



Travel Model Two: Initial Representation of Space

Technical Paper

Metropolitan Transportation Commission with Parsons Brinckerhoff, Inc.

January 17, 2013

m:\development\travel model two\supply\space\initial boundaries\2013 01 17 release initial representation of space.docx

1 Overview

This paper describes the motivation for the initial representation of space for *Travel Model Two*. For more information on the broader Travel Model Two Supply Development effort, please see the [*Travel Model Two: Strategic Design Technical Paper*](#).

Travel models generally segment space into “analysis zones”. As described in the Strategic Design paper, *Travel Model Two* will have two, nested zone systems. The first and larger system will be used to represent the movement of automobiles and its units are referred to as “travel analysis zones” or TAZs. To facilitate efficient model computations, fewer than 6,000 TAZs are preferred. The second and smaller system will be used to represent the movement of people (as well as the short-distance movement of automobiles) and its units are referred to as “micro-analysis zones” or MAZs. The impact of the number of MAZs on computational effort is minor, but we felt ~80,000 to 100,000 MAZs would provide the region sufficient spatial fidelity.

Here we present the initial representations of space. These representations are intended to be a first pass for our partner agencies to review and discuss. Feedback from our partners will be incorporated into a forthcoming final representation of space.

The TAZ and MAZ systems presented here began with geographies defined for the 2010 Decennial Census. Census blocks are the smallest geographic area the Census uses for data tabulation. Census blocks vary in size, but in central business districts they are generally the size of a city block. Blocks were used as the basis for the MAZs. Census block groups are collections of blocks and, in turn, census tracts are collections of block groups. Block groups were used as the basis for the TAZs. Since there were 109,790 blocks and 4,756 block groups, the numbers were in line with the initial targets of 80,000-100,000 MAZs and 4000-6000 TAZs suggested in the Strategic Design paper.

A count of MAZs, TAZs, blocks, and block groups by county is shown in Table 1 below. As expected, the average zone size varies by county. The more urban counties tend to have a smaller median zone size than the rural counties. All counties have some large zones in the hills, which gives the size distributions long right tails (i.e., the mean is greater than the median). Table 2 presents the mean and median MAZ and TAZ size in acres.

Table 1: Zone Counts by County

County	Census Blocks	Micro-analysis Zones (MAZs)	Census Block Groups	Travel Analysis Zones (TAZs)
Alameda	24,063	14,029	1,047	1,020
Contra Costa	18,353	12,425	637	619
Marin	4,506	2,512	175	172
Napa	2,771	1,351	106	98
San Francisco	7,425	5,145	581	573
San Mateo	9,274	7,210	463	408
Santa Clara	22,440	12,871	1,075	1,002
Solano	10,458	5,282	285	266
Sonoma	10,440	5,432	387	351
<i>Bay Area</i>	<i>109,730</i>	<i>66,257</i>	<i>4,756</i>	<i>4,509</i>

Table 2: Zone Size by County

County	Micro-analysis Zones (MAZs)		Travel Analysis Zones (TAZs)	
	Mean (acres)	Median (acres)	Mean (acres)	Median (acres)
Alameda	32	5	446	88
Contra Costa	39	6	788	177
Marin	139	10	2,036	321
Napa	370	12	5,106	285
San Francisco	6	4	57	32
San Mateo	40	5	706	125
Santa Clara	65	8	834	127
Solano	107	9	2,125	176
Sonoma	191	12	2,953	237
<i>Bay Area</i>	<i>69</i>	<i>6</i>	<i>1,009</i>	<i>120</i>

2 Zone Creation Process

2.1 Micro-analysis Zones

The Census block layer was reviewed and edited to create the MAZs. An initial review of the blocks revealed that many were very small and irregular. These shapes were aggregated with other zones, and, when necessary, the boundaries were edited. This process reduced the number of zones by approximately 40,000.

Figure 1 and Figure 2 show an example of an interchange where there are very small, irregular blocks around the road geography. In this example, there is limited activity locations (e.g., households or places of business) in some of the zones. Since MAZ boundaries should contain homogenous land uses, small zones like these were aggregated into larger and more regular shapes.

The process to create the MAZ zone system and reduce the number of small or irregular zones was highly manual. Figure 3 shows an example of how Census blocks were aggregated to create the MAZs. It provides an example of a so-called 'island' zone, in which a zone is completely contained within another zone. Zones with similar land use were aggregated to create more regular shapes. In this particular example, the block groups were not aggregated to create the TAZ zone layer.



Figure 1: Road Census Geography Example



Figure 2: Road Zone Geography Example

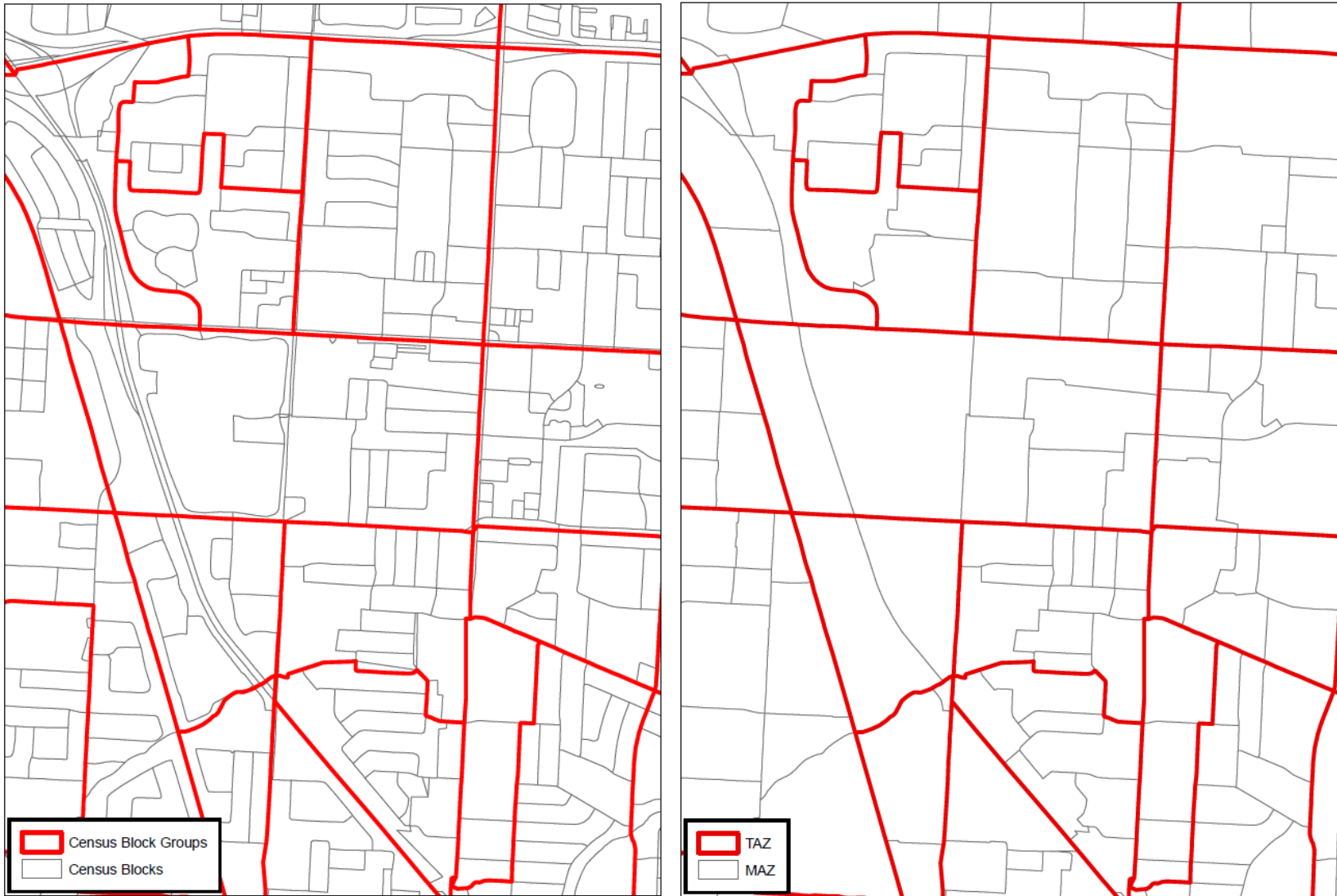


Figure 3: Census and Zone Geography

The Census block geography extends into the ocean. Large blocks encompassing just ocean and containing no activity were removed from the zone system. Figure 4 shows some of these large Census blocks off the west coast of San Francisco.



Figure 4: Ocean Zones

2.2 *Travel Analysis Zones*

The process to create the TAZ layer was similar to the MAZ process. Due to the larger sizes of the Census block groups, the share of irregular zones is smaller. Figure 5 shows an example of a small block group that was almost entirely encompassed by another. The two were aggregated together to create one TAZ. Block group geography was also manually edited similar to the block geography when a zone was highly irregular, though such occurrences were rare.

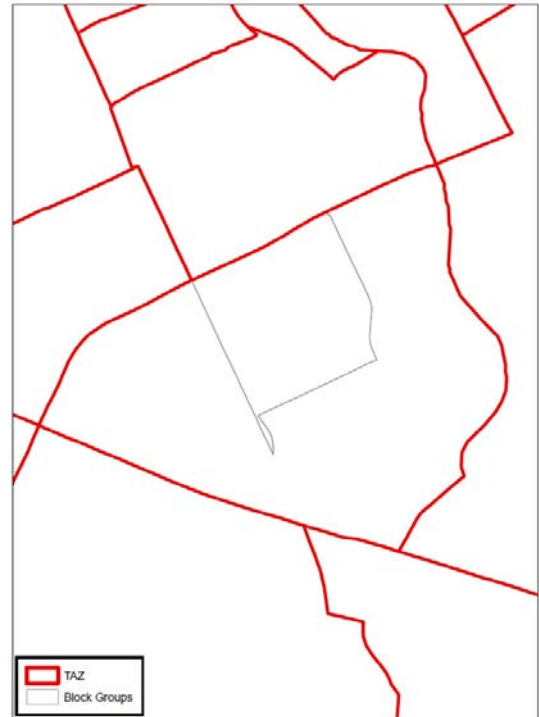


Figure 5: TAZ Aggregation

2.3 Centroids

After creating the MAZ and TAZ layers, draft centroids were created for each layer. The centroid for each zone was initially generated at the geographic center of each shape, and then it was manually moved in cases where it was not located near the activity center of the zone. As we refine our representation of the roadway network, we will update the location of MAZ and TAZ centroids. Figure 6 shows an example of the MAZ and TAZ centroids. Note that for the TAZ in middle of the image, the MAZ centroids are located in the middle of the MAZs. In these cases, the geographic center is used because these are fairly uniform zones. Because the TAZ in the middle of the image encompasses suburban households as well as the Sunset Reservoir, the activity center is over the homes, not the water, and therefore the TAZ centroid was moved accordingly.



Figure 6: TAZ and MAZ Centroids

3 Review

Basic checks were performed on the data to identify irregularly shaped and/or very small MAZs. Because the Bay Area is very large and the geographic details highly local, our primary review will be accomplished via the assistance of our county partners. We will rely on them to review the work done to date and provide suggestions for changes to these initial boundaries.

Below are some guidelines for reviewing the MAZ and TAZ layers. We have created a series of on-line, editable maps¹ that should allow for feedback to be efficiently transmitted from our partners to the project team. When reviewing the layers, we ask our partners to consider the following:

3.1 *Micro-analysis Zones*

- MAZs are intended to model non-motorized travel (i.e., walk, bike, and walk to/from transit). Therefore, MAZs in areas where there is a significant amount of walk travel should be small enough to walk across.
- MAZs should encompass similar land uses so that measures of density and land use mix are meaningful. For example, if one zone has two distinct areas, one with housing and one with employment, each distinct area should be a separate MAZ.
- For areas in which development is anticipated, please suggest segments of larger MAZs that should be separate MAZs.
- Our review likely missed a large number of irregularly shaped census blocks, which we converted to MAZs. These MAZs should be tagged for review.
- MAZs that only encompass a roadway element (e.g., a rectangular-shaped MAZ that covers a freeway and no open space, buildings, or households) should be combined with neighboring MAZs.
- MAZ boundaries should generally not cross streets, unless the street is a very low volume road or alley. If MAZs encompass land on either side of a higher-level street, they should be split.
- MAZ centroids should be the center of activity for people, i.e. where people entering the zone want to go.

3.2 *Travel Analysis Zones*

- TAZs are intended to model automobile travel. Therefore, they can be much larger than MAZs since automobile impedance is less sensitive to small differences in zone size/shape.
- TAZs should encompass TAZs of similar land uses so that measures of density and land use mix are accurate.
- For areas in which development is anticipated, reviewers should suggest segments of larger TAZs that should be separate TAZs.
- TAZs with a highly irregular shape should be tagged so they can be fixed.
- TAZ boundaries should generally not cross freeways or major arterials. They should be bounded by roads used by regional travelers and/or natural boundaries.
- TAZ centroids should be the center of activity for automobiles, i.e. where automobiles entering the zone want to go.

¹ Links to the maps are available here: <http://analytics.mtc.ca.gov/foswiki/Main/Development>.

4 Supporting Files

The following scripts were used for data processing:

- 1) Dissolve.py – ArcPy script used to dissolve edited block shapes into MAZ and calculate X and Y coordinates for the MAZ and TAZ centroid shapefiles.
- 2) Zone_checks.R – R script used to verify consistency between MAZ and TAZ zones and centroids.

The following ArcGIS MXD files and shapefiles contain the zone and centroid systems for each county:

- 1) <county>.mxd
- 2) <county>MAZ.shp
- 3) <county>TAZ.shp
- 4) <county>Centroids.shp
- 5) <county>TAZCentroids_sp.shp

Shapefiles are projected in 1983 State Plan California VI US Feet. The fields in each shapefile are in Table 3 below.

Table 3: Shapefile Dbf Fields

File	Field Name	Description
<county>MAZ.shp	MAZ	MAZ Number
<county>TAZ.shp	TAZ	TAZ Number
<county>Centroids.shp	MAZ	MAZ Number
	POINT_X	X coordinate of centroid
	POINT_Y	Y coordinate of centroid
	COUNTY	County ID code: 1 Alameda 2 Contra Costa 3 Marin 4 Napa 5 San Francisco 6 San Mateo 7 Santa Clara 8 Solano 9 Sonoma
	N	Node number of centroid
<county>TAZCentroids_sp.shp	TAZ	TAZ Number
	POINT_X	X coordinate of centroid
	POINT_Y	Y coordinate of centroid
	COUNTY	1 digit County ID code
	N	Node number of centroid