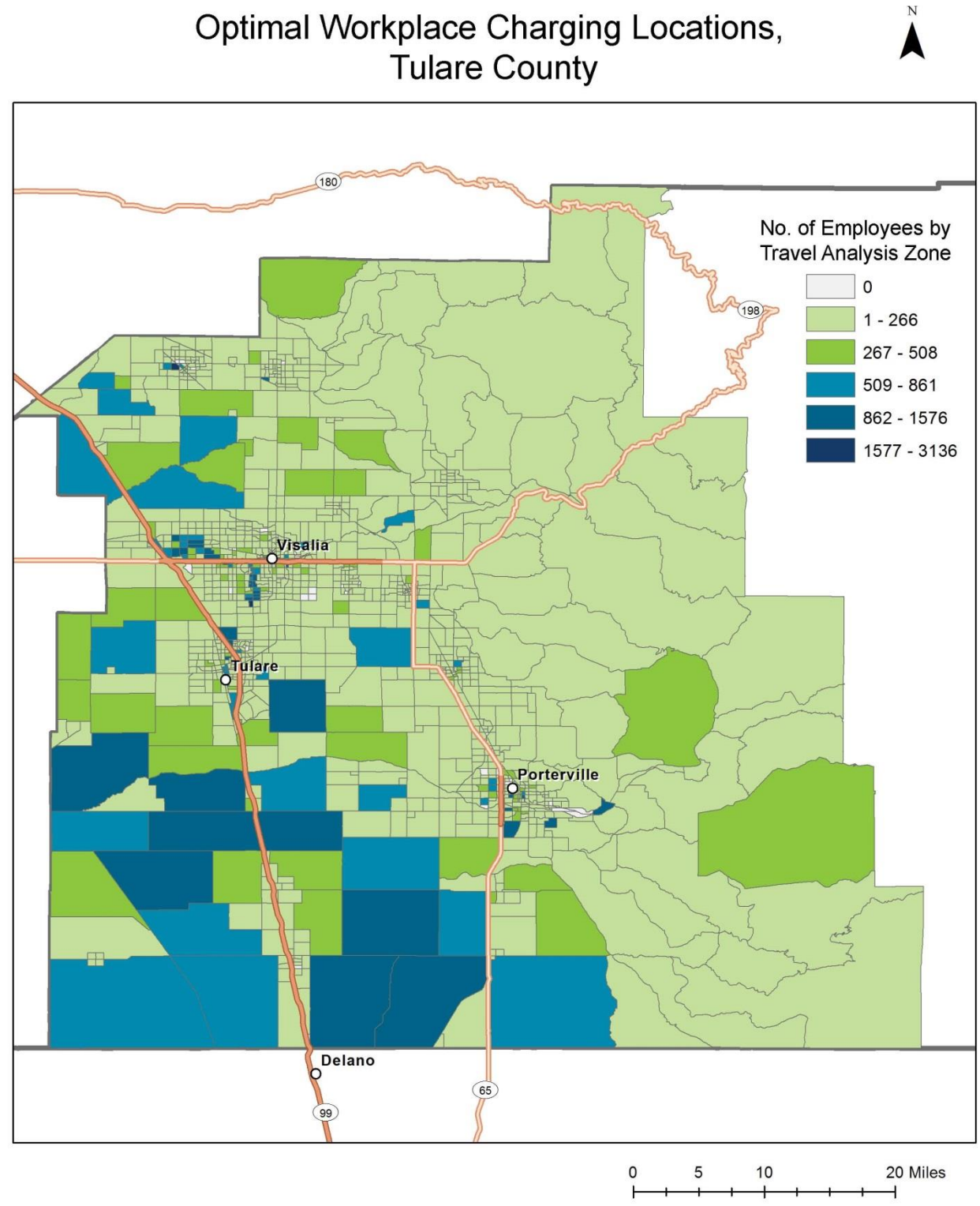
0 0.75 1.5 3 Miles

Optimal Workplace Charging Locations, Fresno County



Optimal Workplace Charging Locations, Kern County




Optimal Workplace Charging Locations,
Tulare County
N
No. of Employees by
Travel Analysis Zone
0
1 - 266
267 - 508
509 - 861
862 - 1576
1577 - 3136
180
198
Visalia
Tulare
Porterville
Delano
65
99
0
5
10
20 Miles

V. Data Limitations

A major limitation in the analysis was the lack of consistency among TAZ data provided by regional COGs. The original goal was to obtain TAZ data with information about vehicle trips per day along with land use information to identify where commercial and workplaces clustered. Mapping vehicle trips per day reveals information about how often destinations are visited, which, in turn, show specific areas that may experience more potential charging demand from regional PEV drivers. Some COGs were able to provide land use or trip destination data, but rarely could they offer both.

To address this inconsistency, Google Places API was used as a proxy for acquiring vehicle trip and destination data. The API was used to gather information on the location of destinations in ten Valley cities. It is assumed that areas with a higher density of destinations also experience a high volume of visitations and that PEV drivers will benefit from charging at these locations. The analysis does not take into consideration the designated land use, ownership or on-site electrical capacity for public access charging to host chargers at each location. Despite the benefits of Google's API, the dataset of destinations for each city has not been verified by another source and is not exhaustive.

Each map is intended for informational purposes only. It is encouraged that local stakeholders use these maps as a resource when planning for PEV infrastructure deployment. Ultimately, it is up to individual stakeholders to decide whether these suggested locations are feasible for EVSE installations.