Estimation Procedure of Various Measures of Effectiveness (MOE) for Transportation Investments

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Evaluating Community Building Effectiveness of Transportation Investments: Using Traditional and Big Data Oriented Analytical Approaches

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1 BACKGROUND

1.1 Transportation Infrastructure

According to Florida Chamber of commerce, Florida ranks number one in the US in terms of transportation infrastructure rankings. It is the third largest state by population, after California and Texas with a yearly growth rate of more than 1.5%. Orlando is the most thriving city of the region; its growth being bolstered by its job creation rate (1,000 jobs are added per week). The economic and demographic trends suggest that Orlando has an expanding consumer market and these trends are set to drive increased demand for passengers and freight transportation in the coming years. To accommodate the future demand in an efficient and sustainable manner, several small and big transportation projects are underway in the region including second phase of SunRail commuter rail extension, I-4 expansion, pedestrian and bicycling facility installation, and bicycle sharing system (Juice) introduction. The proposed research effort is geared towards examining the community impacts of three transportation infrastructure investment projects: SunRail, I-4 expansion, and JUICE Orlando bikeshare system (see Figure 1).

1.2 MOE Computation

The development of the MOEs is a data intensive process. The process involves collection of appropriate data from different sources, extracting data for the geographic regions under study, and eventually combining layers of data as needed. Informed from the literature review, we propose five MOEs to evaluate the community building effects of the major transportation investment projects currently underway in the Central Florida Region. The proposed MOEs are:

- Property value change
- Changes to job accessibility
- Commuting time change
- Land use type change
- Changes to travel patterns for zero car households

The proposed changes will be evaluated for the time period 2011-2017. For sake of brevity, we present the layer preparation steps for 2012. The procedure was repeated for the entire time period of analysis. For job accessibility, commuting time and zero car household pattern based MOEs, data for 2017 was unavailable and the analysis was conducted from 2011-2016.

The development of these MOEs is a data intensive process. These indicators/measures can be developed by collating appropriate data collected from different sources using the ArcGIS platform. In this deliverable, we discuss the data preparation steps, MOE computation process.

1.3 Current Study

The development of above MOEs is a data intensive process. These indicators/measures can be developed by collating appropriate data collected from different sources using the ArcGIS platform. In this report, we discuss the data preparation steps, MOE computation process using ArcGIS and SPSS.

The proposed MOE changes will be evaluated for the time period 2011-2017 and also for all three transportation infrastructure (SunRail, I-4 ultimate and JUICE Orlando Bikeshare system). For sake of brevity, we present the layer preparation steps for 2012 and for SunRail stations only.

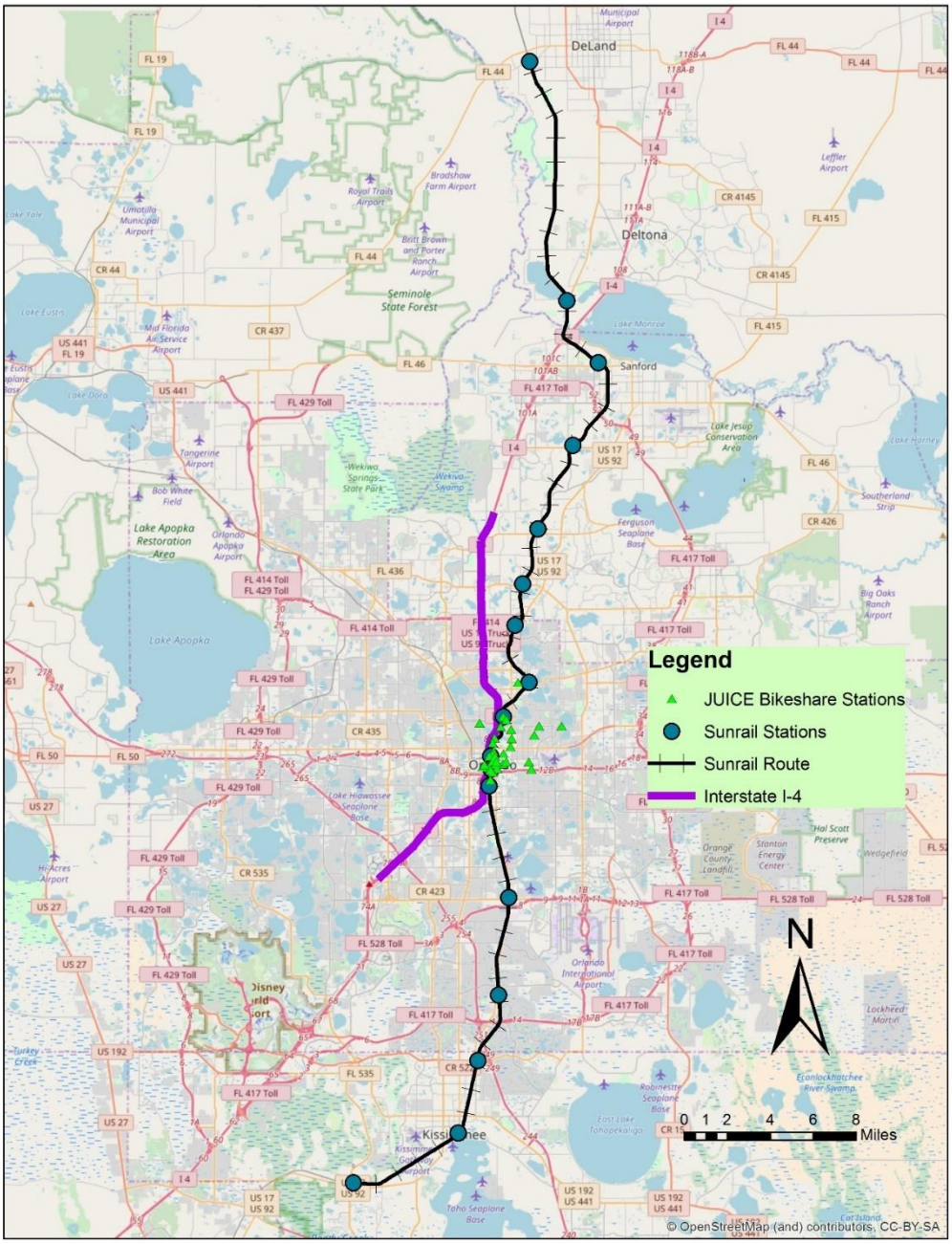


Figure 1: Major Transportation Investment Projects (SunRail, I-4 Expansion and JUICE Bikeshare) in Central Florida Region

2 PROPERTY VALUE ESTIMATION BY LAND USE TYPE

To estimate the property value for different use type, county 'Parcel' data were used. Several data preparation steps were followed for estimating the property value by using GIS. Here, we will give a brief description of estimation steps of property value using GIS for SunRail stations only.

2.1 Parcel Data Preparation

2.1.1 County Parcel Shapefile

- To capture the change in property value, parcel data for (2011-2017) obtained from Florida Department of Revenue (FDOR) were utilized (ftp://sdrftp03.dor.state.fl.us/Map%20Data/).
- County parcel shapefile contains unique parcels within each county that indicated by unique 'Parcel No' together with each parcel's length and area (Figure 2).

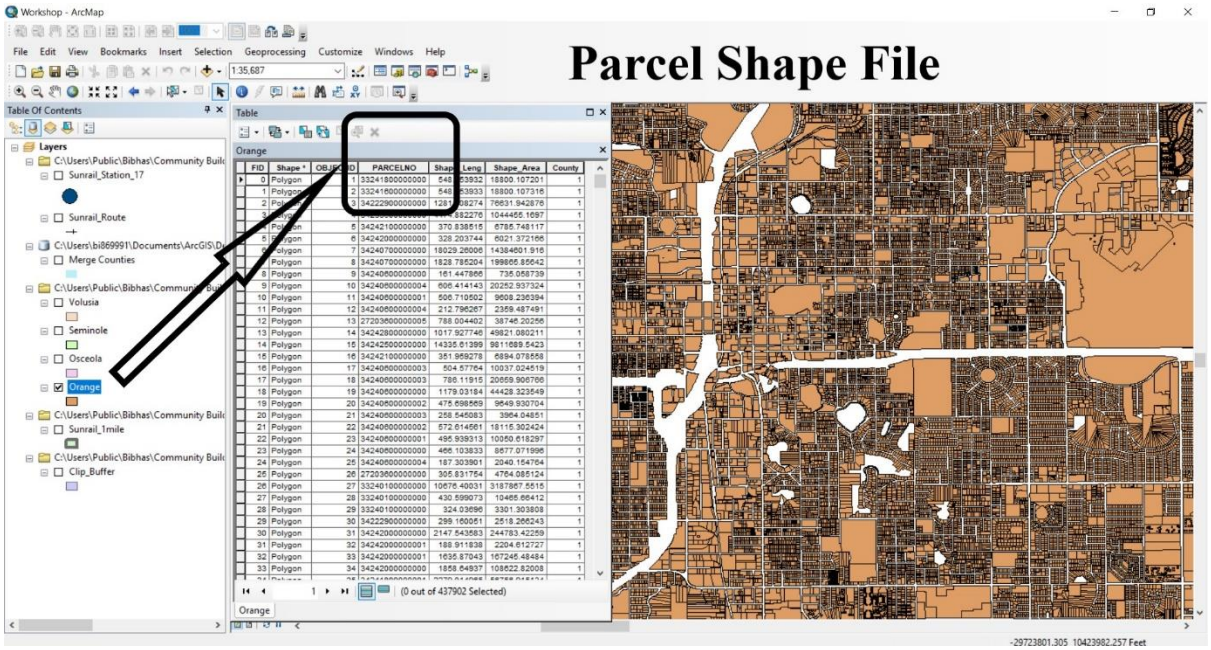


Figure 2: Parcel Shapefile

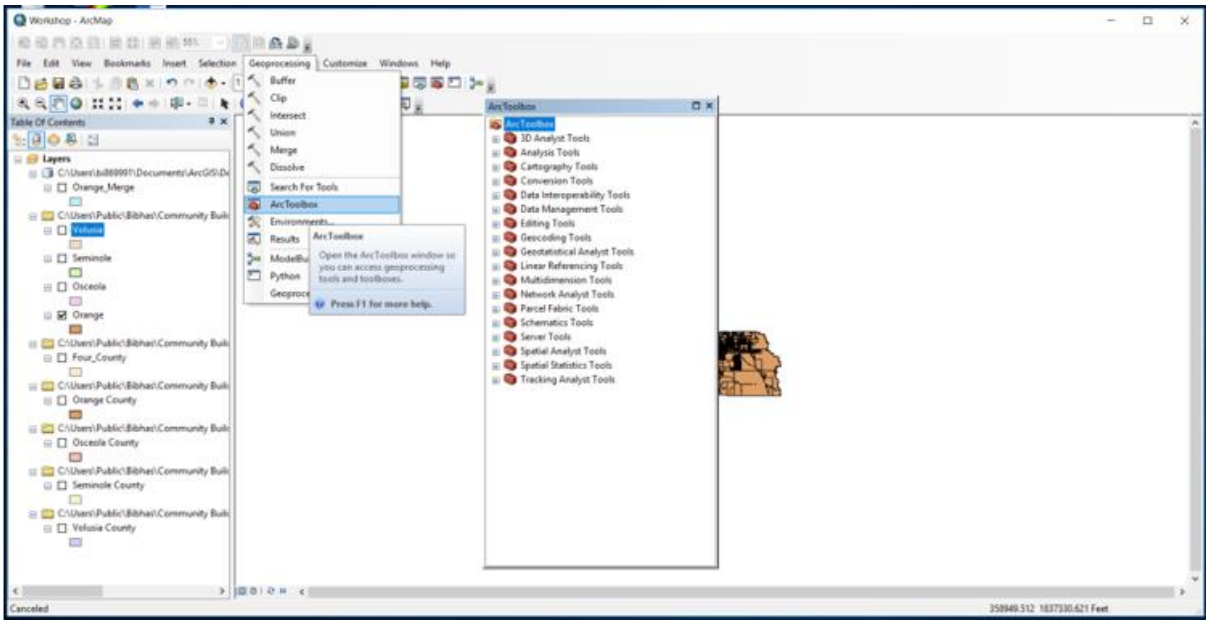
- The transportation infrastructure projects considered in our research passes through four counties: Orange, Osceola, Seminole and Volusia (See Figure 3).

Figure 3: Counties Parcel Shapefile

2.1.2 Shapefile Co-ordination System Projection

- The 1st step among all is to project all the parcel shapefile to same coordination system.
- Following are the steps to project all parcel shapefile to same coordination system:
  - ✓ 1st select Geoprocessing
  - ✓ Choose Arc Toolbox bar in Geoprocessing (See Figure 4(a))
  - ✓ Select 'Data Management Tools' (See Figure 4(b))
  - ✓ Select 'Projections and Transformations' from 'Data Management Tools'
  - ✓ Then click to 'Project' to select coordinate system

- ✓ Select county shapefile in as input features (See Figure 4(c))
- ✓ Click ‘Output Coordinate System’
- ✓ There are two coordinate systems available in Output Coordinate System – Geographic and Projected Coordinate System (See Figure 4(d))
- ✓ Select NAD 1983 within Universal Transverse Mercator (UTM) bar (See Figure 4(e))
- ✓ Finally Select NAD 1983 UTM Zone 17N that represents the infrastructure zone (See Figure 4(f))



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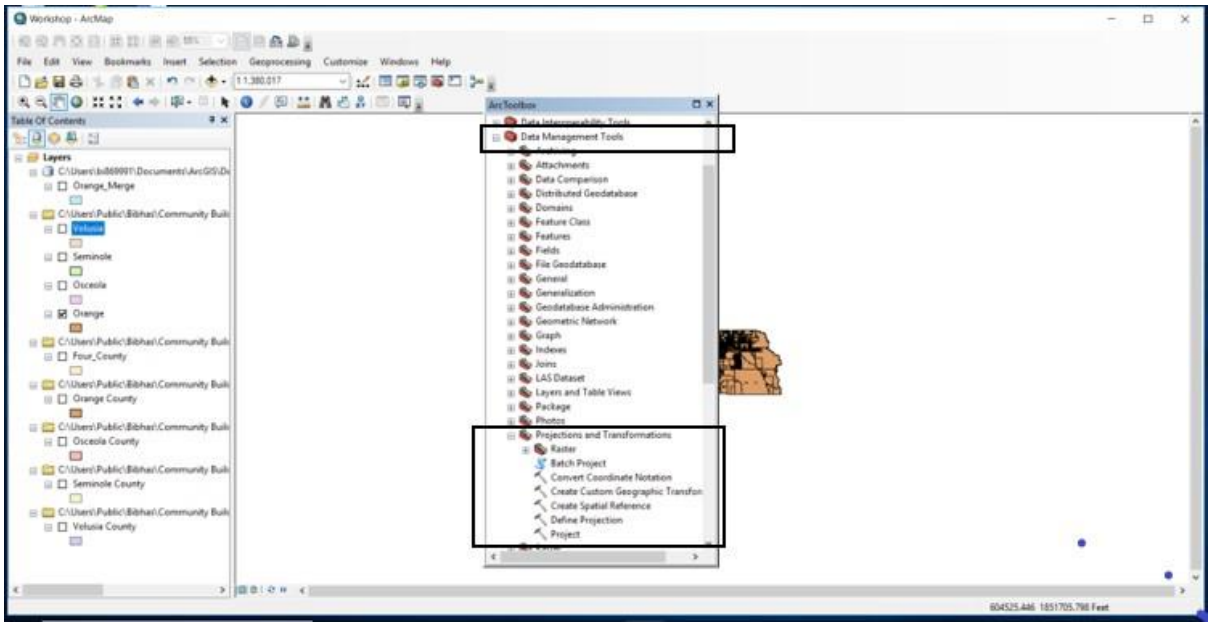

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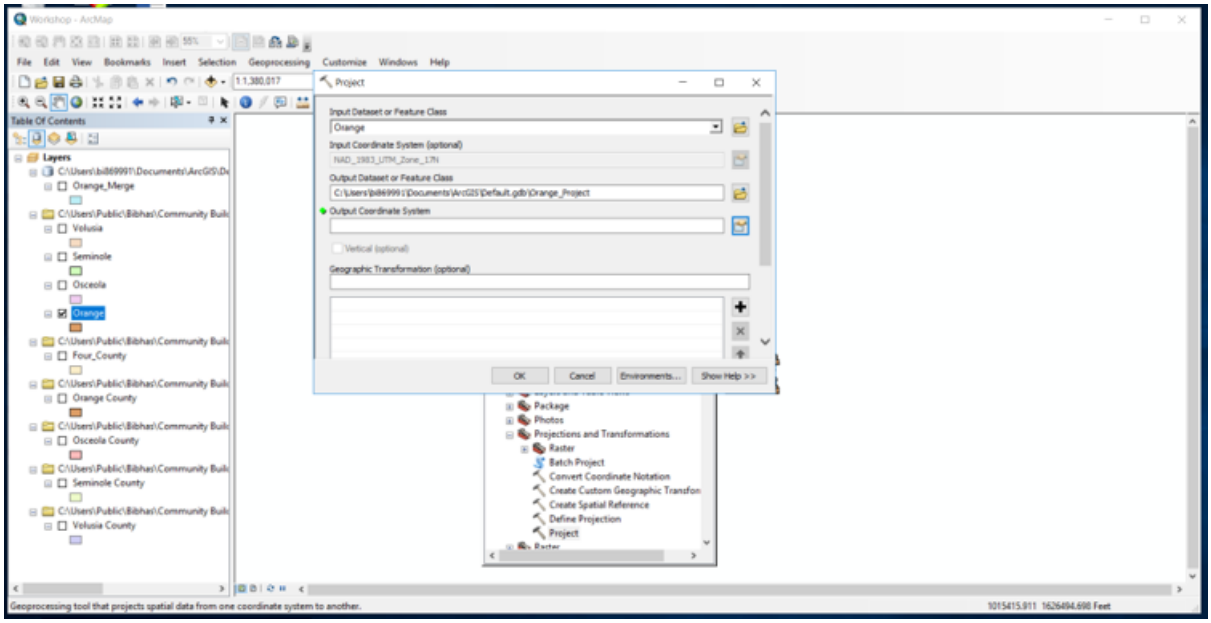
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File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
Project
Input Dataset or Feature Class
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Input Coordinate System (optional)
Output Dataset or Feature Class
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OK
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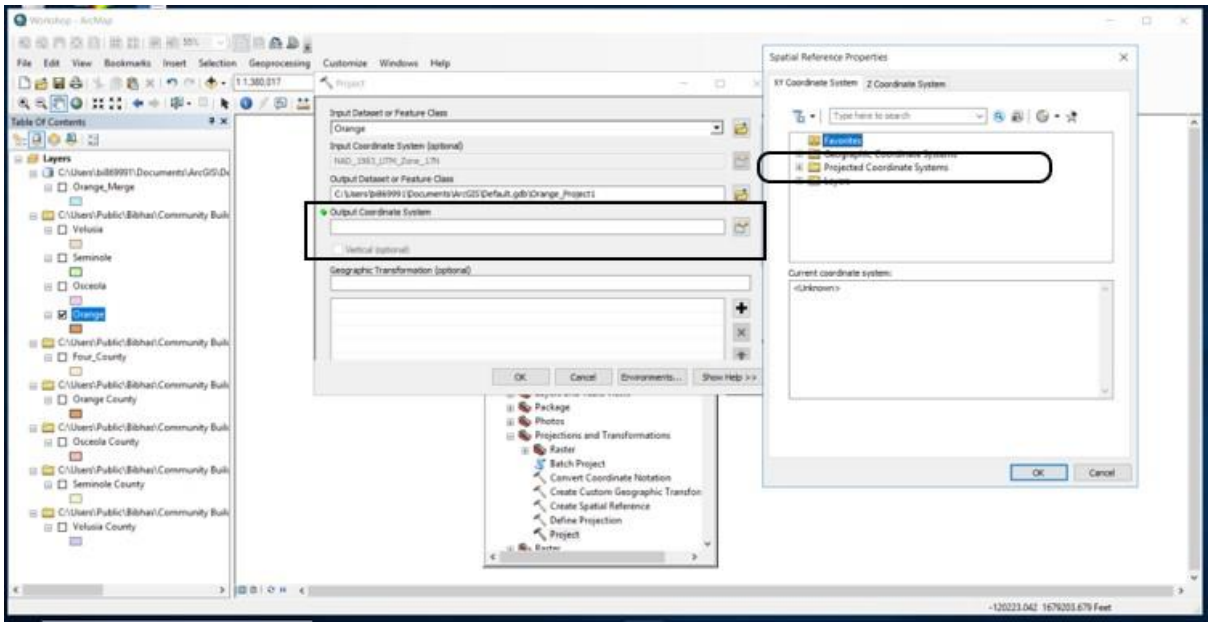
Create Spatial Reference
Define Projection
Project
Geoprocessing tool that projects spatial data from one coordinate system to another.

(c)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Raster
Batch Project
Convert Coordinate Notation
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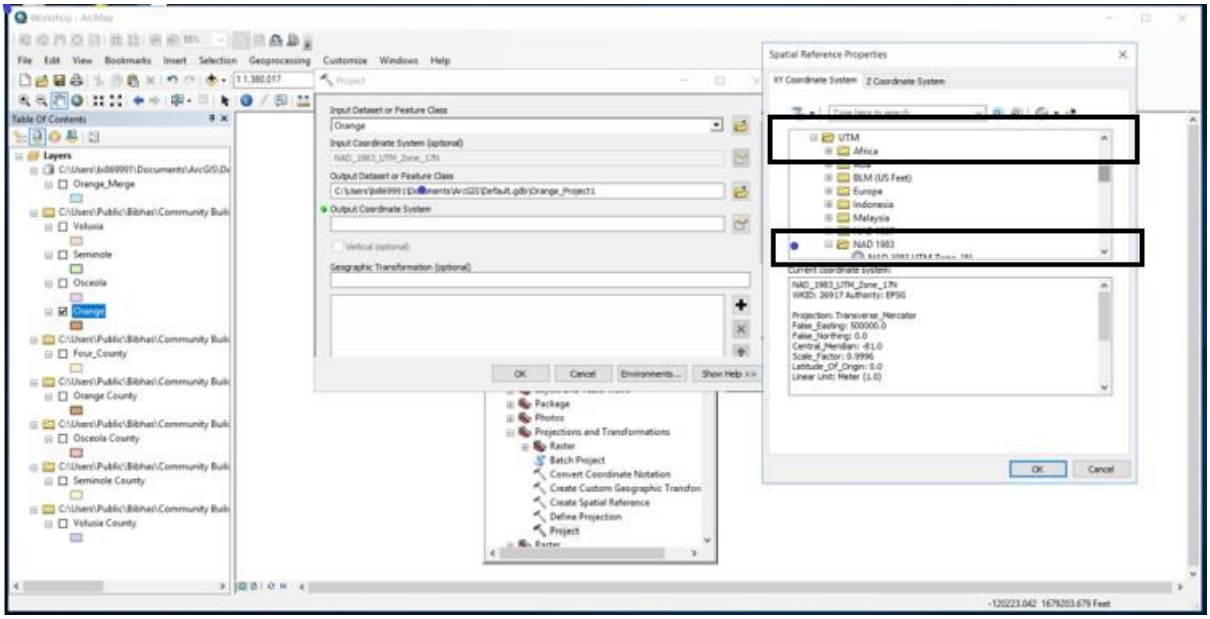
(d)



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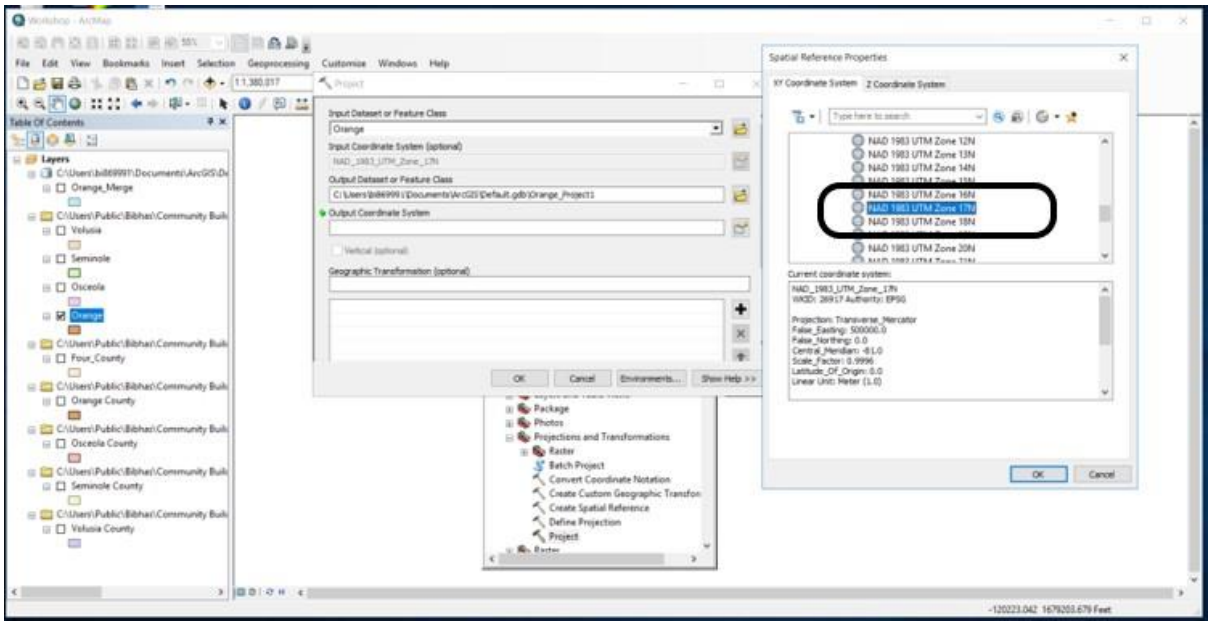


(f)

Figure 4: Projected Coordination System

2.1.3 Parcel Data Layer Preparation

- The Name-Address-Legal (NAL) file for 2011-2017 was used together with parcel level county shapefile to get the property value information for parcel level (ftp://sdrftp03.dor.state.fl.us/Tax%20Roll%20Data%20Files/).
- NAL file has unique parcel ID with equivalent parcel level attribute information such as property/feature value, land value, land area in square feet, land use codes (DOR-UC), owner name, owner address, physical address, physical zip code, building details and so on (Figure 5).
- Please note that Just Value (land just value, building value, and special feature value) of a property includes: present cash value; use; location; quantity or size; cost; replacement value of improvements; condition; income from property; and net proceeds if the property is sold. The net proceeds equal the value of the property minus 15% of the true market value. This accounts for the cost of selling the property. In calculating the change in property values, we consider Just Value reported by DOR as a surrogate measure for direct property value and in the following sections, we will refer to this value as the property value for simplicity.

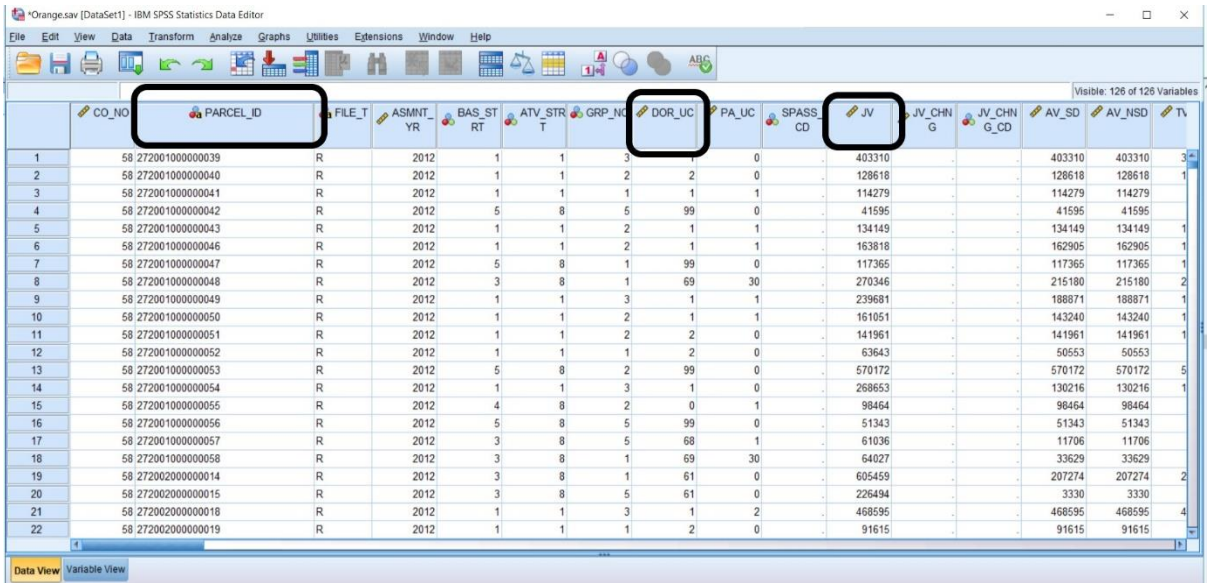


Figure 5: Name-Address-Legal (NAL) File

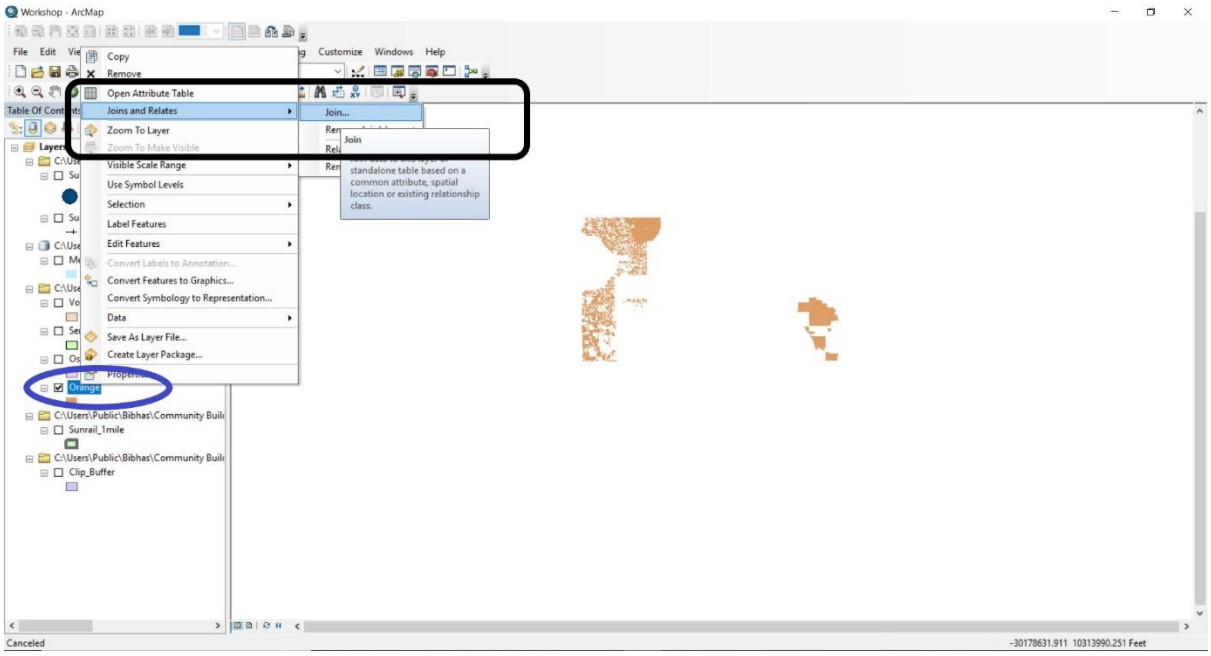
2.1.4 Merging NAL File Information

- Parcel No from county parcel shapefile contains unique parcels within each county file linking it with equivalent parcel level attribute information contained in the Name-Address-Legal (NAL) file.
- Following are the steps to linking parcel shapefile with NAL file information:
  - ✓ 1st click right cursor
  - ✓ Select 'Join and Relates' button
  - ✓ Double click on 'Join' bar (See Figure 6(a))

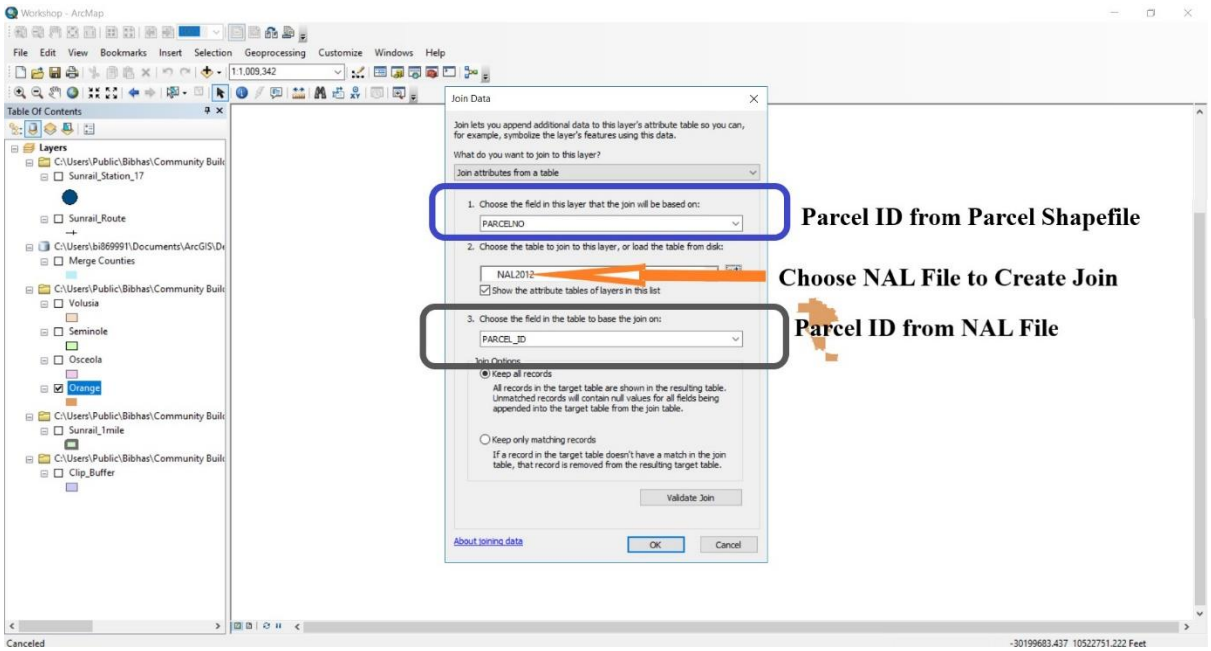
- There are three options in Join tool - 1 and 3 is the joining field option based on these options NAL file information were added to Parcel shapefile while 2 is the option where NAL file must be included (See Figure 6(b))
  - ✓ Select 'Parcel No' from Parcel shapefile in option 1
  - ✓ Choose 'Parcel ID' from NAL file in option 3

- ✓ Select NAL file for corresponding year for option 2
- ✓ Finally click Ok

- From Figure 6(c), it is clearly seen that property value (JV) and land use type value (DOR_UC) was added to shape file attributes table.
  - ✓ Select shapefile and click on right side of mouse
  - ✓ Select 'Open Attribute Table' to see the new variables



(a)



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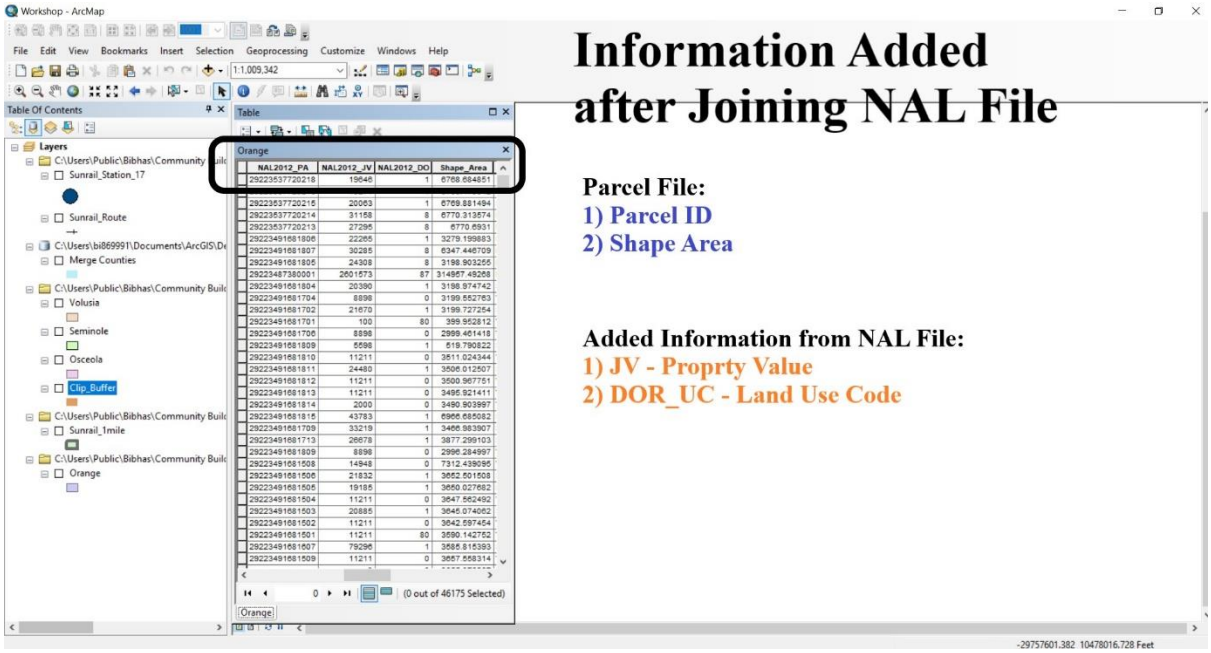


(c)

Figure 6: Adding NAL Information to Parcel Shapefile

2.2 Create Appropriate Information

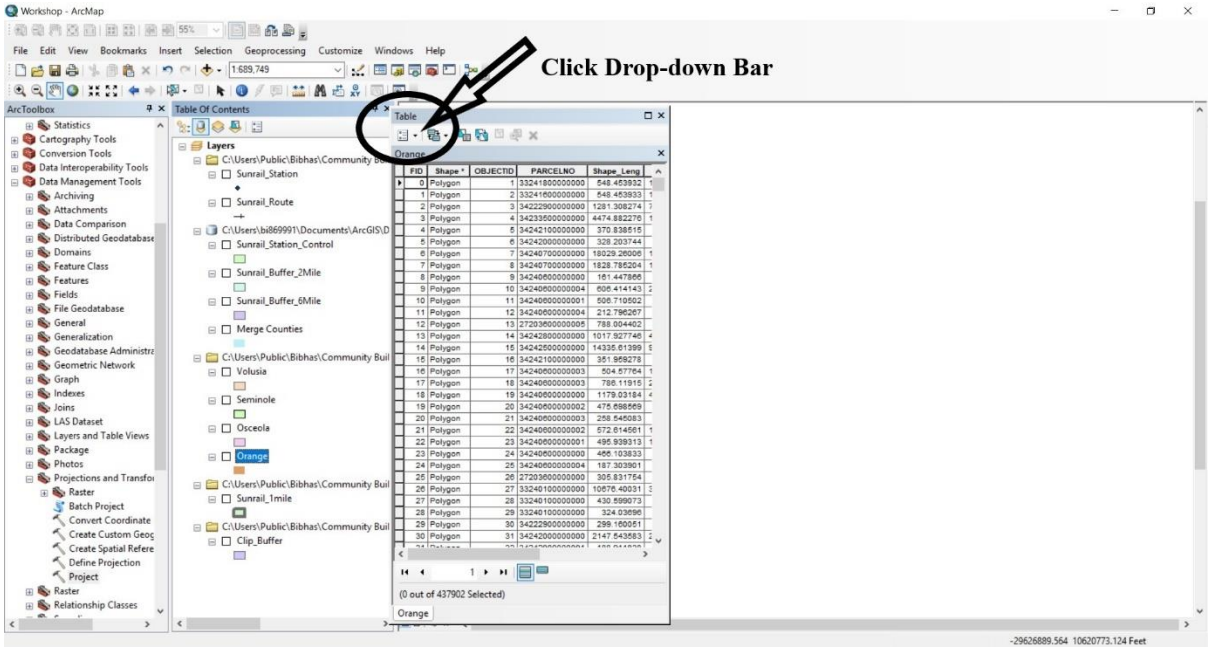
To continue further estimation, we categorized few land use types from DOR_UC (Land use value) information and area was transformed into acres unit also.

2.2.1 Land Use Type

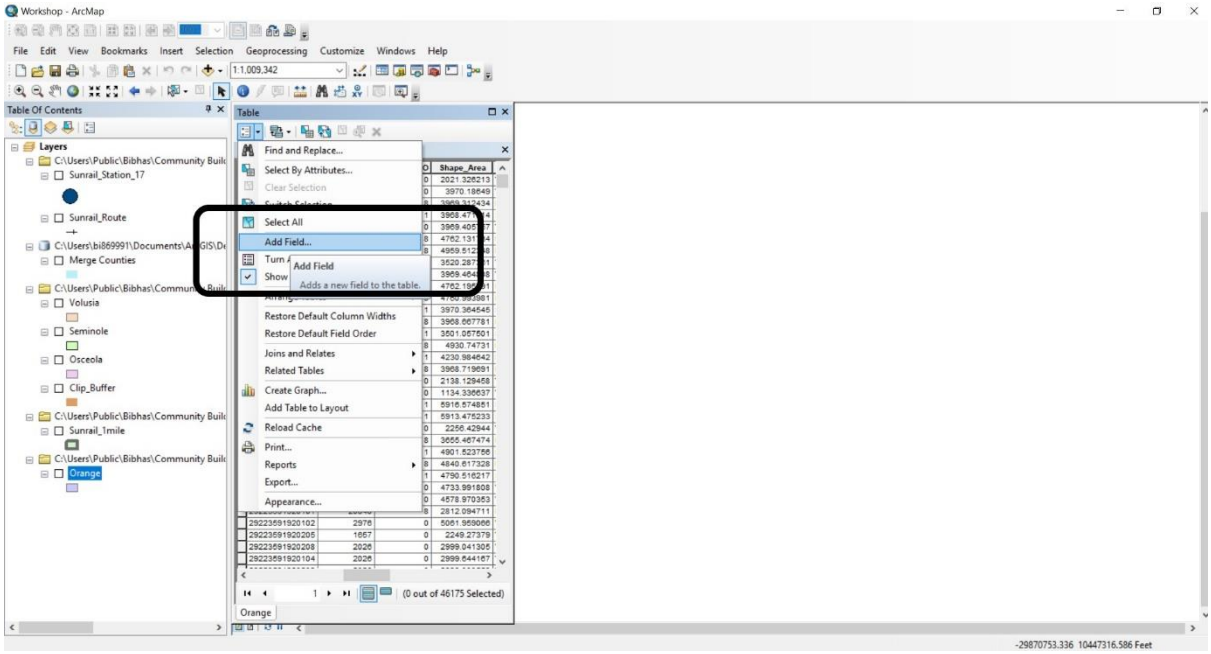
2.2.1.1 Adding New Field

Several steps were followed to categorize DOR_UC to various land use types as follows:

- Select shapefile and click on right cursor
- Select 'Open Attribute Table'
- Click drop-down bar as shown in Figure 7(a)
- Click on 'Add Field' (See Figure 7(b))
- Choose a new name as 'NAL2012_LA'
- Select variable type (See Figure 7(c))
- Select 'String' as a variable type since land use type is a string variable (See Figure 7(c))



(a)



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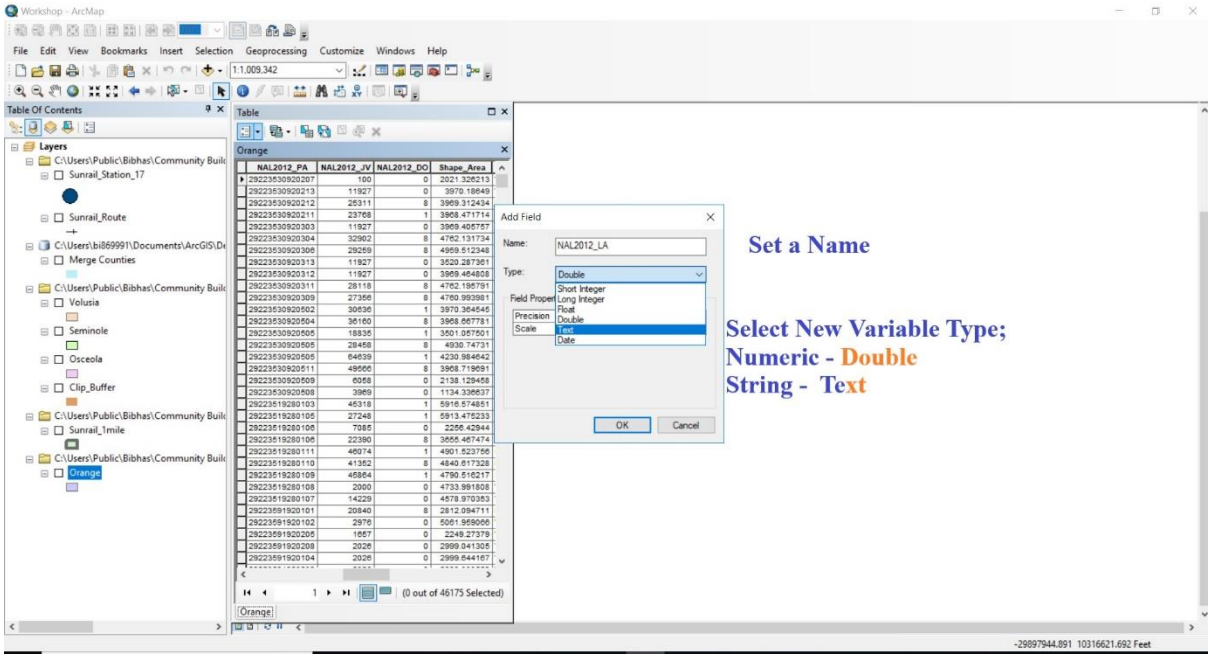


(c)

Figure 7: New Field Adding Procedure

2.2.1.2 Selection of Land Use Category

- For our analysis purpose, we consolidated the land use categories reported by DOR into 12 land use categories. These are Single Family Residential, Multi-Family Residential, Retail/Office, Industrial/Manufacturing, Agriculture, Institutional/Infrastructure, Public, Recreational, Water, Vacant, and Others (see Table 1). See Appendix A for DOR land use code.
- However, we will be reporting values for the following 5 out of the 12 categories: (1) Single family residential, (2) Multiple family residential, (3) Retail/Office area, (4) Institutional, and (5) Industrial.

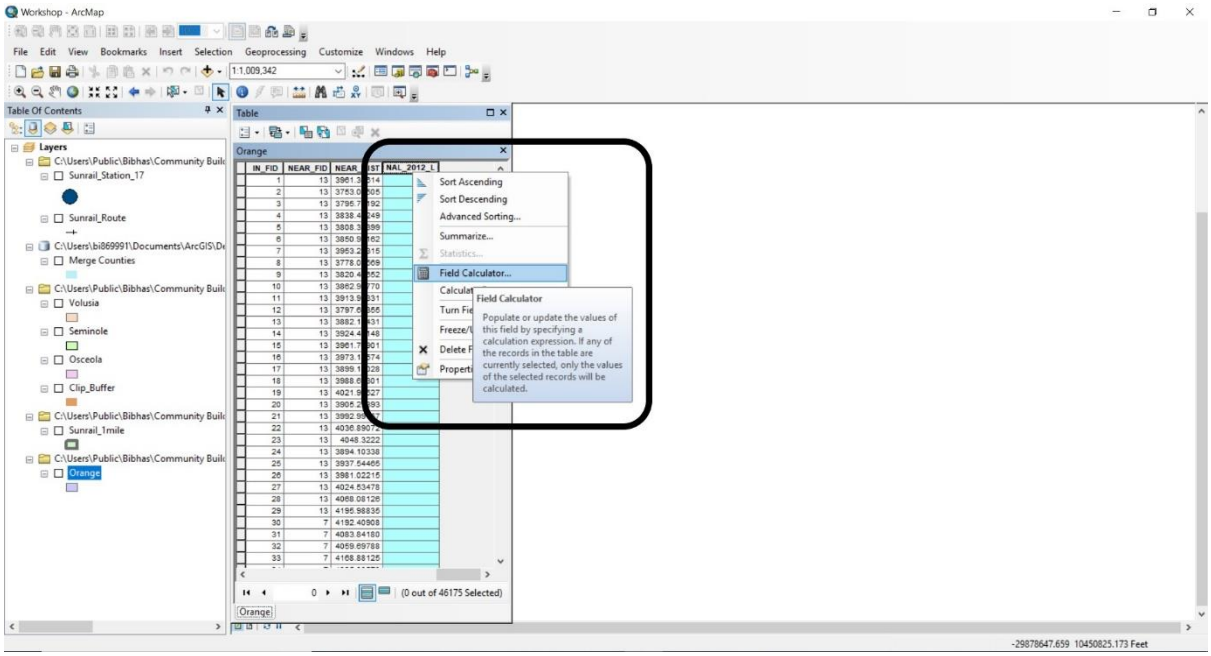
Table 1: Land Use Category Based on DOR Land Use Codes

Land Use Category	DOR Land Use Code
Single Family Residential	1
Multi-Family Residential	3,8
Other Residential	2,4-7,9
Retail/Office	11-39
Industrial	41-49
Agricultural	50-69
Institutional	71-79, 81, 84
Public	83, 85-91
Recreational	82, 97
Water	95
Vacant	0, 10, 40, 70, 80
Others	92-96, 98, 99, 100, 995, 999

2.2.1.3 Land Use Type Conversion Technique from DOR Land Value

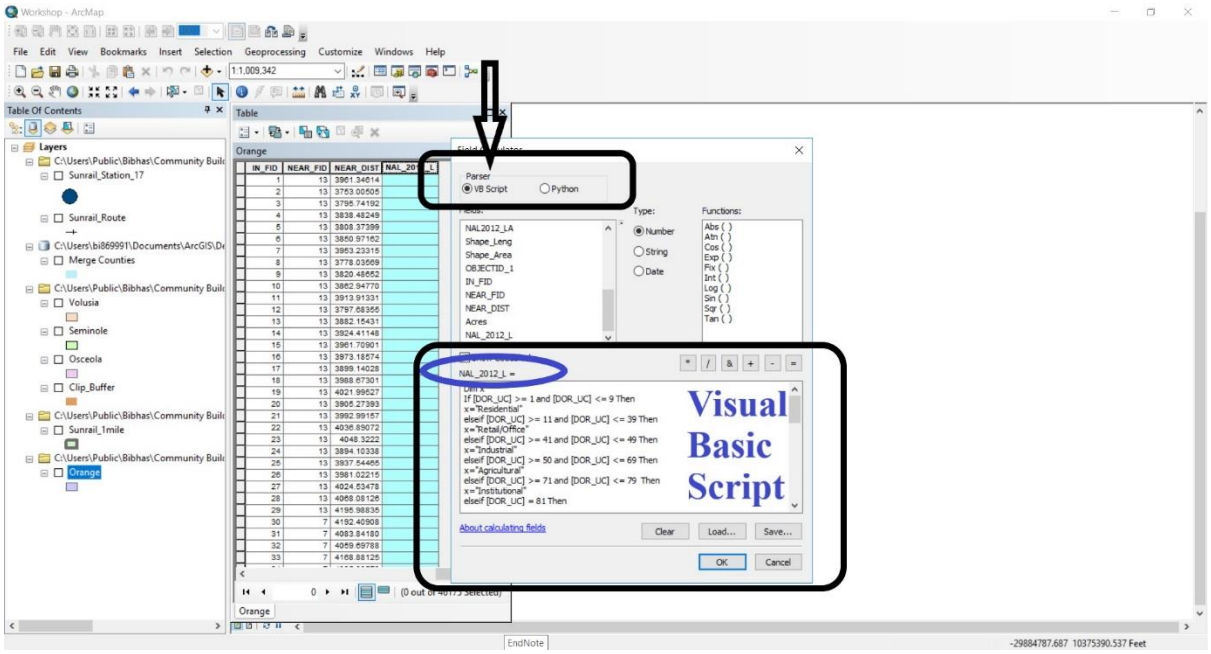
Following steps were used to convert DOR_UC land value to selected 12 land use categories.

- Select new added variable 'NAL2012_LA' and click on right cursor
- Select 'Field Calculator' (See Figure 8(a))



(a)

- One can select either Visual Basic (VB) Script or Python option
- VB Script was selected for conversion of land use type category (See Figure 8(b))
- A code was written within the box to convert DOR land value (See Table 2)



(b)

Figure 8: Land Use Type Conversion Technique from DOR Land Value

Table 2: VB Script for Land Use Type Conversion

```
Dim x
If [DOR_UC] >= 1 and [DOR_UC] <= 9 Then
x="Residential"
elseif [DOR_UC] >= 11 and [DOR_UC] <= 39 Then
x="Retail/Office"
elseif [DOR_UC] >= 41 and [DOR_UC] <= 49 Then
x="Industrial"
elseif [DOR_UC] >= 50 and [DOR_UC] <= 69 Then
x="Agricultural"
elseif [DOR_UC] >= 71 and [DOR_UC] <= 79  Then
x="Institutional"
elseif [DOR_UC] = 81 Then
x="Institutional"
elseif [DOR_UC] = 84 Then
x="Institutional"
elseif [DOR_UC] >= 85 and [DOR_UC] <= 91  Then
x="Public"
elseif [DOR_UC] = 83 Then
x="Public"
elseif [DOR_UC] >= 92 and [DOR_UC] <= 96  Then
x="Other"
elseif [DOR_UC] = 98 Then
x="Other"
elseif [DOR_UC] = 99 Then
x="Other"
elseif [DOR_UC] = 82 Then
x="Recreational"
elseif [DOR_UC] = 97 Then
x="Recreational"
elseif [DOR_UC] = 95 Then
x="Water"
elseif [DOR_UC] = 0 Then
x="Vacant"
elseif [DOR_UC] = 10 Then
x="Vacant"
elseif [DOR_UC] = 40 Then
x="Vacant"
elseif [DOR_UC] = 70 Then
x="Vacant"
elseif [DOR_UC] = 80 Then
x="Vacant"

else x=0

end if
```

2.2.2 Area Unit Conversion

2.2.2.1 Adding New Field

Several steps were followed to categorize DOR_UC to various land use types as follows (See Figure 9).

- Select shapefile and click on right cursor
- Select 'Open Attribute Table'
- Click drop-down bar
- Click on 'Add Field'
- Choose a new name as 'Area_Acres'
- Select variable type
- Select 'Double' as a variable type since area is a numeric variable

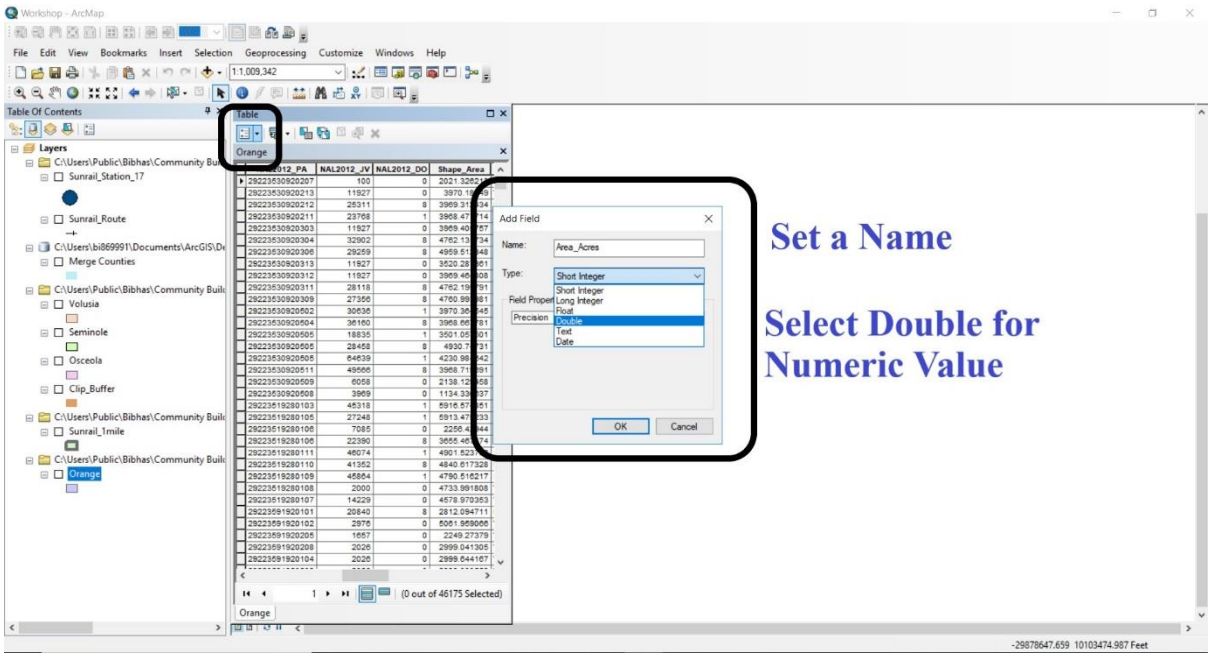
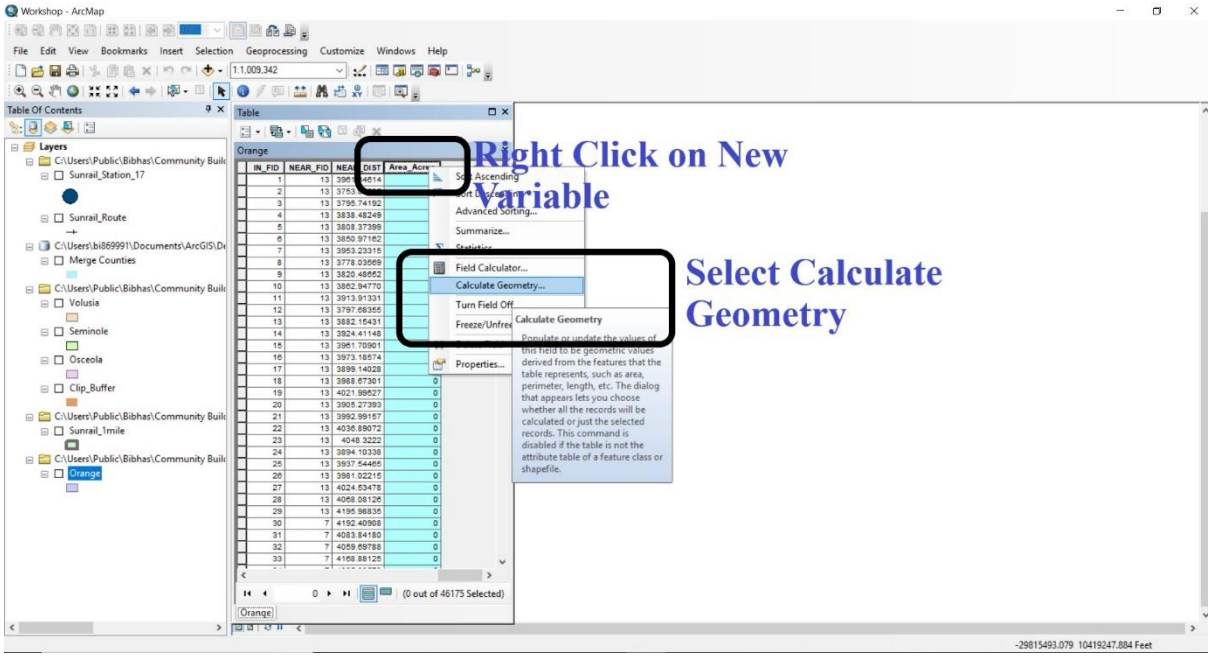


Figure 9: Area Unit Conversion

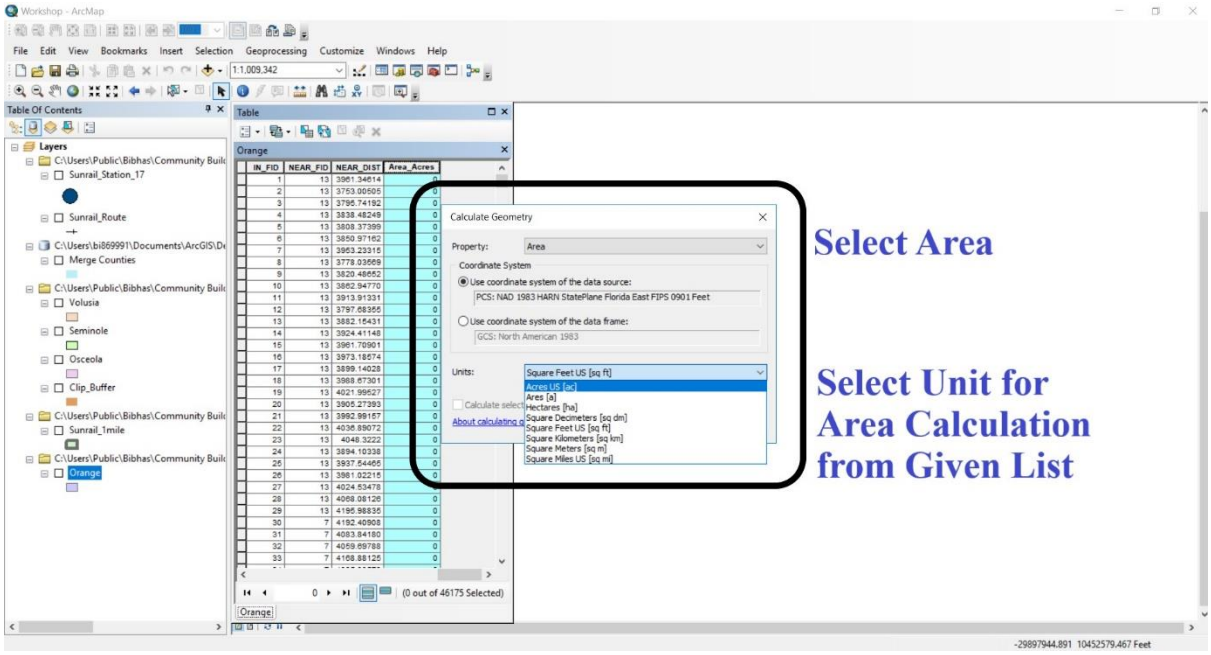
2.2.2.2 Area Unit Conversion

Following steps were used to convert shape area to new area unit such as acres.

- Select new added variable 'Area_Acres' and click on right cursor
- Select 'Calculate Geometry' (See Figure 10(a))
- Then choose Area option on top and select area unit such as Acres (See Figure 10(b))



(a)



(b)

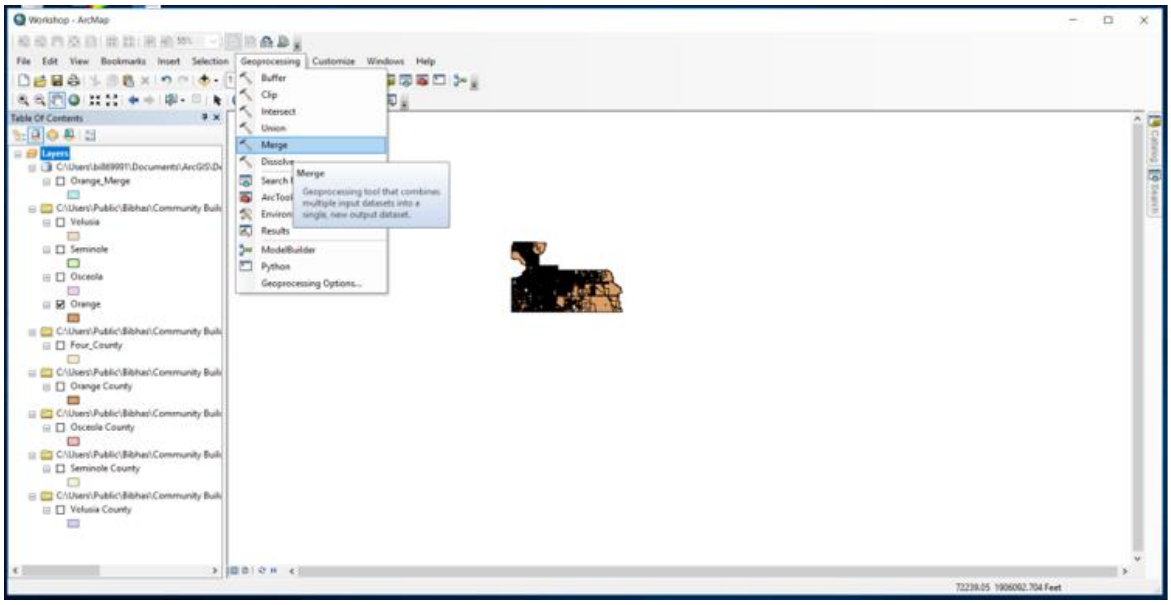
Figure 10: Area Unit Conversion

2.3 Merge Counties

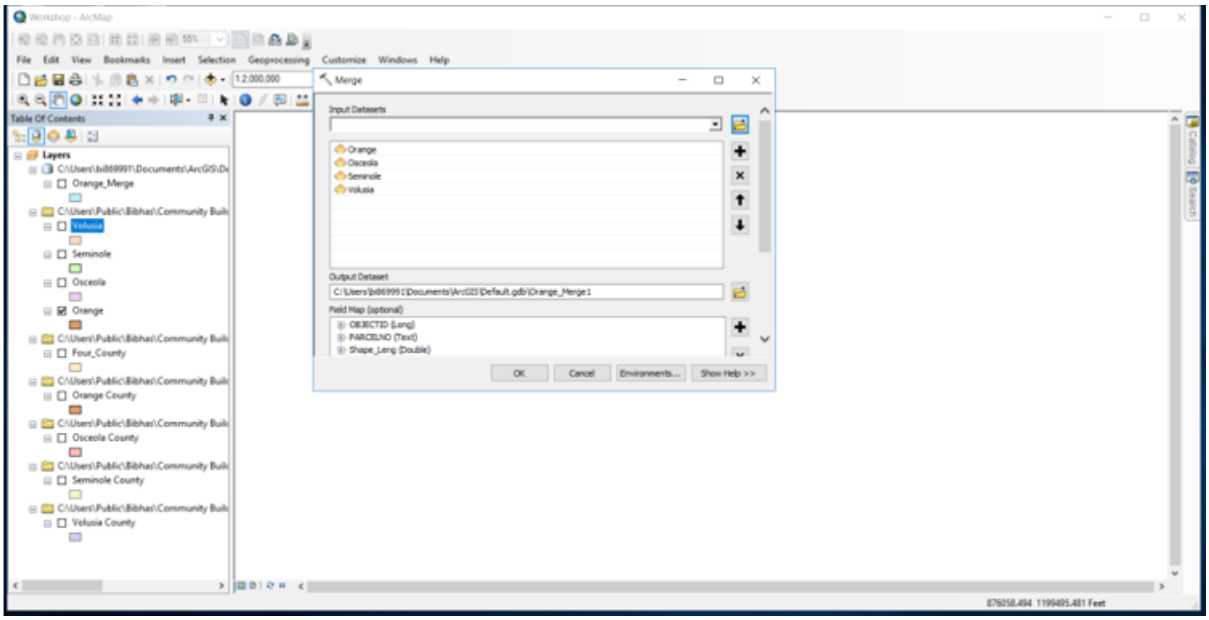
After preparing parcel data layer for all four counties (Orange, Seminole, Seminole and Volusia), a merged county shapefile was created. Following steps were followed to merge all four counties.

- At first, select 'Geoprocessing' toolbar
- Then click on 'Merge' option (see Figure 11(a))
- Then put all of the counties within 'Merge' toolbar (see Figure 11(b))
- Finally, click 'Ok'

After merge all counties a new shapefile was created (see Figure 12).



(a)



(b)

Figure 11: Merging Techniques

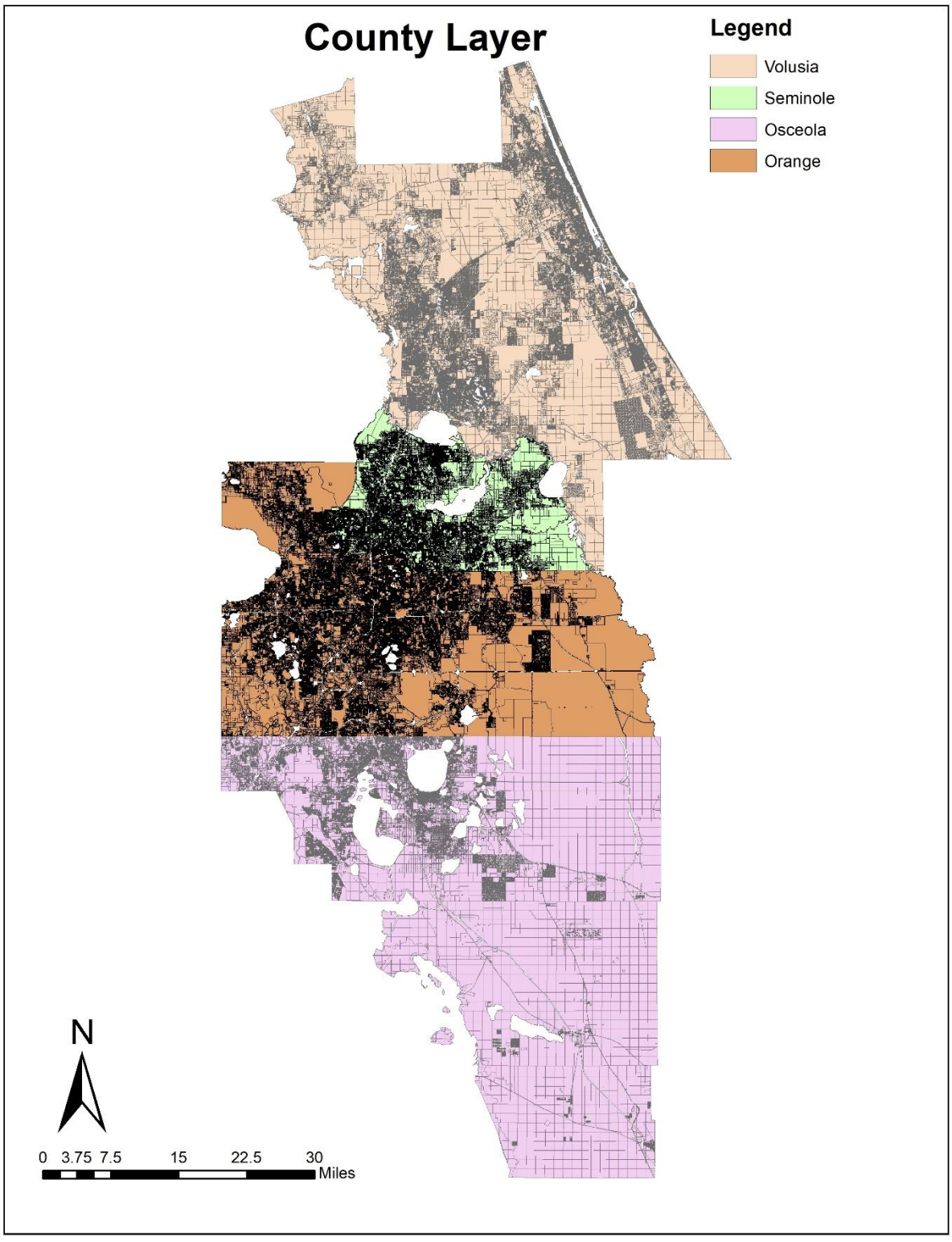


Figure 12: Merged Counties Shapefile

2.4 SunRail Stations Layer Preparation

We divided the stations into three segments: (1) Downtown Stations[1] including Lynx Central station, Church Street station, and Orlando Health/Amtrak station; (2) Outside Downtown Stations comprised of DeBary, Sanford, Lake Mary, Longwood, Altamonte Springs, Maitland, Winter Park, Florida Hospital Health Village, and Sand Lake Road stations; (3) Phase-2 stations including northbound DeLand and Southbound Meadow Woods, Osceola Parkway, Kissimmee Amtrak, and Poinciana stations. Figure 13 represents all 17 SunRail stations along with SnRail route.

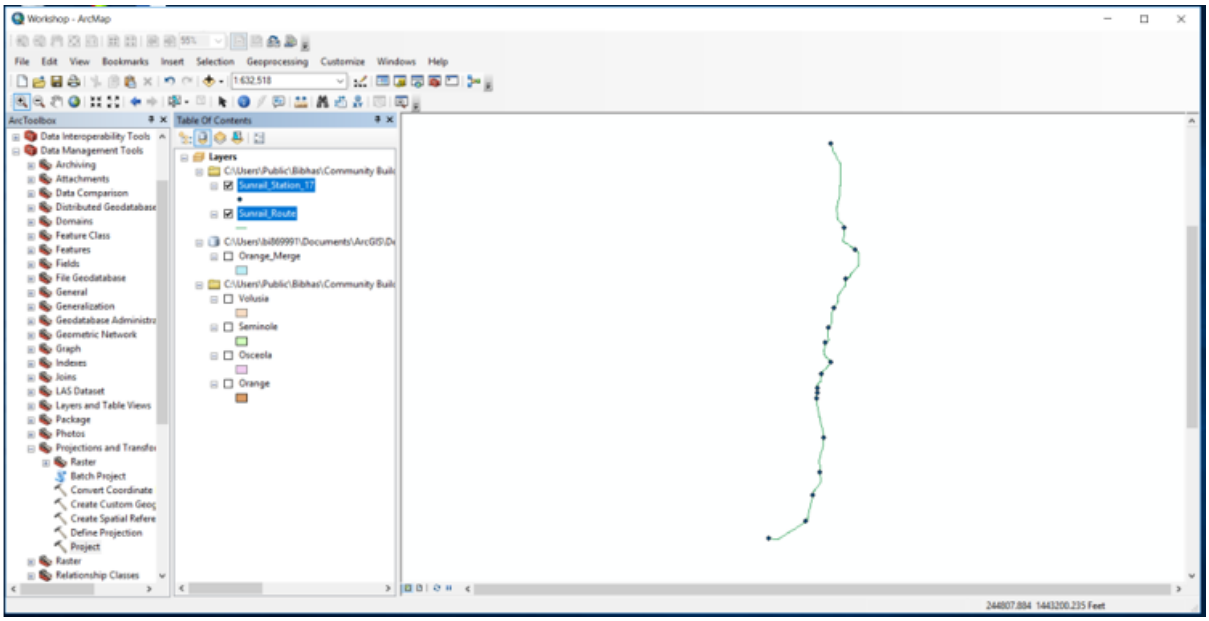


Figure 13: SunRail Staions

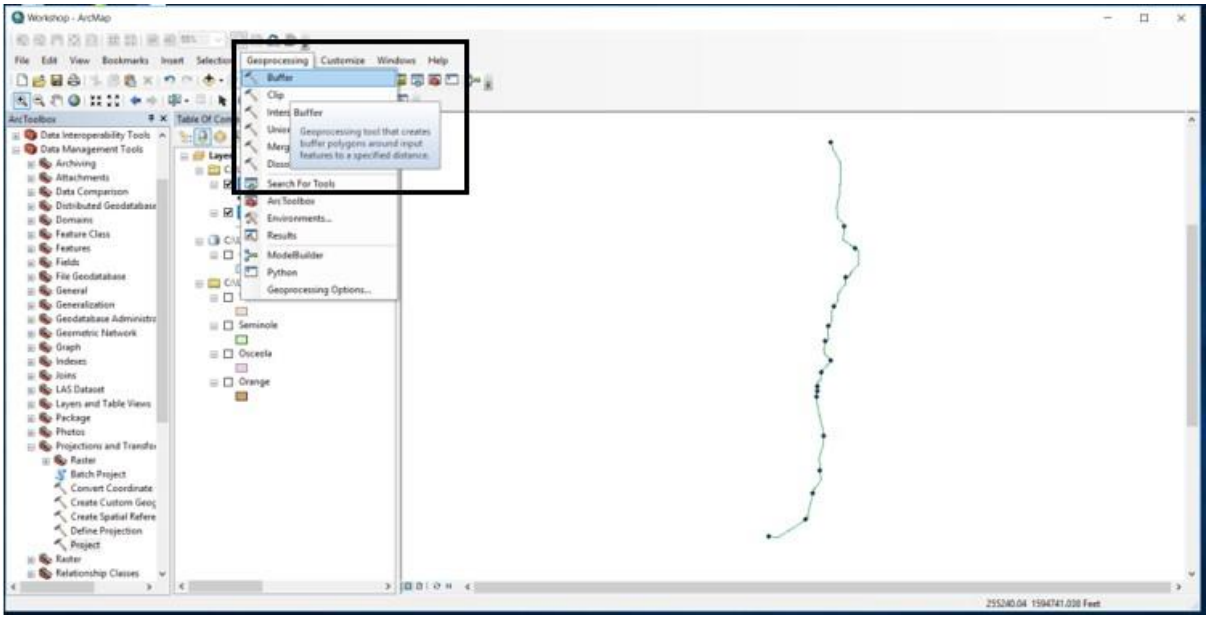
2.4.1 Case Area Selection

2.4.1.1 Creating Buffer

- At first, select 'Geoprocessing' toolbar
- Then click on 'Buffer' option (see Figure 14(a))
- Then put SunRail station's shapefile in 'Buffer' toolbar (see Figure 14(b))
- In 'Linear Unit' option put the numeric value such as 1 and choose mile as unit
- Select default buffer type 'Round'
- Finally, click 'Ok'

A new buffer map was created around SunRail stations (see Figure 14(c)).

[1]Downtown Stations are fixed based on the downtown area projected at 'I-4 Ultimate Project' construction map at https://i4ultimate.com/construction-info/construction-map/#constructionAlerts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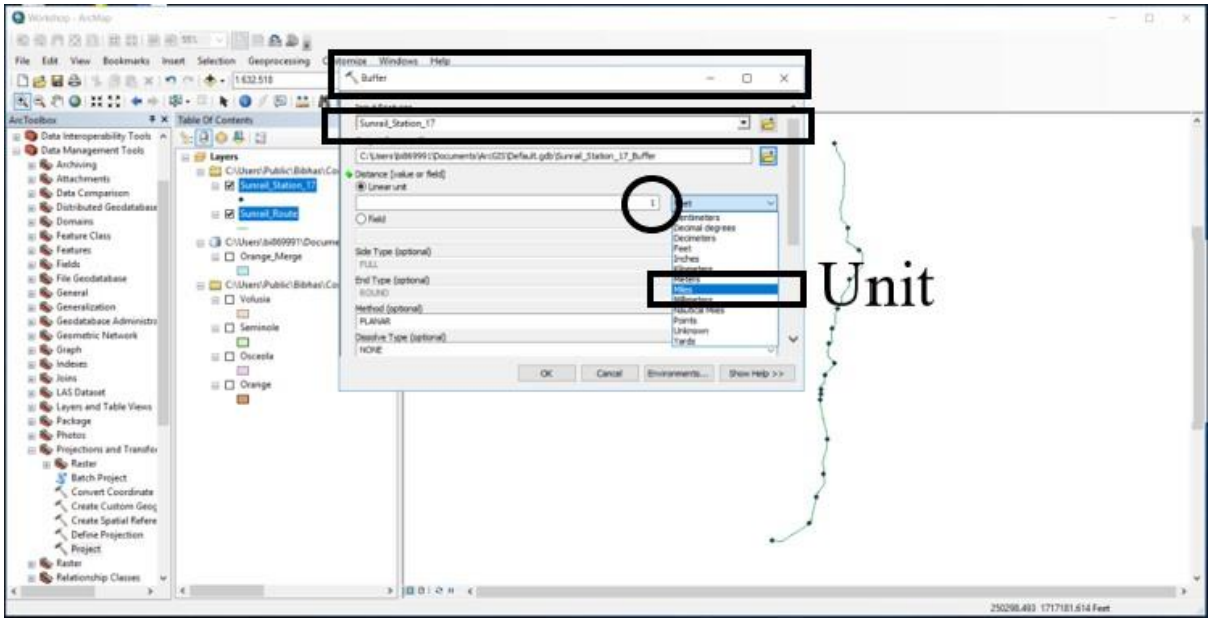
Python
Geoprocessing Options...

(a)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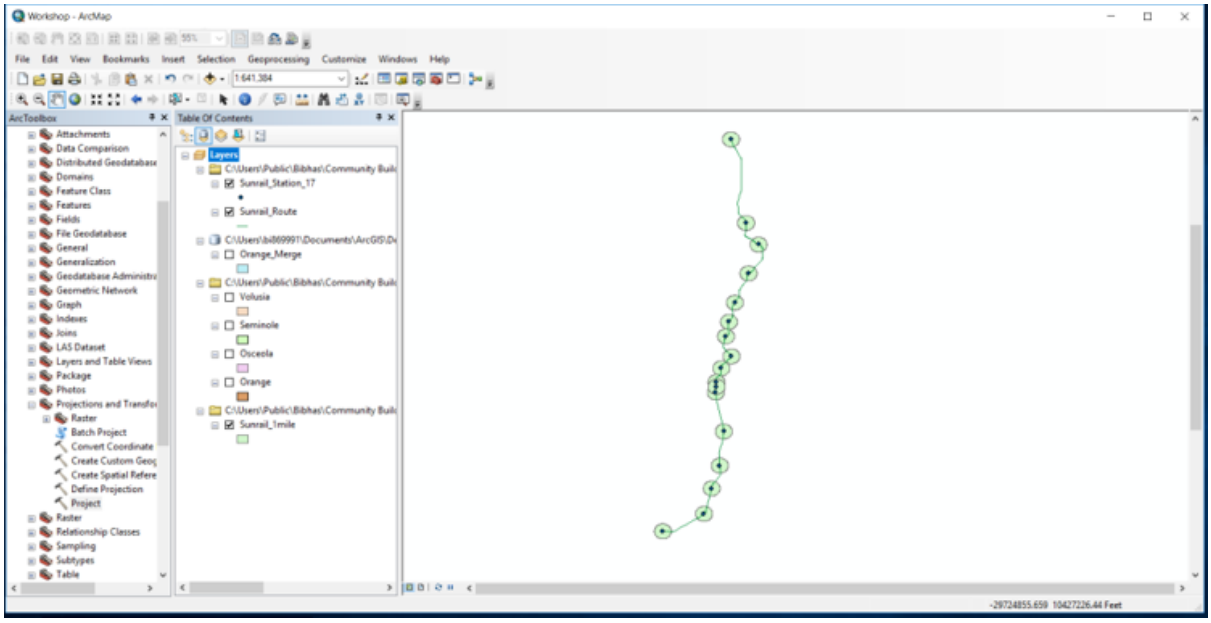
Sunrail_Station_17
Linear unit
Field
Unit
OK
Cancel
Environments...
Show Help >>

(b)

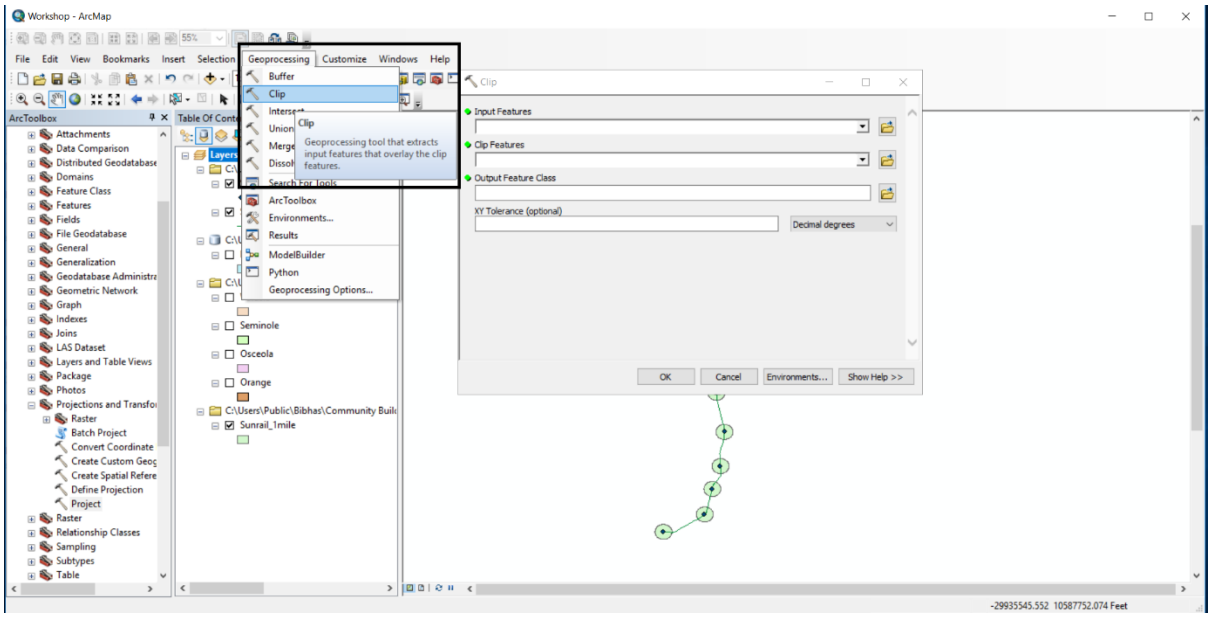


(c)

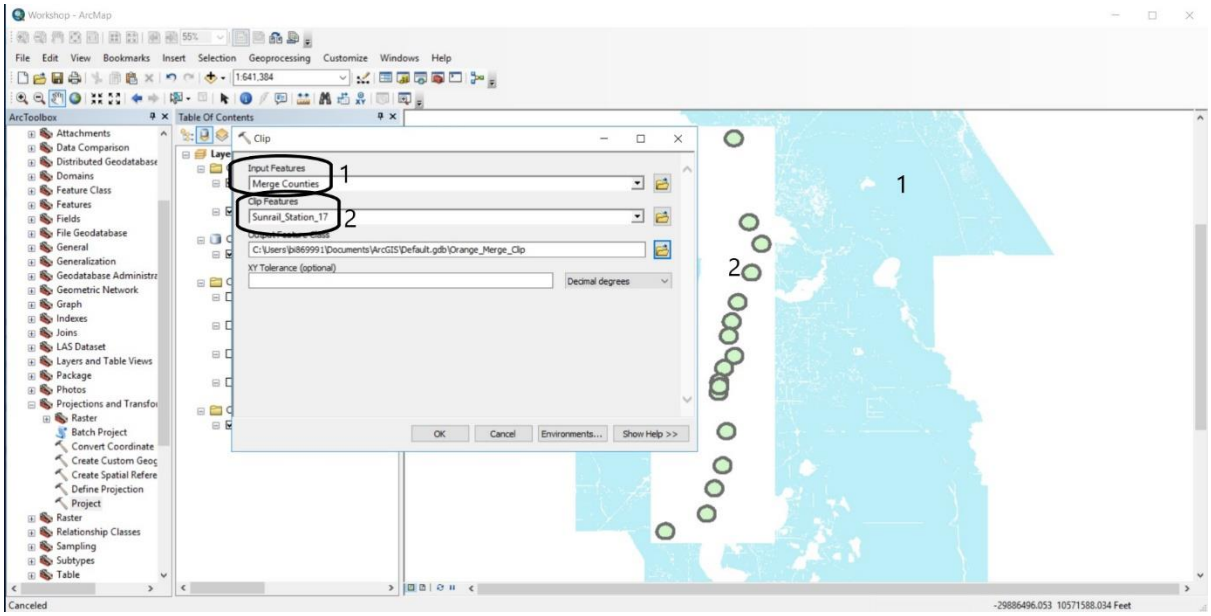
Figure 14: 1 mile Buffer Around SunRail Stations

2.4.1.2 Clip from Merge Counties

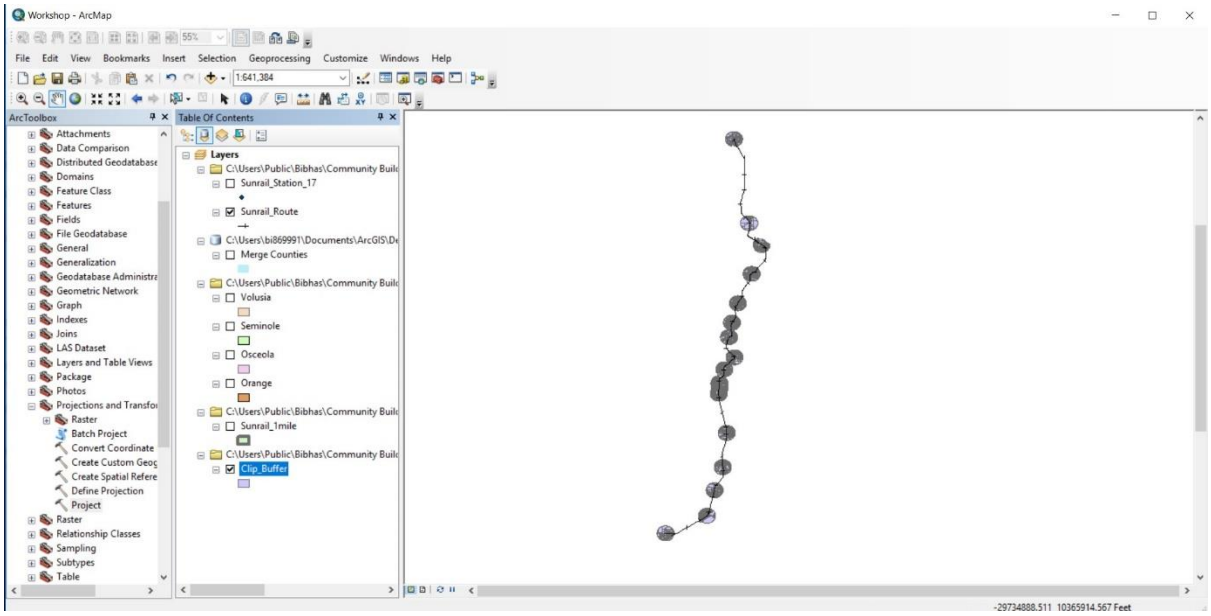
- At first, select ‘Geoprocessing’ toolbar
- Then click on ‘Clip’ option (see Figure 15(a))
- In ‘Input Features’section put Merge counties (see Figure 15(b))
- Upload SunRail buffer created in previous step on ‘Clip Features’ section (see Figure 15(b))
- Finally, a new buffer layer was created contains corresponding parcel level information such property value, land use type, area etc. (see Figure 15(c))



(a)



(b)



(c)

Figure 15: Case Area Selection

2.4.2 Overlapping Problem

2.4.2.1 Theoretical Approach

- A 1-mile buffer was created around each of the SunRail stations. Please note that the nearness of the stations, particularly in the downtown areas, cause overlapping problem.
- As a result of the overlapping, the same parcel might be part of two different stations.
- ArcGIS proximity tool (Near Generate Table operation) was used to assign a parcel to a unique station. More specifically, we computed the straight line distances from each parcel to the nearest station and the parcel was assigned to the station which was the

nearest. Figure 16 demonstrates an example of the station overlapping problem in the downtown area.

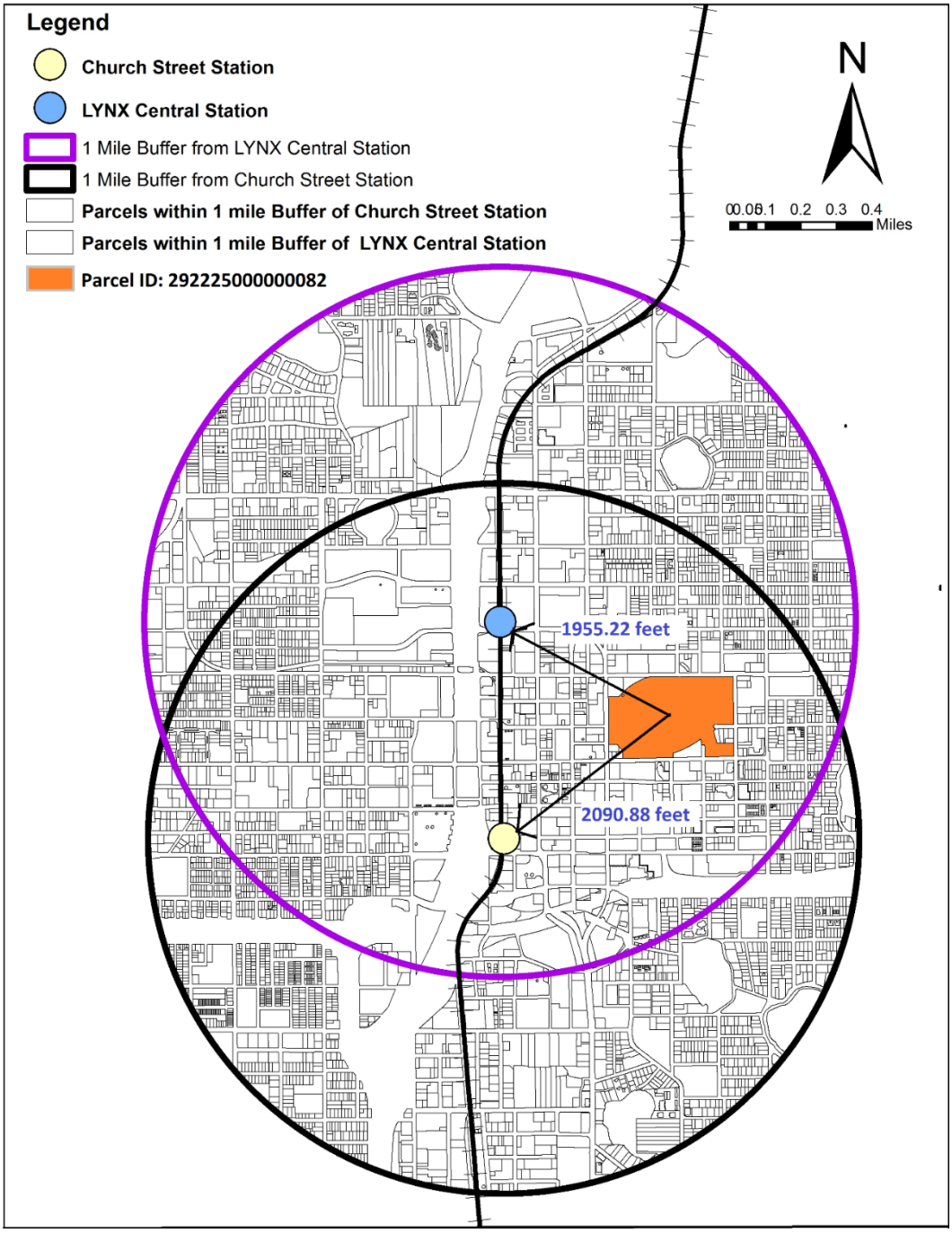


Figure 16: Example of Overlapping Buffers and Proximity Analysis

2.4.2.2 Practical Overlapping Solution Technique

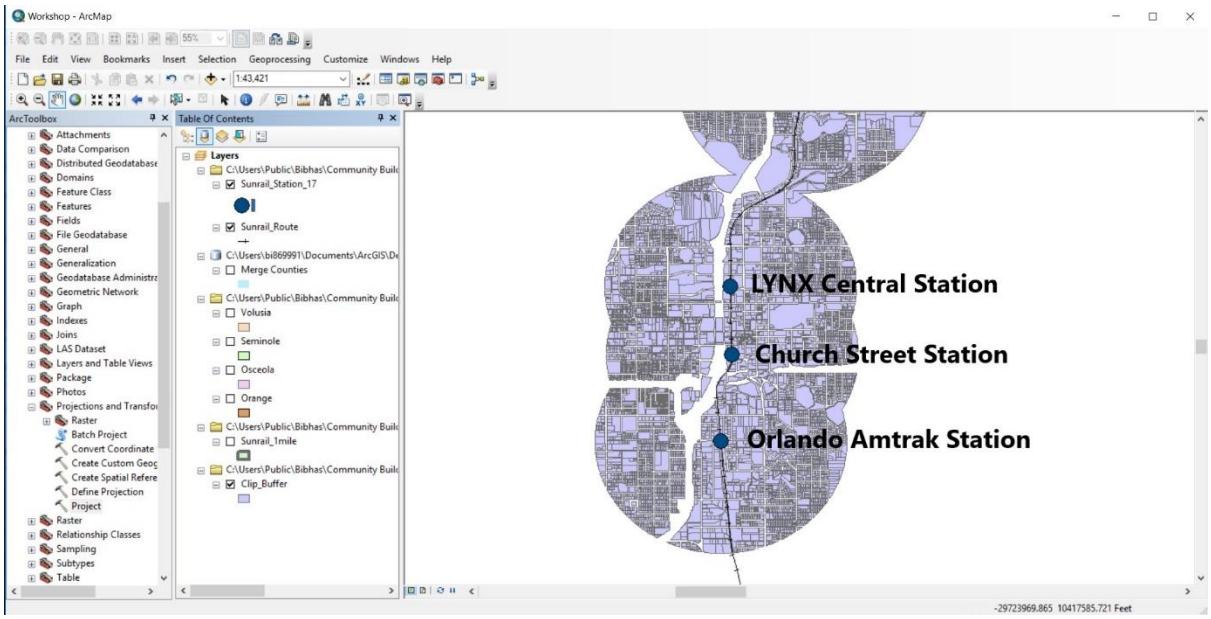
Three downtown stations are clear example of overlapping parcels (Figure 17(a)). Following are the steps to solve the overlapping buffer problem:

- 1st select Geoprocessing
- Choose Arc Toolbox bar in Geoprocessing (See Figure 17(b))
- Select 'Analysis Tools' (See Figure 17(b))
- Select 'Proximity' from 'Analysis Tools'

- Then click to ‘Near’ for the overlapping solution
- Select parcel buffer layer shapefile in as input features (See Figure 17(c))
- Then put SunRail stations as Near Features
- Click ‘Ok’

After all the actions were taken, three new columns will be added in the attribute table (See Figure 17(d)). They are:

- In_FID = Parcel ID
- Near_FID = Station ID
- Near_Dist = Estimated nearest distance from parcel to each SunRail statins



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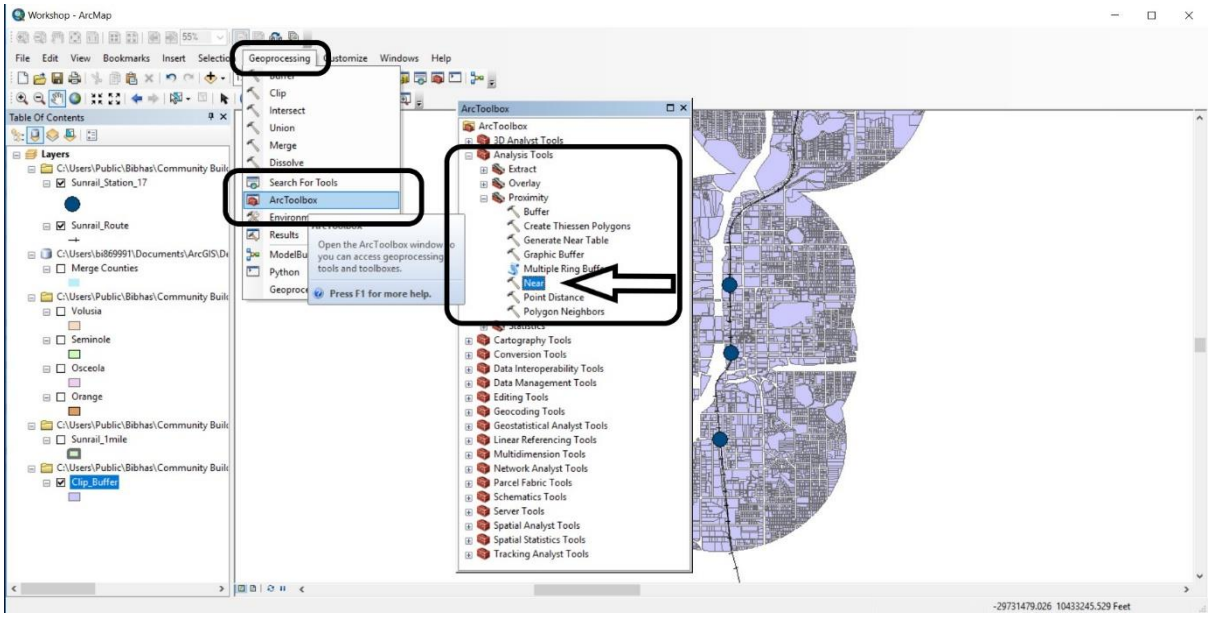

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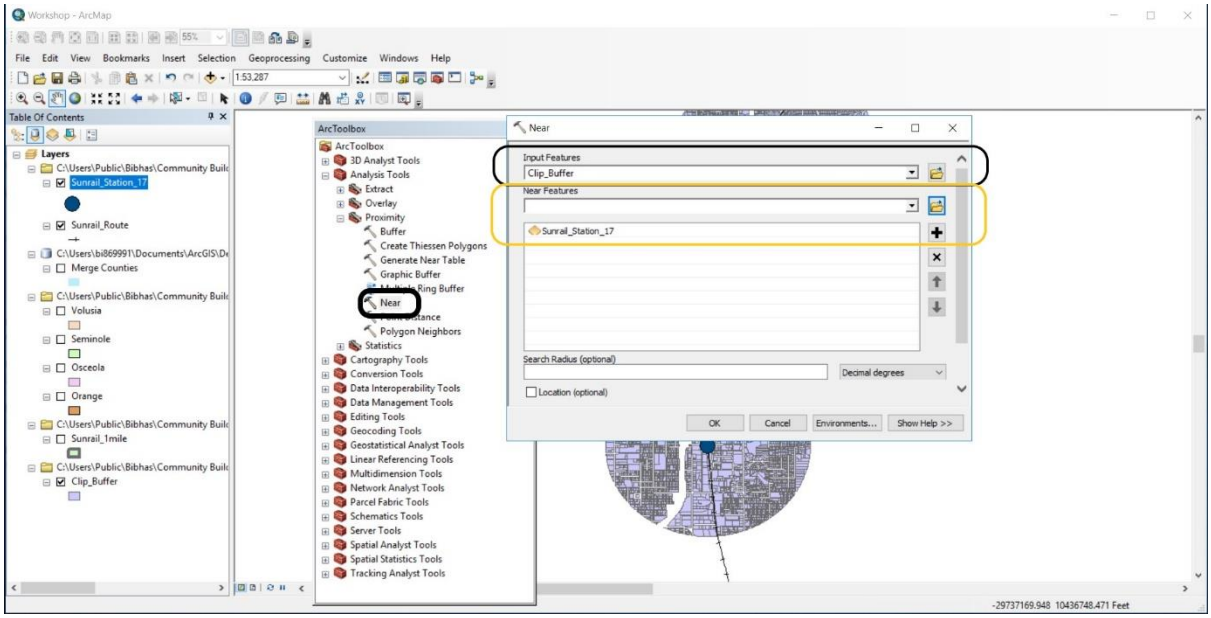

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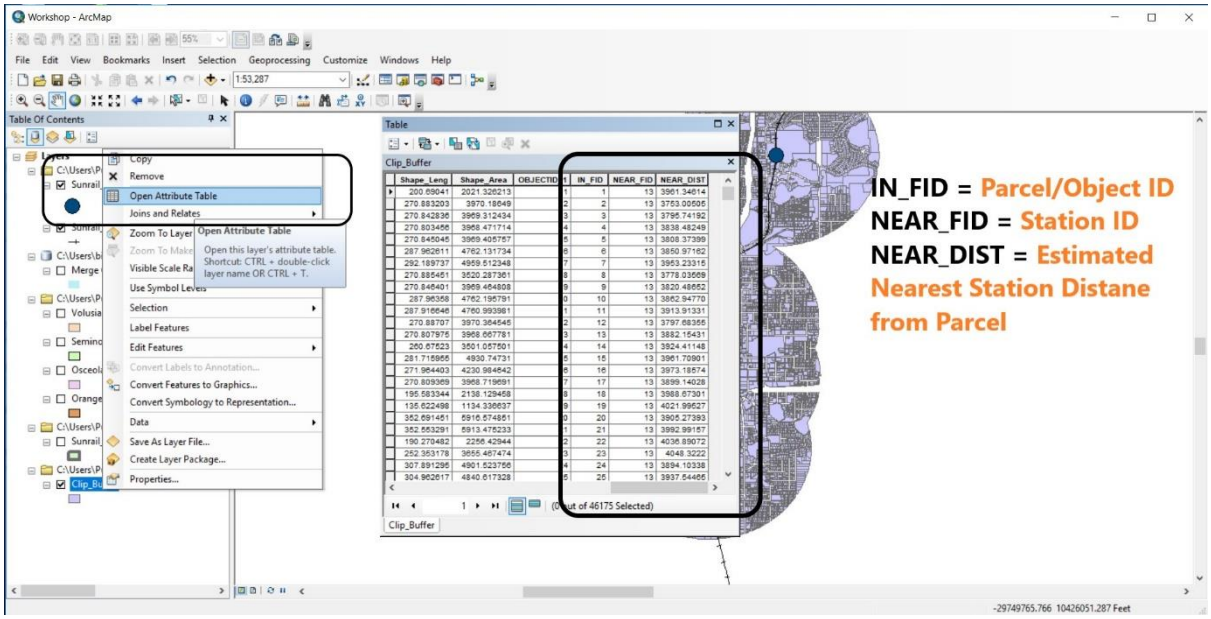


(d)

Figure 17: Uses of Near Tool to Overcome Overlapping Problem on ArcGIS

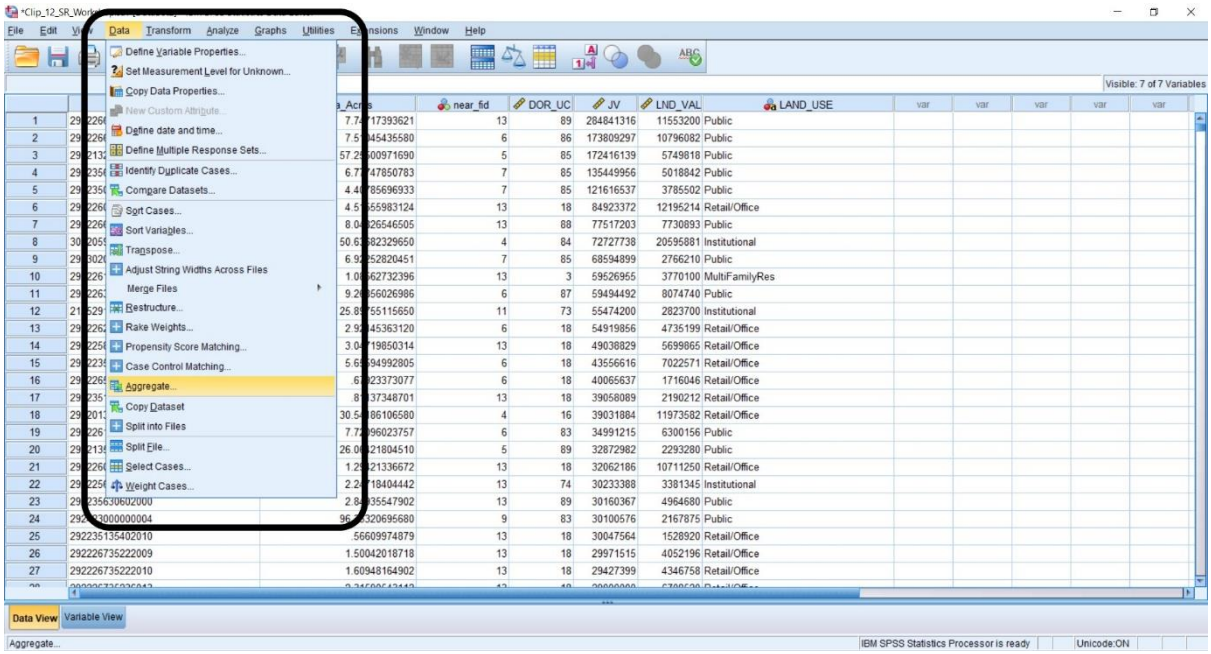
2.4.3 Property Value Estimation

After allocating all parcels to their nearest stations, dbf file was converted to SPSS file for estimation of property value by land use type. Following steps were followed:

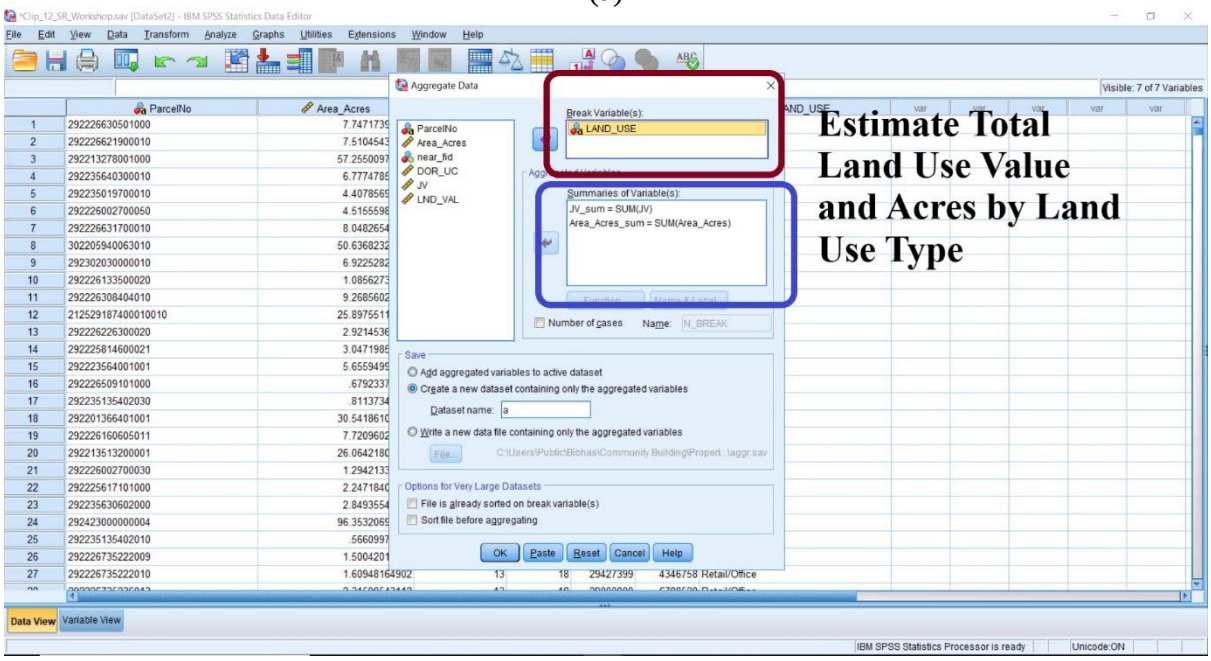
- Select 'Data' toolbar
- Click on 'Aggregate' option (See Figure 18(a))
- Put 'Land Use Type' as break variable (See Figure 18(b))
- For 'Summary of Variables' section choose JV as property value and Area (Acres)
- Also change the 'Function' option from default 'Mean' to 'Sum'

This action will give a new dataset of total property value and total area in acres for each land use type. Then average property value was estimated for each land use type by dividing the total property value by total area in acres. Please note that, property value by land use type

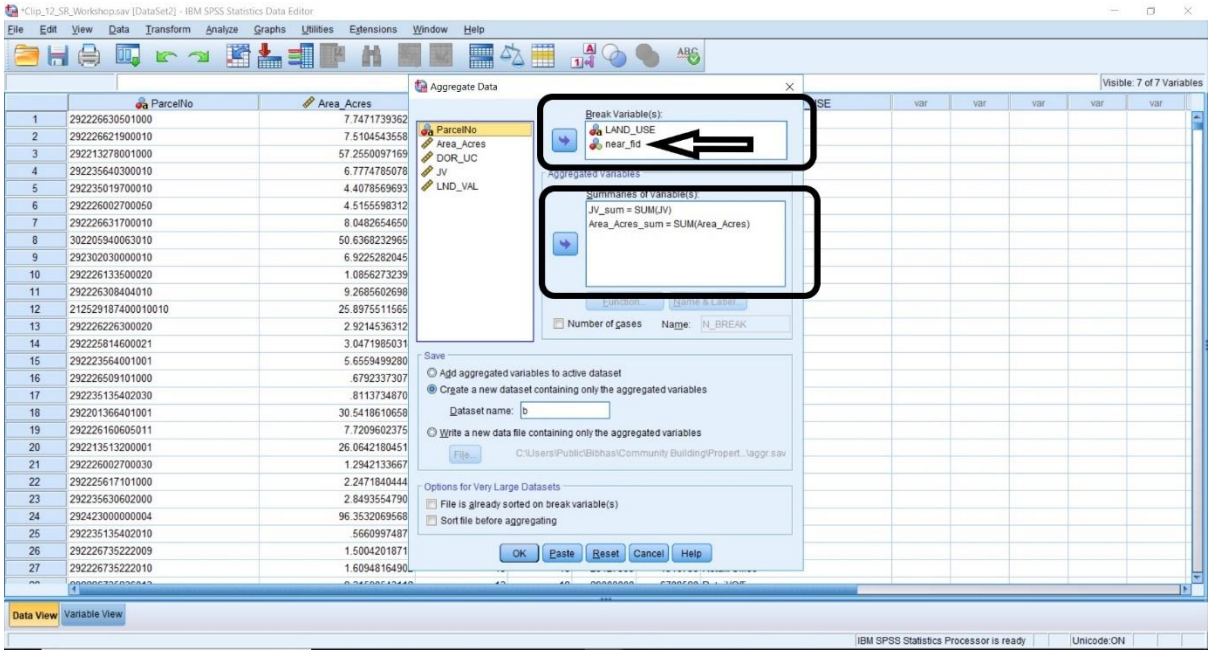
around each SunRail station' buffer needed to be estimated, then put 'Land Use Type' and 'SunRail Station ID (Near_FID)' in 'Aggregate' section as break variables (See Figure 18(c)).



(a)



(b)



(c)

Figure 18: Average Property Value Estimation

2.4.4 Average Property Value Estimation

- The property value evaluation was carried out for the parcels within the 1-mile buffer. These parcels are referred to as Case parcels. Figure 19-22 presents the result.
- The average property value (per acre) for all parcels for each station by 5 land use types mentioned before (see Table 3).

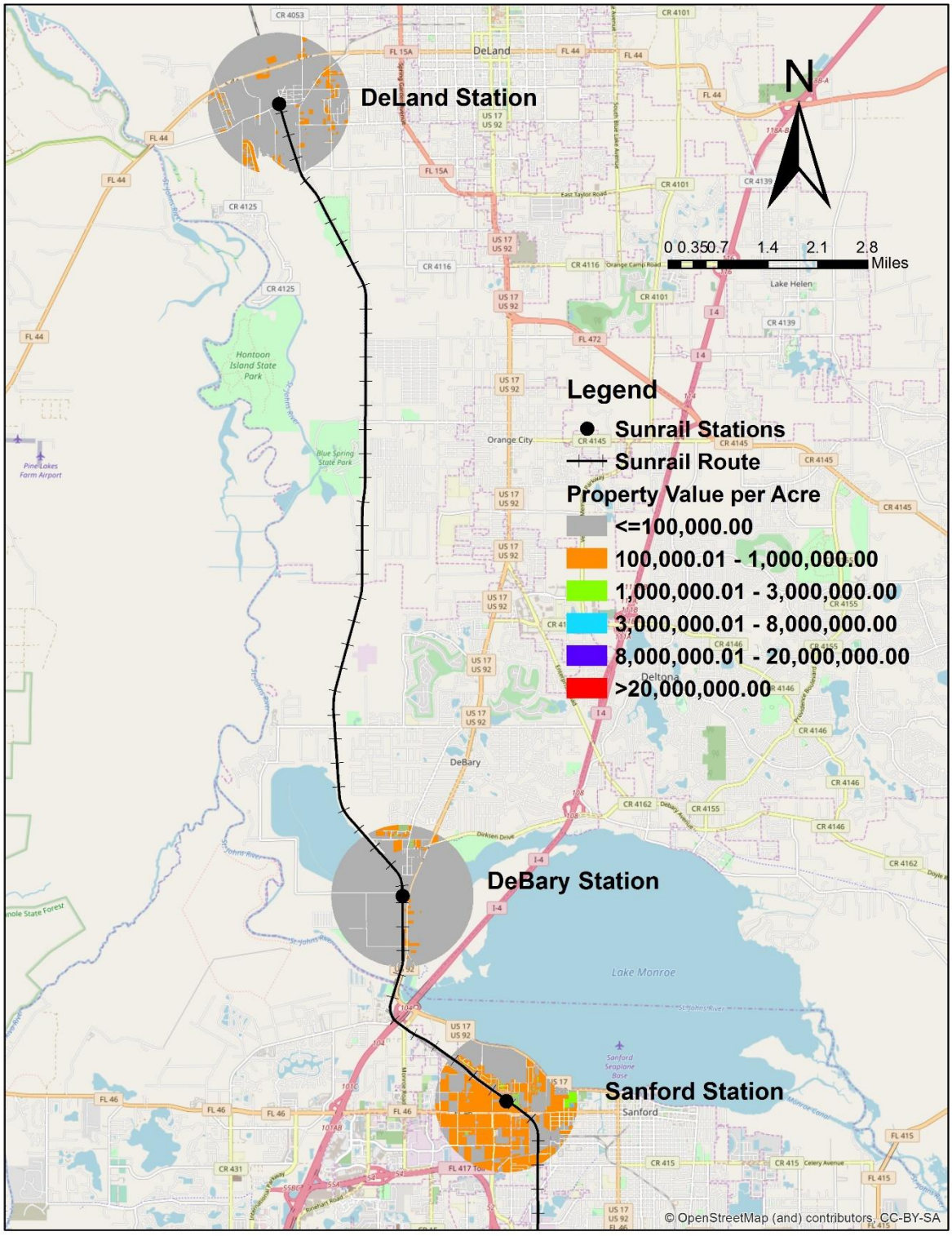


Figure 19: Average Property Value (DeLand, DeBary and Sanford Station)

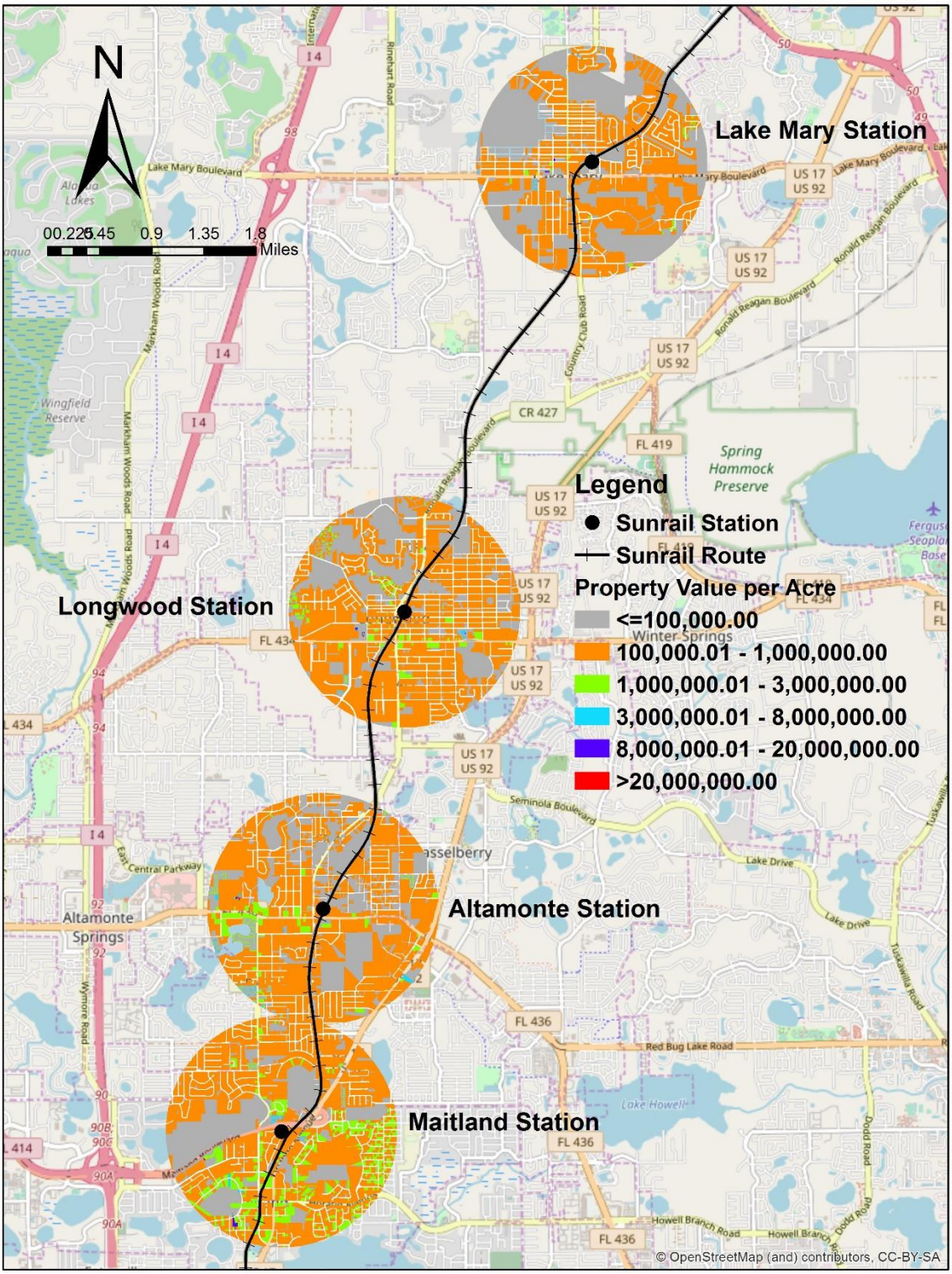


Figure 20: Average Property Value (Lake Mary, Longwood, Altamonte Springs and Maitland Station)

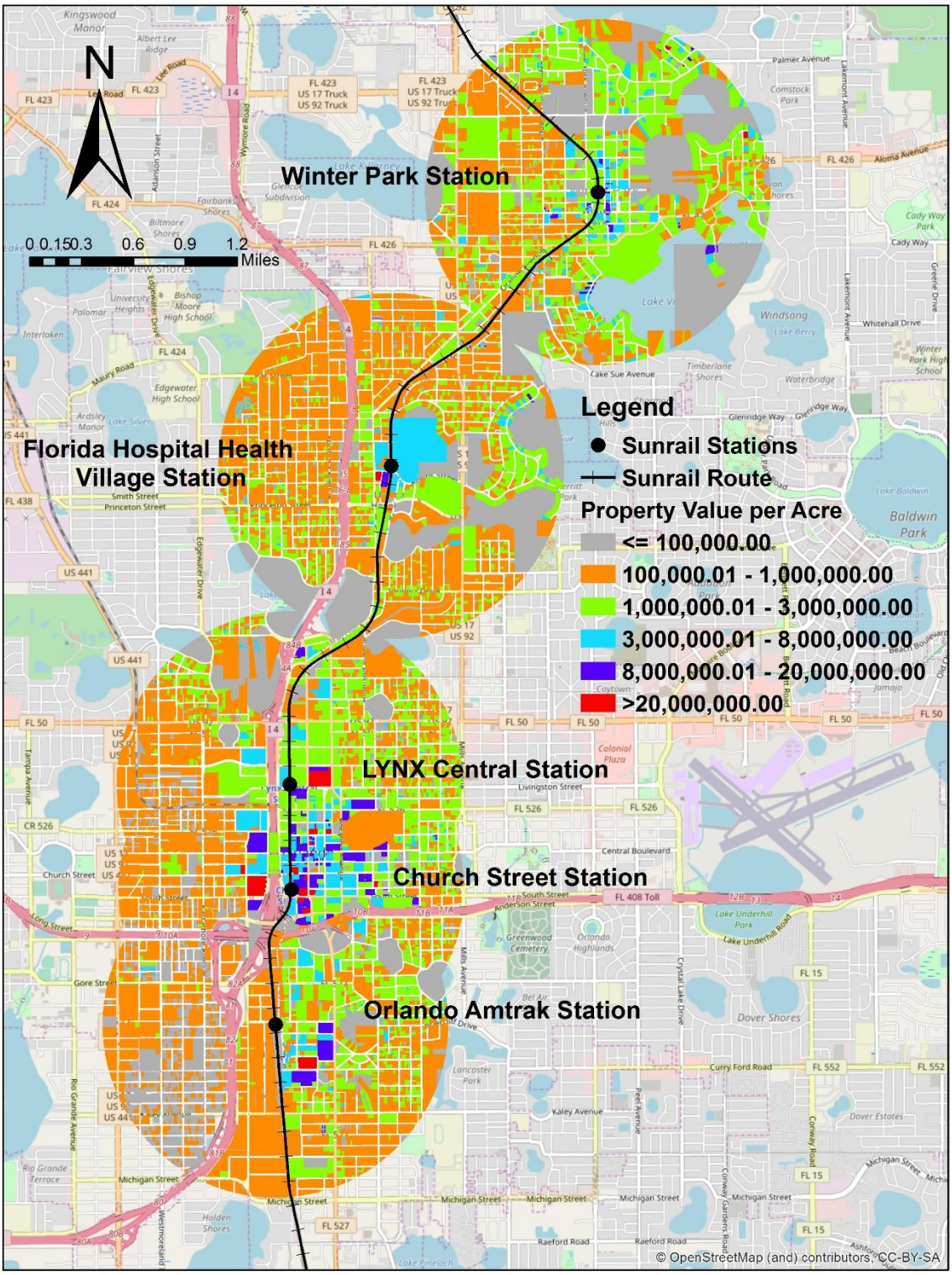


Figure 21: Average Property Value (Winter Park, Florida Hospital Health Village, LYNX Central, Church Street and Orlando Amtrak Station)

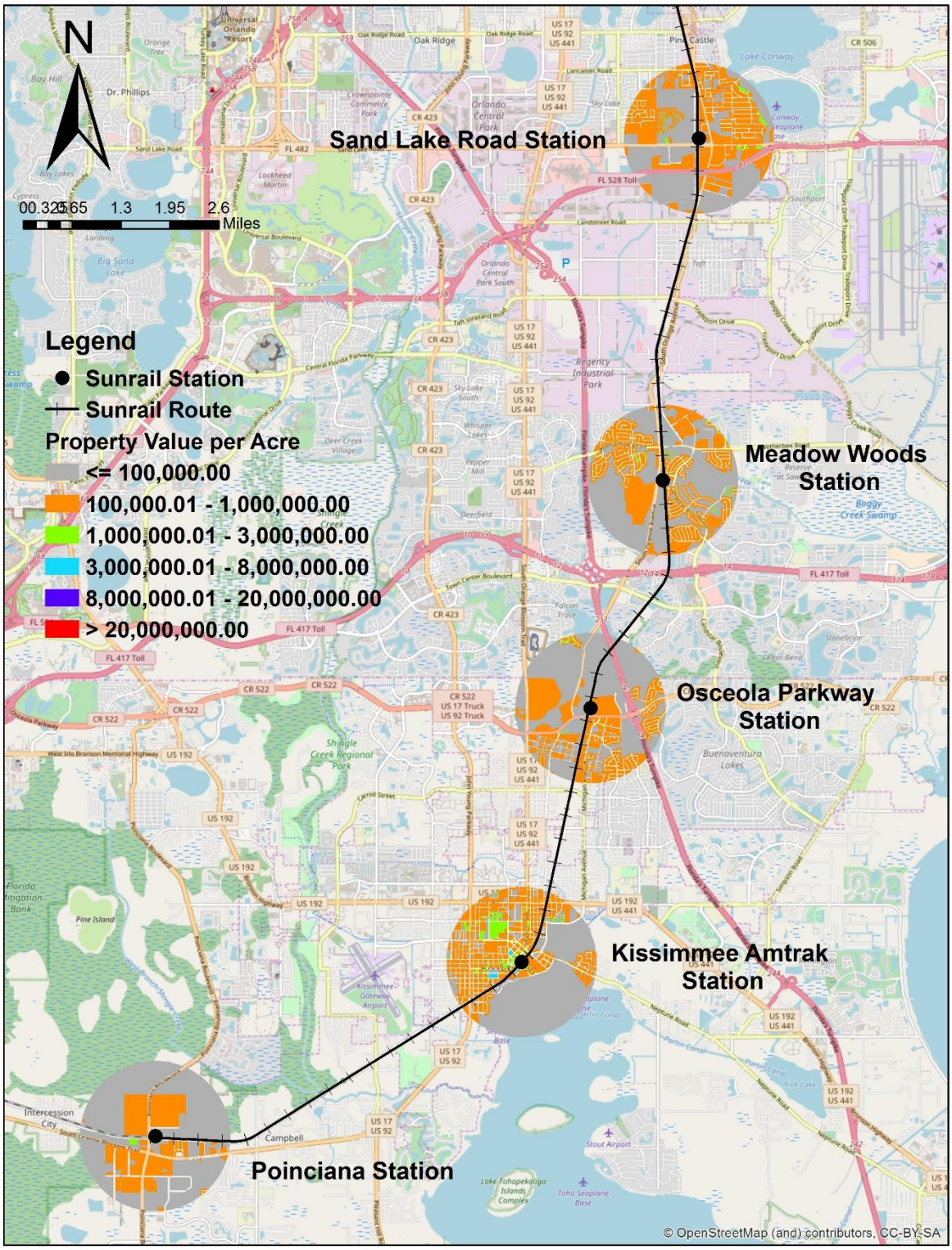


Figure 22: Average Property Value (Sand Lake Road, Meadow Woods, Osceola Parkway, Kissimmee Amtrak and Poinciana Station)

Table 3: Average Property Value per Station by Land Use Type for 2012

Station	Single Family Residential (USD)	Multi- Family Residential (USD)	Retail/Office (USD)	Industrial (USD)	Institutional (USD)
Downtown Stations					
LYNX Central Station	906,590	988,491	1,790,503	630,578	1,462,136
Church Street Station	981,280	2,401,727	5,214,377	281,022	4,683,842
Orlando Amtrak/Sligh Blvd Station	625,409	474,380	1,159,111	419,089	1,492,057
Phase-I Outside Downtown Stations					
DeBary Station	49,601	--	136,409	225,568	181,761
Sanford Station	401,223.	570,141	254,061	361,616	400,609
Lake Mary Station	288,673	337,571	673,920	--	81,433
Longwood Station	345,402	344,385	599,405	413,580	564,793
Altamonte Springs Station	295,864	373,609	829,133	429,185	653,548
Maitland Station	632,226	903,955	708,436	430,167	569,418
Winter Park Station	1,393,663	1,353,358	1,601,312	789,060	1,449,902
Florida Hospital Health Village Station	918,072	626,616	1,208,935	724,904	1,083,417
Sand Lake Road Station	456,825	363,302	405,738	256,050	280,571
Phase-II Stations					
DeLand Station	111,661	86,914	56,488	71,328	108,124
Meadow Woods Station	534,753	351,368	75,014	387,552	159,837
Osceola Parkway Station	414,276	245,964	272,880	204,007	161,955
Kissimmee Amtrak Station	255,253	406,806	693,784	317,913	1,034,599
Poinciana	173,863	--	129,603	379,231	175,979

2.5 Control Area Selection

While property values in the vicinity of the stations have substantially increased it is not possible to attribute all the increase to SunRail construction without examining the other parts of the urban region. To determine if the changes in property values is truly influenced by SunRail's development, control areas were systematically selected.

We adopted the following procedure for selecting the control areas.

- First, we created 2 and 8 mile buffer, respectively around the stations. The parcels located within that 6 mile buffer were selected to be the candidate control areas.
- Next, based on land use type and property value range (within 15% of the mean property value found for each land use type for case areas), control areas for analysis were identified. The same number of control parcels were selected for each land use type. Second, the control parcels were assigned to a unique station by using the nearest distance analysis.
- Third, the same procedure as case area is followed to estimate average property price per land use category type for downtown, outside downtown, and Phase-2 stations.

2.5.1 1st Step Technique

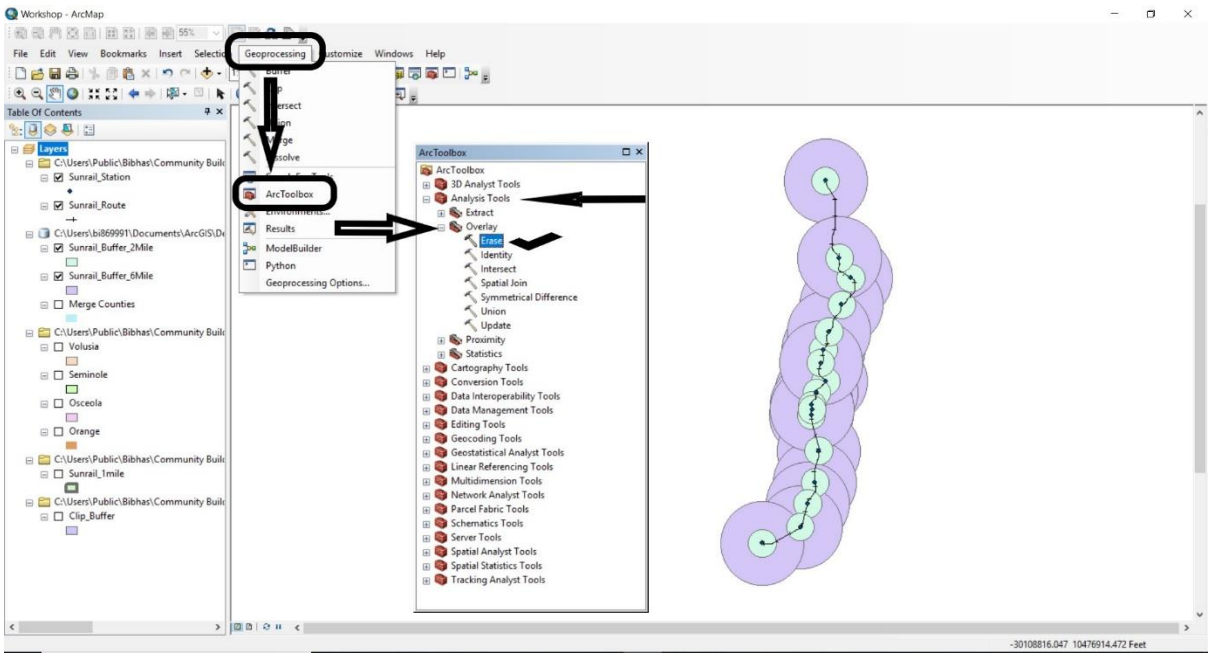
2.5.1.1 Draw 2 and 8 mile Buffer

- 2 and 8 mile buffer around each SunRail station was created using similar technique as case area selection

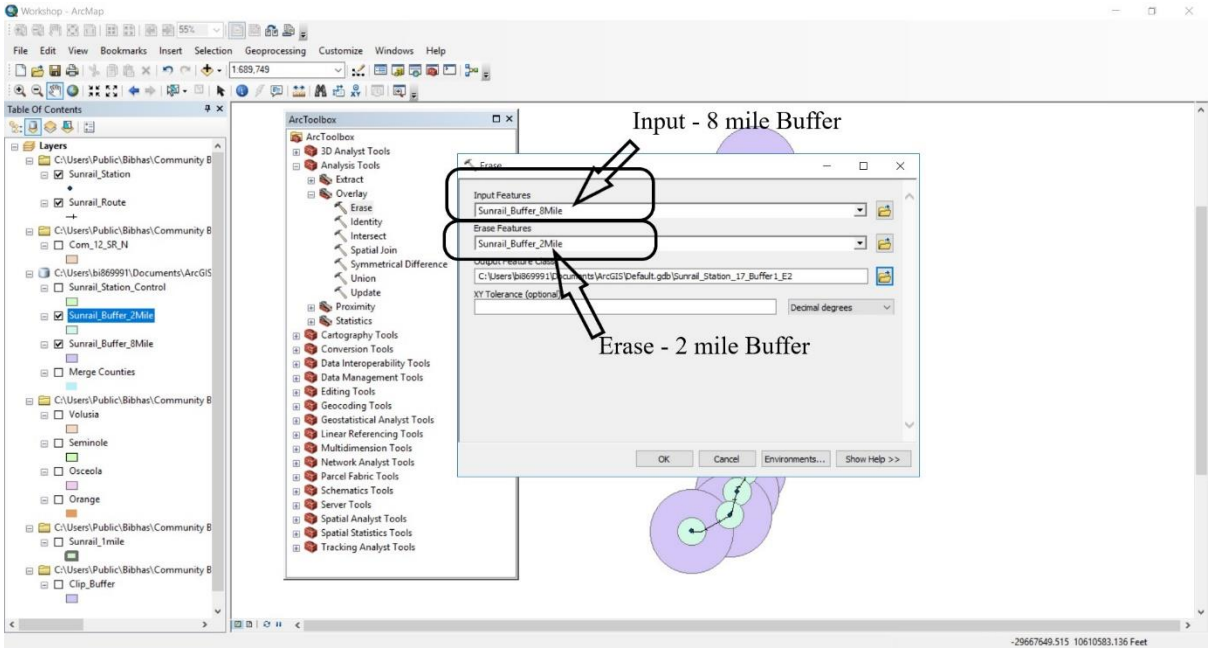
2.5.1.2 Erase Inner 2 Miles

- 1st select Geoprocessing toolbar
- Choose Arc Toolbox bar in Geoprocessing (See Figure 23(a))
- Select 'Analysis Tools' (See Figure 23(a))
- Select 'Overlay' from 'Analysis Tools'
- Then click to 'Erase' for the overlapping solution
- Select 8 mile buffer layer shapefile in as input features (See Figure 23(b))
- Then put 2 mile buffer layer shapefile as Erase Features
- Click 'Ok'

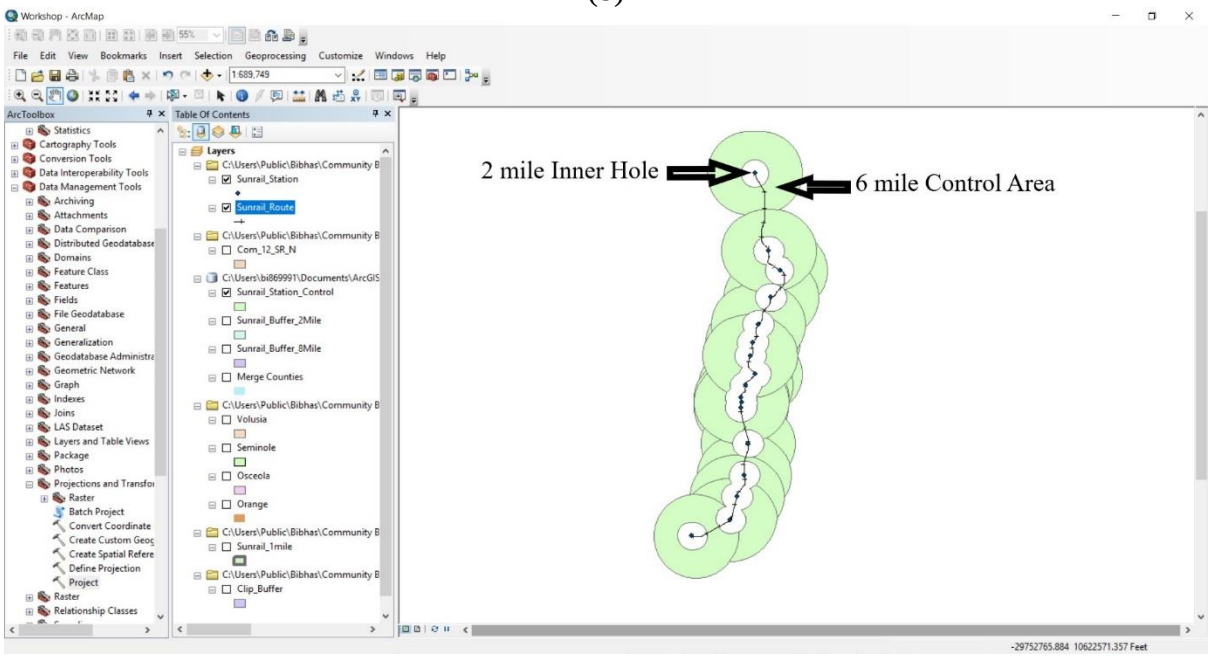
Figure 23(c) represents the control area where 6 mile area was accounted after 2 mile inner radius from each SunRail station.



(a)



(b)



(c)

Figure 23: Control Area Selection

3 ACCESSIBILITY TO EMPLOYMENT

Job accessibility can be defined as number of jobs accessible from a desirable point. To capture the change in number of jobs around the chosen investment projects, the employment (number of workers in the labor force) data for the years 2011-2016 was drawn from American Community Survey (ACS). This data contains information on total employment of individuals aged 20 through 64 years. These data were merged with the Florida census tract shapefile using the unique ID created by concatenating county and census tract IDs.

3.1 Case Area Selection

Job accessibility was computed using jobs accessible within a particular driving distance. Several travel time values are potentially used in literature to identify job. In our study, we used 10 minutes' drive time from our origin of interest as the appropriate threshold. The driving distance was computed using weekday peak period (8am on Tuesday). Street network of Florida has been used to draw driving area for both driving time and driving distance. 2011-2016 street network of 'NAVSTREET' data was used.

3.1.1 Driving Network Area

10 minutes driving network area around all SunRail stations was created to select case area for 'Job Accessibility' estimation. This procedure can be divided into two parts.

3.1.1.1 Road Network

- At first, a street network must need to be created to draw a driving area around SunRail stations.
- 'NAVSTREET' street network shapefile was used to create street network.
- Please note that, to estimate driving time, we need speed limit of the corresponding street. We define a fixed speed for a street from variable called 'Speed Category'. Conversion of speed from defined speed limit range is shown in Table 4.

Table 4: Speed Definition

Speed Category	Definition (MPH)	Speed, V (MPH)
1	Above 80	80
2	65-80	70
3	55-64	60
4	41-54	50
5	31-40	40
6	21-30	30
7	6-20	20
8	Below 6	6

- Since driving area was estimated based on time, so travel time need to be calculated on street network file.
- Travel time (in minutes) needed to travel the corresponding street was estimated by using equation, $T = (L/V) * 60$ where T is travel time needed to travel the total length of street in minutes, L is total length in miles and V is speed in mph (as mentioned Table 4).

- Three new variables as Speed, length and minutes need to be created by using similar to 2.1.2.1.

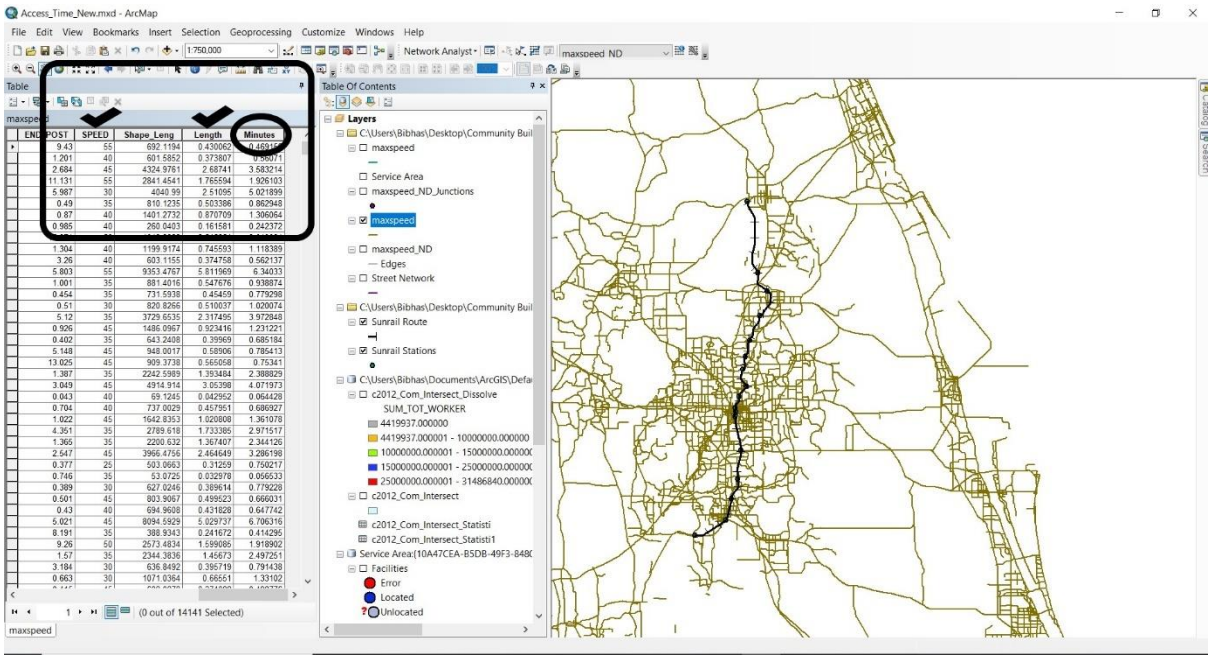
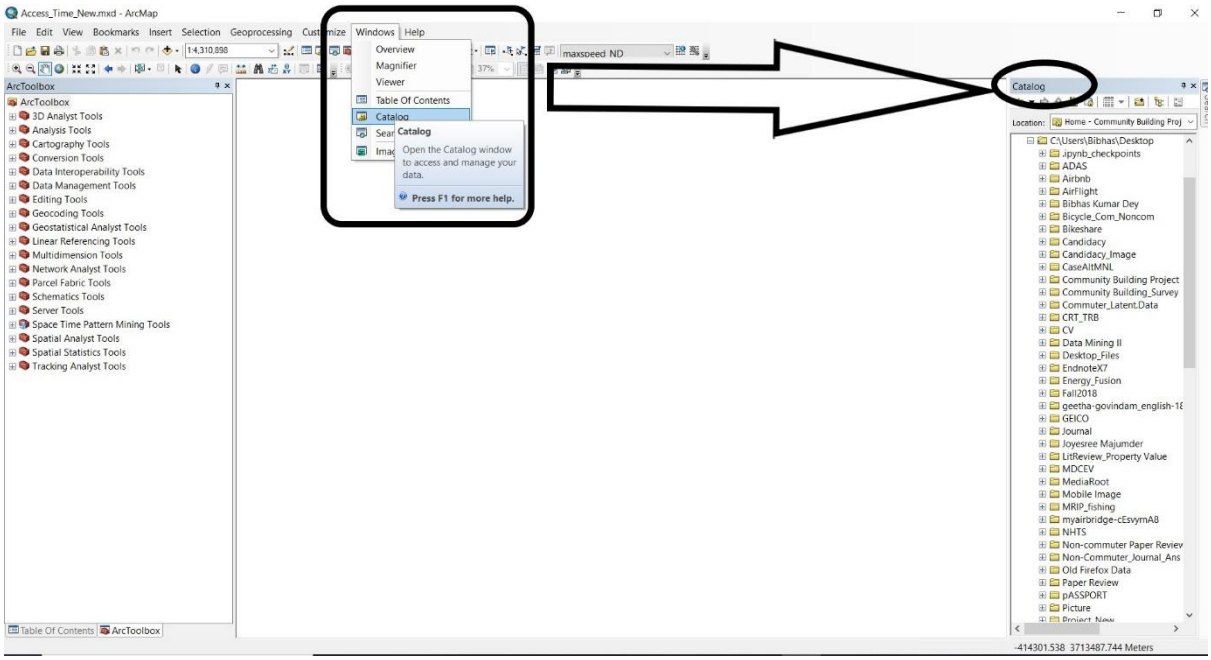


Figure 24: Travel Time Added

Several steps were followed to create 'Road Network' by using Network Analyst tool on ArcGIS (See Figure 25 (a) – 25 (m)).[2]

- Select 'Catalog' from 'Windows' toolbar (See Figure 25 (a))
- Select Road Network shapefile by using 'Catalog' (See Figure 25 (b))
- Click on the 'New Network Dataset' from 'Road Network' file
- Follow all the steps shown in Figure 25 (d) to Figure 25 (l)
- All the above steps will create a new road network with 'junction' and 'edges'

[2] How to create a road network in ArcGIS can be found on this YouTube link (https://www.youtube.com/watch?v=IcETd6oHZtQ)


Access_Time_New.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Overview
Magnifier
Viewer
Table Of Contents
Catalog
Catalog
Open the Catalog window to access and manage your data.
Press F1 for more help.
ArcToolbox
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Space Time Pattern Mining Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Table Of Contents
ArcToolbox
Catalog
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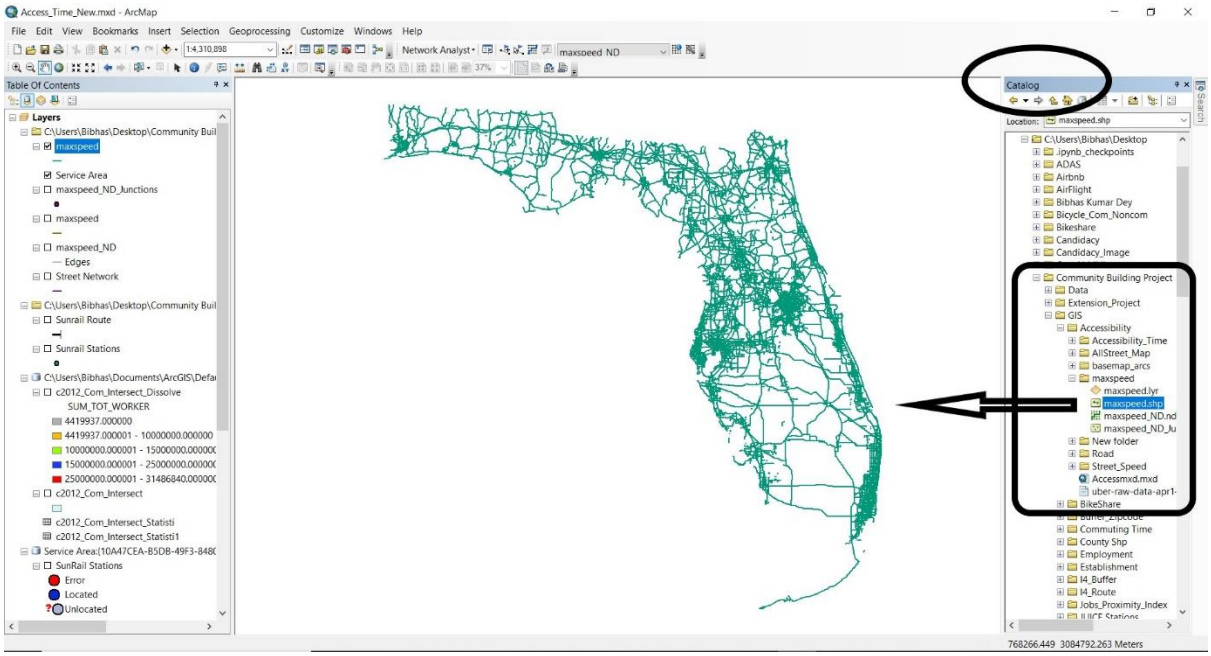
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maxspeed
maxspeed_ND
Edges
Street Network
Sunrail Route
Sunrail Stations
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SUM_TOT_WORKER
c2012_Com_Intersect
SunRail Stations
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Located
Unlocated
Catalog
Community Building Project
Data
Extension_Project
GIS
Accessibility
Accessibility_Time
AllStreet_Map
basemap_arcs
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maxspeed.lyr
maxspeed.shp
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Road
Street_Speed
Accessmxd.mxd
BikeShare
Commuting Time
County Shp
Employment
Establishment
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I4_Route
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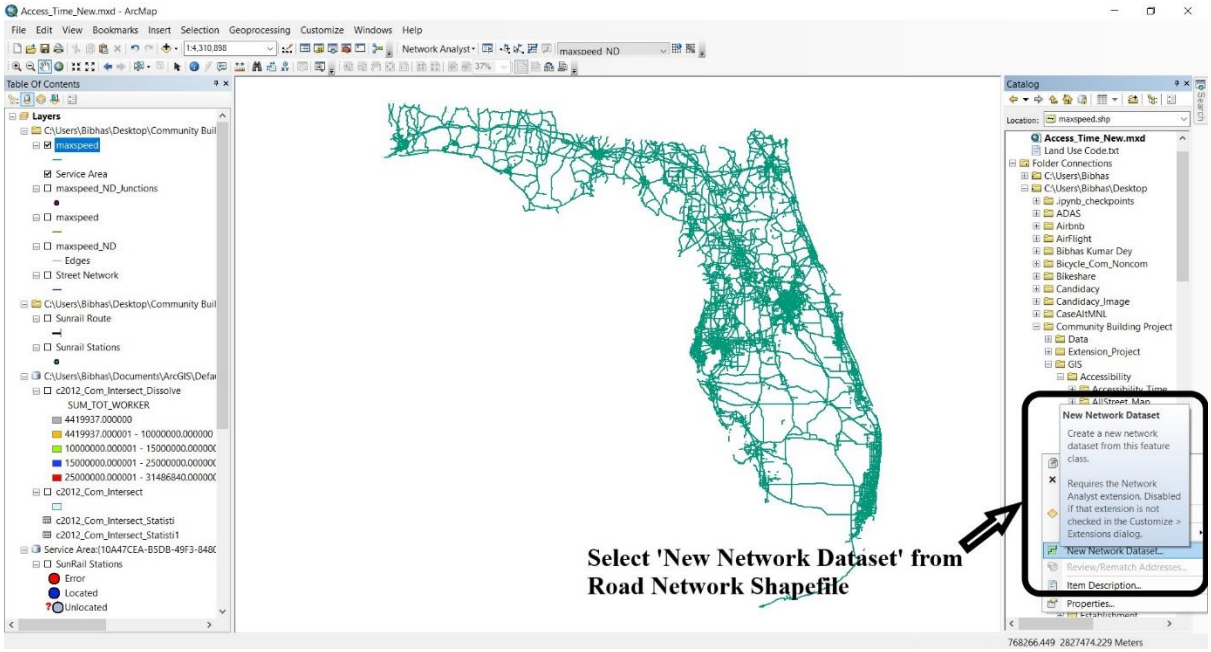
(b)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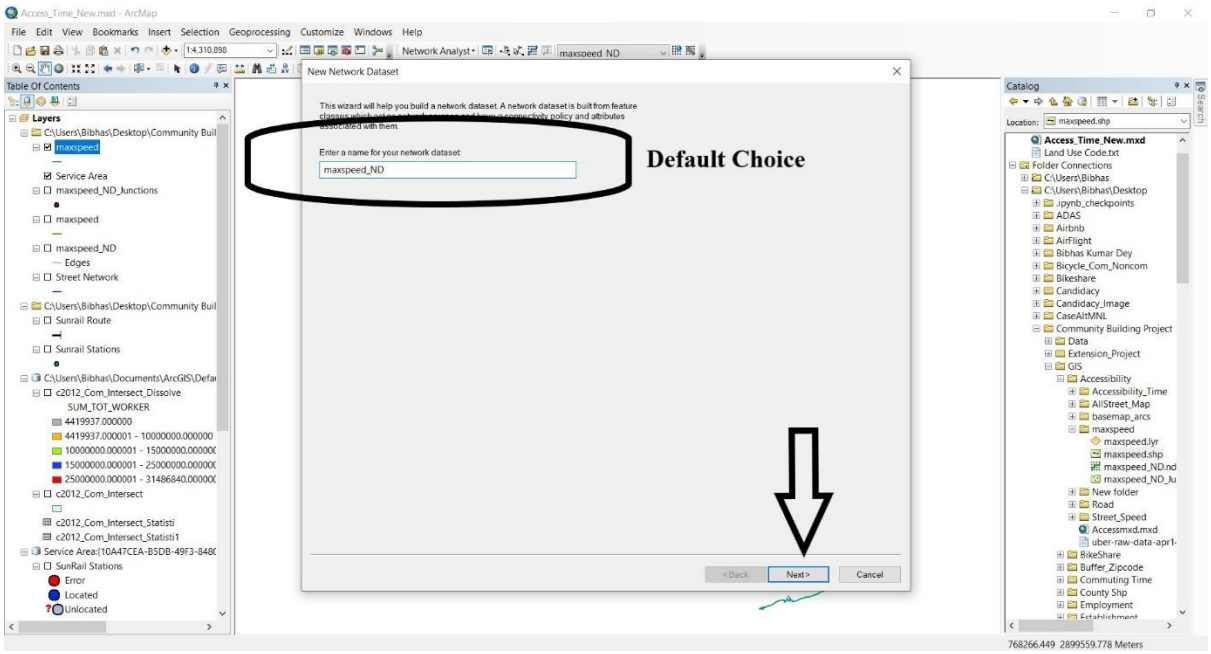
Road Network Shapefile

(c)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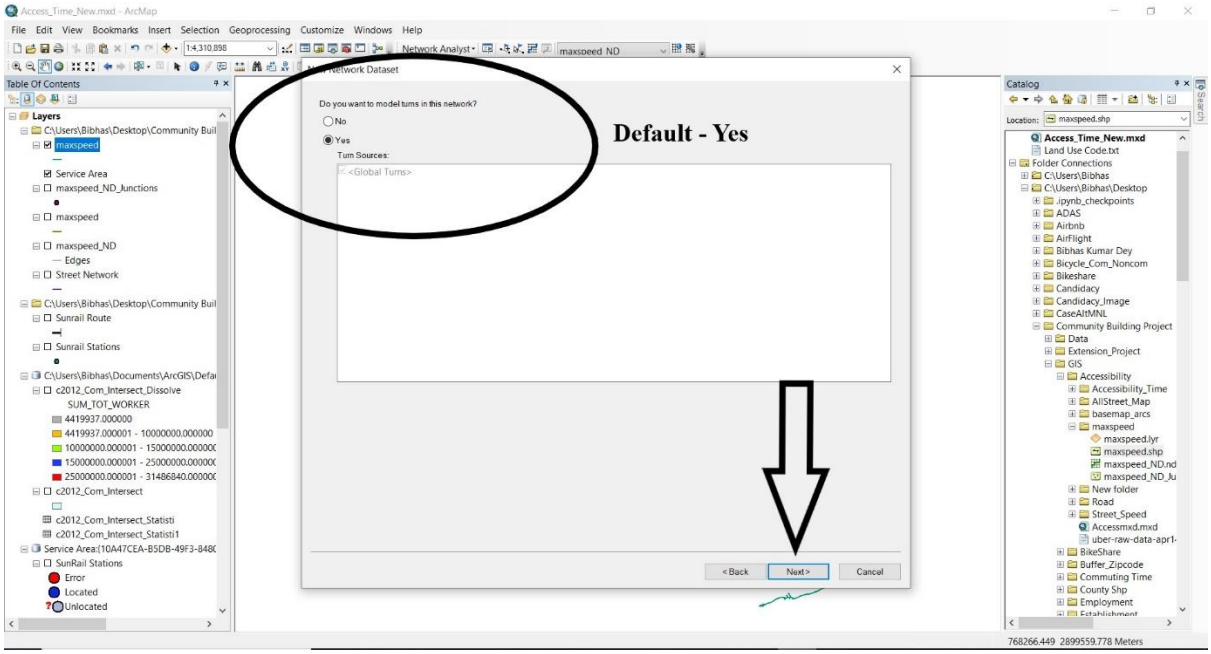
Default - Yes
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Do you want to model turns in this network?
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Yes
Turn Sources:
<Global Turns>
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Next >
Cancel

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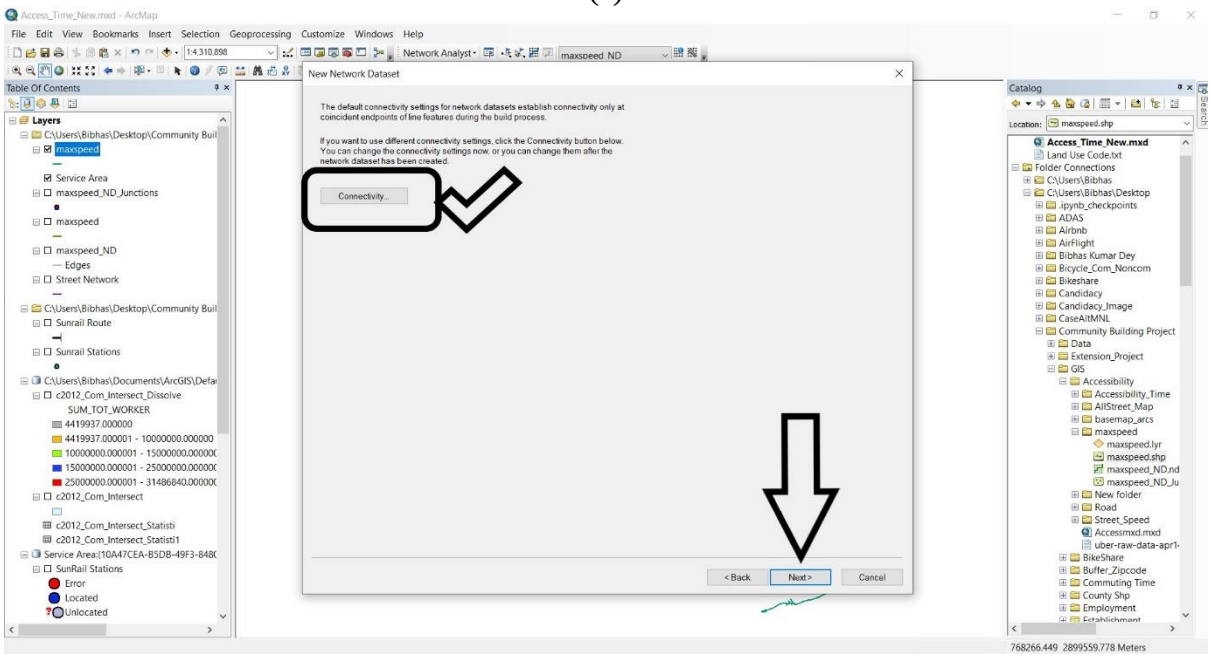
New Network Dataset
The default connectivity settings for network datasets establish connectivity only at coincident endpoints of line features during the build process.
If you want to use different connectivity settings, click the Connectivity button below. You can change the connectivity settings now, or you can change them after the network dataset has been created.
Connectivity...
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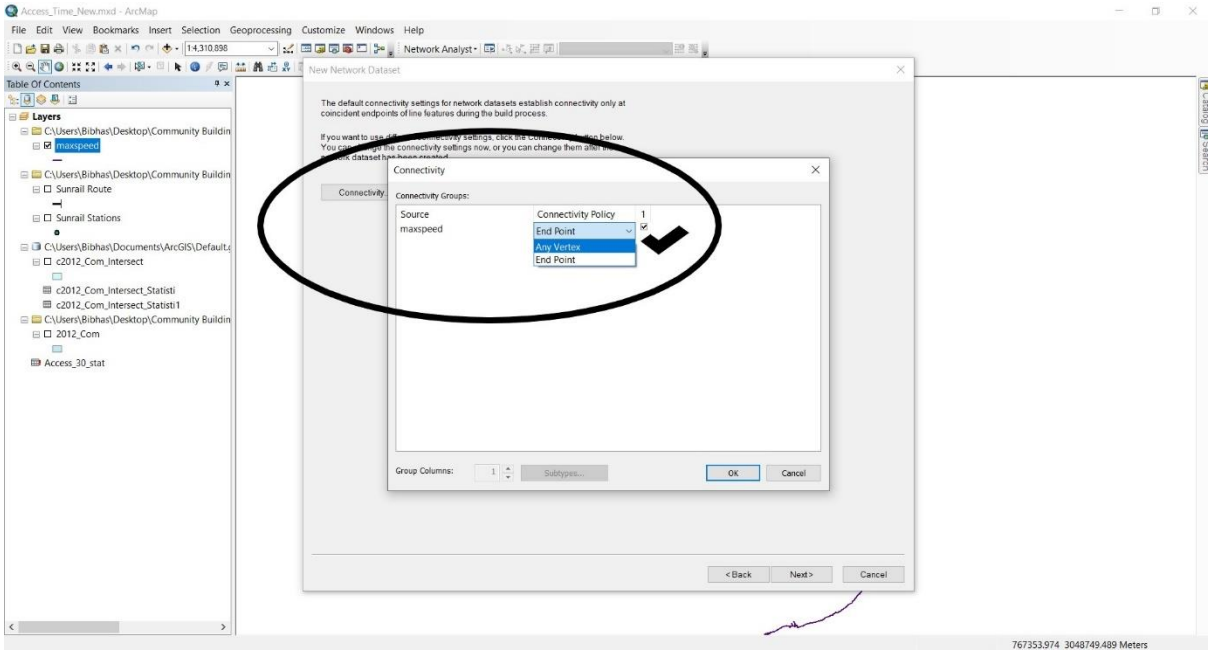
Next >
Cancel

(f)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Network Analyst
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Sunrail Route
Sunrail Stations
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Access_30_stat
New Network Dataset
The default connectivity settings for network datasets establish connectivity only at coincident endpoints of line features during the build process.
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Connectivity Groups:
Source
Connectivity Policy
maxspeed
End Point
Any Vertex
End Point
Group Columns:
Subtypes...
OK
Cancel
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Cancel
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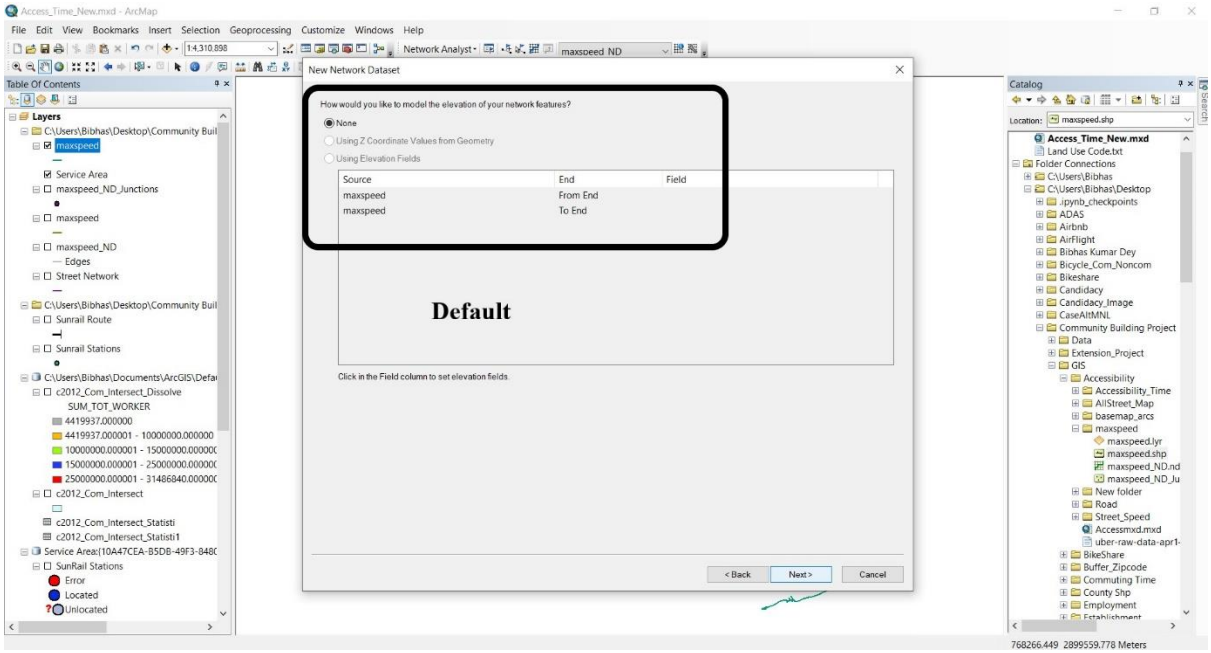
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Network Analyst
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maxspeed_ND
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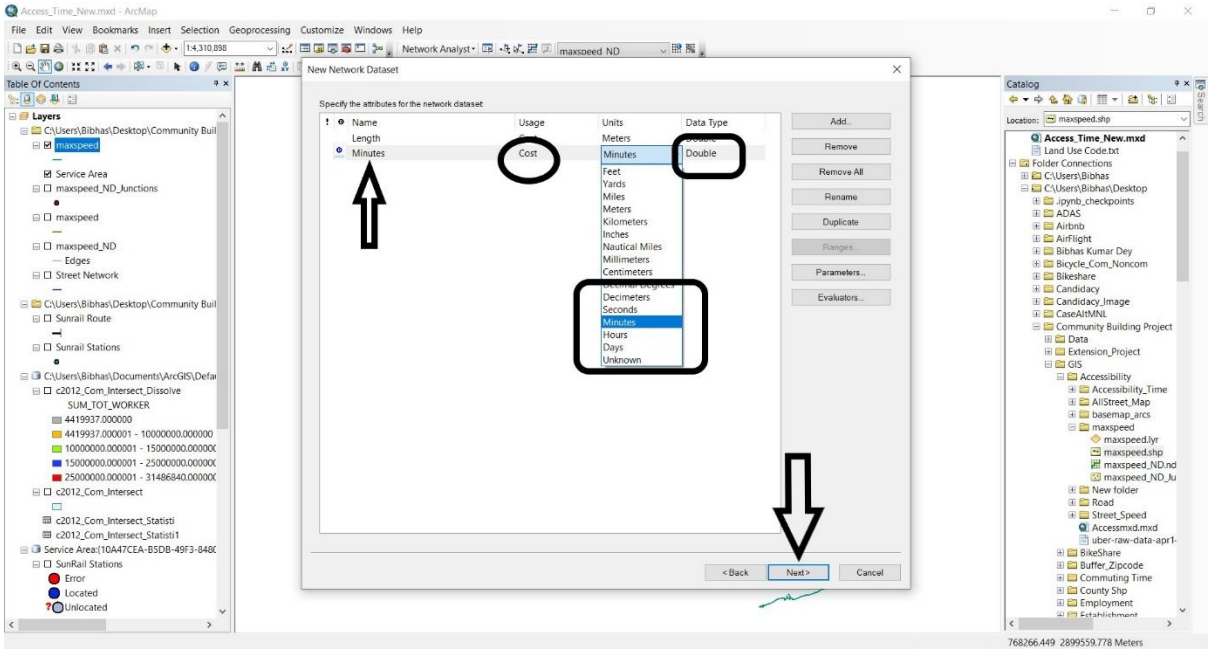
Sunrail Route
Sunrail Stations
c2012_Com_Intersect_Dissolve
SUM_TOT_WORKER
c2012_Com_Intersect
c2012_Com_Intersect_Statisti
c2012_Com_Intersect_Statisti1
SunRail Stations
Error
Located
Unlocated
New Network Dataset
How would you like to model the elevation of your network features?
None
Using Z Coordinate Values from Geometry
Using Elevation Fields
Source
End
Field
maxspeed
From End
maxspeed
To End
Default
Click in the Field column to set elevation fields.
< Back
Next >
Cancel
Catalog
Location:
maxspeed.shp
Access_Time_New.mxd
Land Use Code.txt
Folder Connections
Community Building Project
Data
Extension_Project
GIS
Accessibility
maxspeed
maxspeed.lyr
maxspeed.shp
New folder
Road
Street_Speed
BikeShare
Buffer_Zipcode
Commuting Time
County Shp
Employment
768266.449 2899559.778 Meters

(h)


New Network Dataset
Specify the attributes for the network dataset
Name
Usage
Units
Data Type
Length
Meters
Minutes
Cost
Minutes
Double
Feet
Yards
Miles
Meters
Kilometers
Inches
Nautical Miles
Millimeters
Centimeters
Decimeters
Seconds
Minutes
Hours
Days
Unknown
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Remove
Remove All
Rename
Duplicate
Ranges...
Parameters...
Evaluators...
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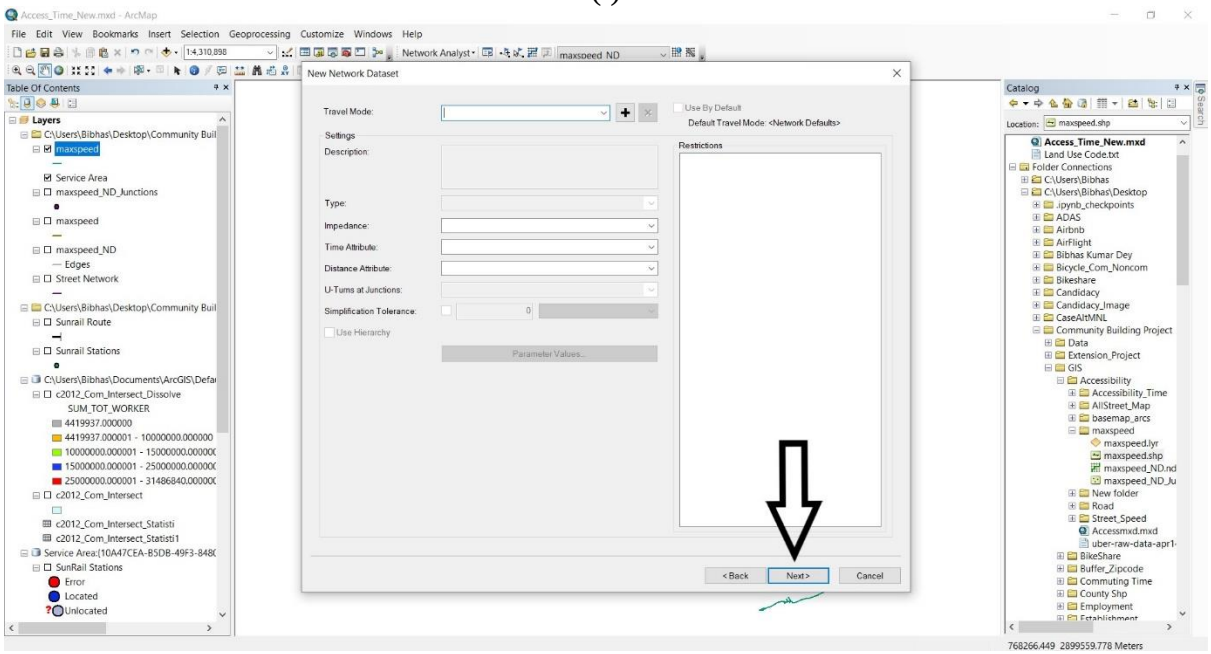
New Network Dataset
Travel Mode:
Use By Default
Default Travel Mode: <Network Defaults>
Settings
Description:
Restrictions
Type:
Impedance:
Time Attribute:
Distance Attribute:
U-Turns at Junctions:
Simplification Tolerance:
Use Hierarchy
Parameter Values...
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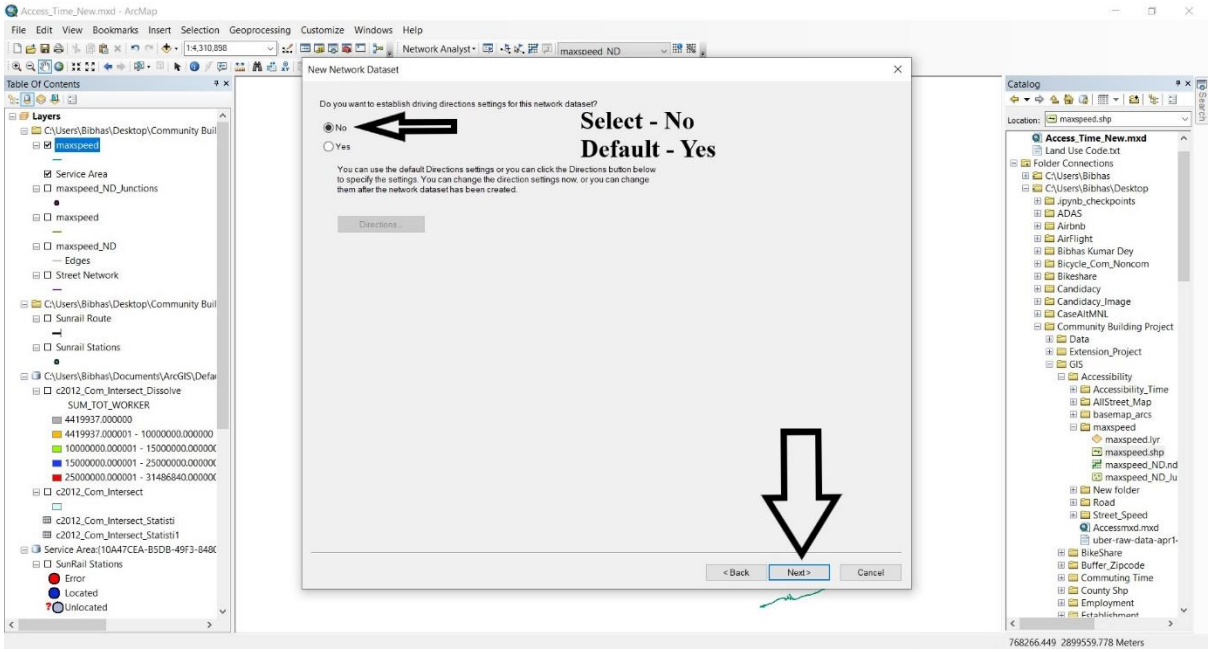
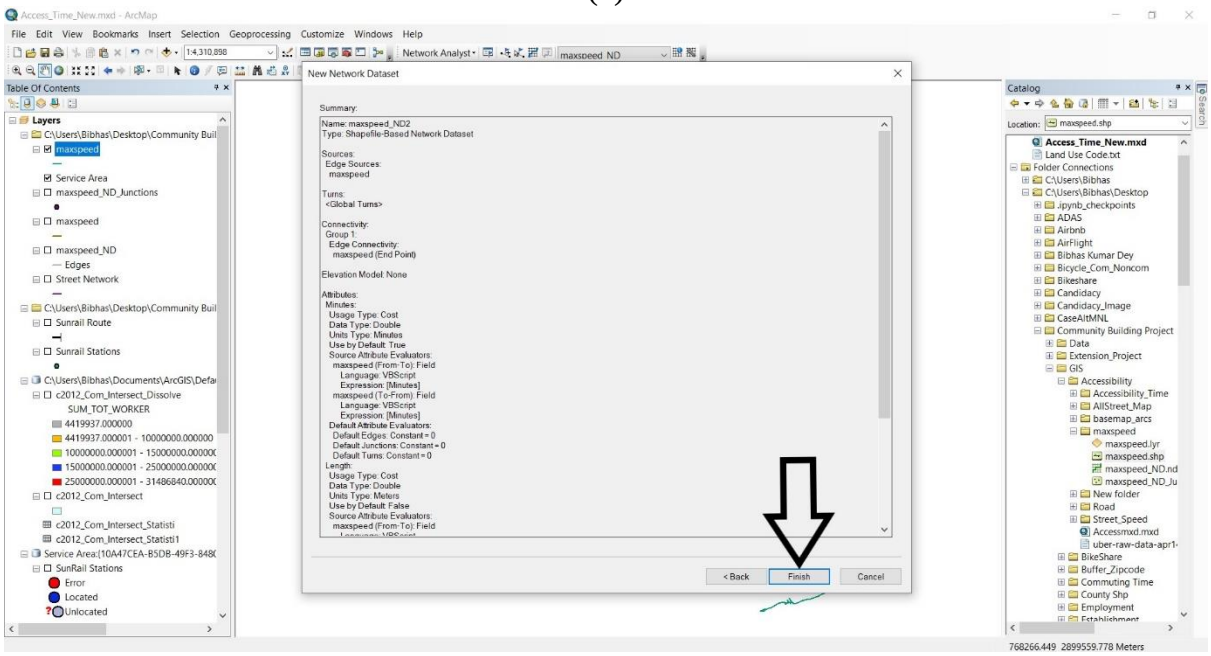
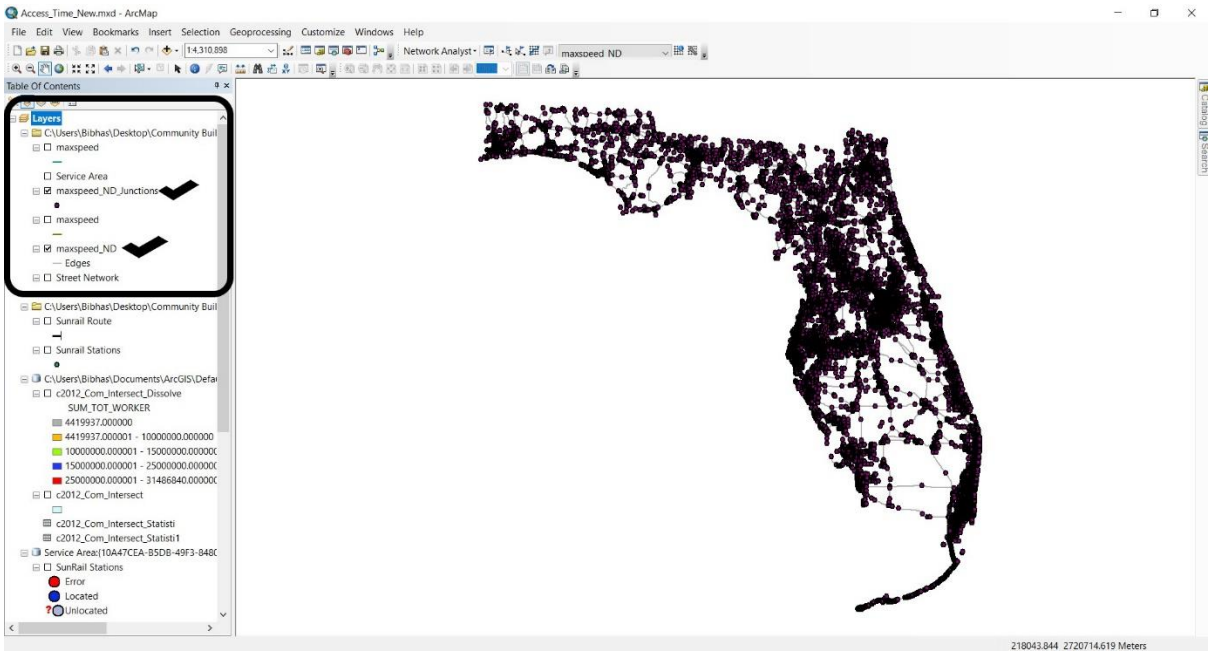

New Network Dataset
Do you want to establish driving directions settings for this network dataset?
No
Yes
Select - No
Default - Yes
You can use the default Directions settings or you can click the Directions button below to specify the settings. You can change the direction settings now, or you can change them after the network dataset has been created.
Directions...
< Back
Next >
Cancel

(k)


New Network Dataset
Summary:
Name: maxspeed_ND2
Type: Shapefile-Based Network Dataset
Sources:
Edge Sources:
maxspeed
Turns:
<Global Turns>
Connectivity:
Group 1:
Edge Connectivity:
maxspeed (End Point)
Elevation Model: None
Attributes:
Minutes:
Usage Type: Cost
Data Type: Double
Units Type: Minutes
Use by Default: True
Source Attribute Evaluators:
maxspeed (From-To): Field
Language: VBScript
Expression: [Minutes]
maxspeed (To-From): Field
Language: VBScript
Expression: [Minutes]
Default Attribute Evaluators:
Default Edges: Constant = 0
Default Junctions: Constant = 0
Default Turns: Constant = 0
Length:
Usage Type: Cost
Data Type: Double
Units Type: Meters
Use by Default: False
Source Attribute Evaluators:
maxspeed (From-To): Field
< Back
Finish
Cancel

(l)



(m)

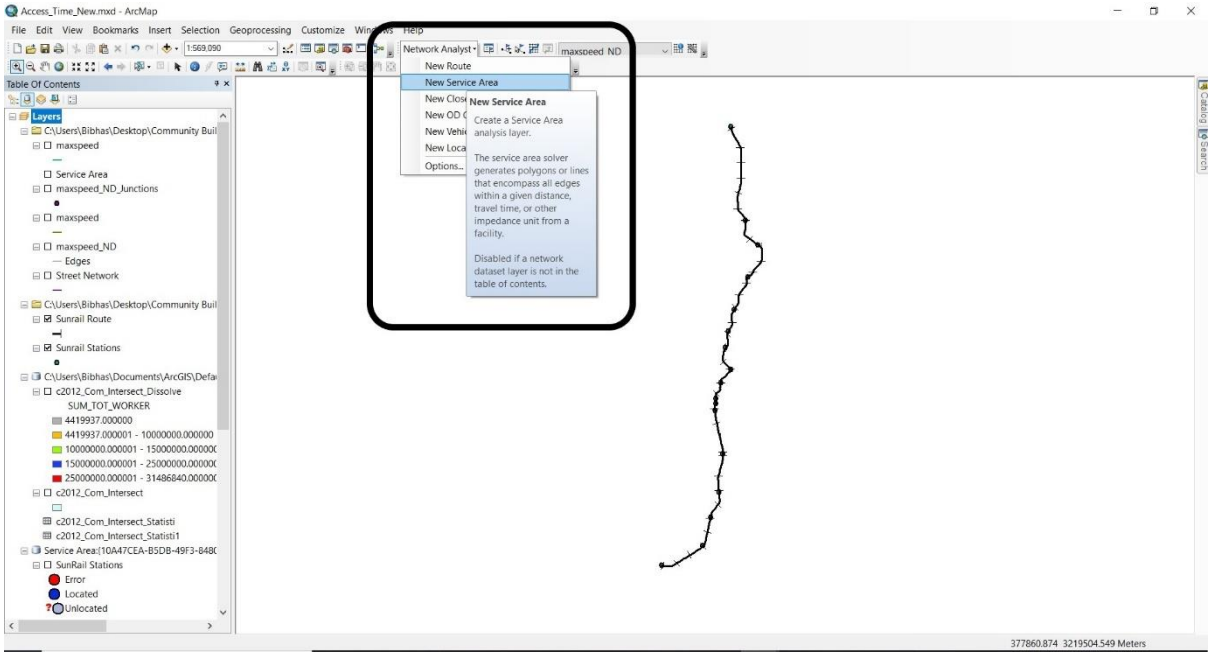
Figure 25: Road Network Create in ArcGIS

3.1.1.2 Driving Area

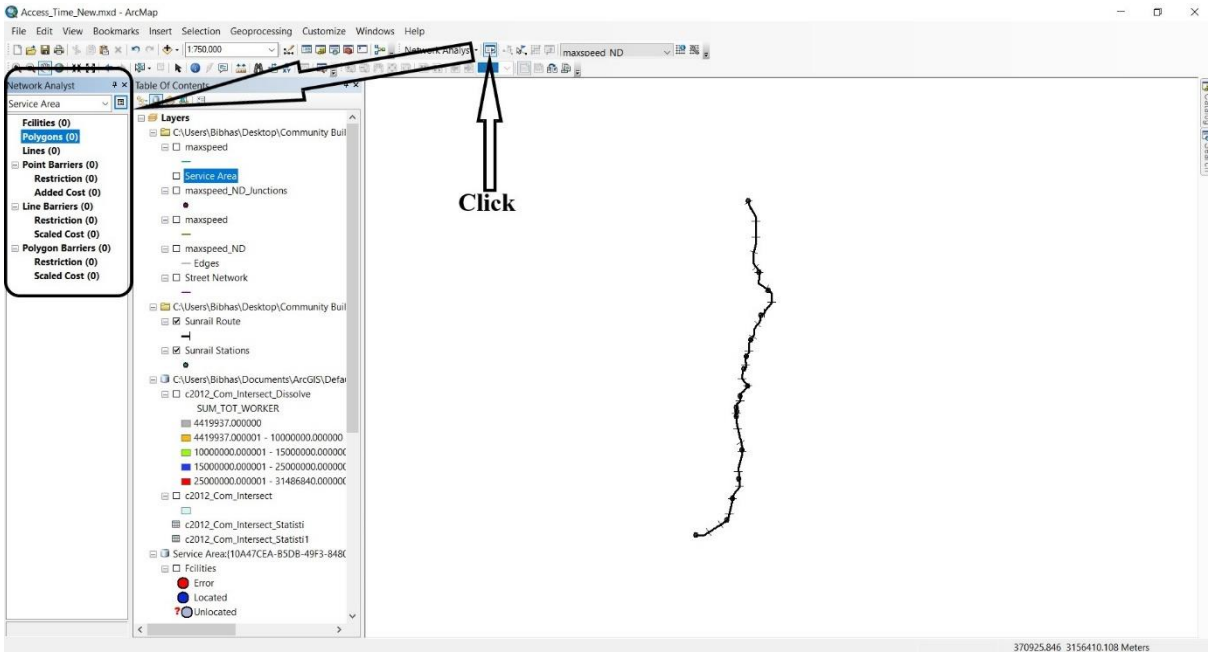
Several steps were followed to create a 10 minutes driving area by using road network in ArcGIS[3].

- Select 'Network Analysts'
- Click on 'New Service Area' (See Figure 26 (a))
- Click Network Analyst Window (See Figure 26 (b))
- Within Network Analyst toolbar, select 'Facilities'
- Click 'Load Locations' in Facilities (See Figure 26 (c))
- Put 'SunRail Stations' in Load Locations (See Figure 26 (d))
- Click 'Service Area' in Layers and select 'Properties' (See Figure 26 (e))
- Click on 'Analysis Settings' in Properties menu bar (See Figure 26 (f))
- In Impedance option, select 'Travel Time (Minutes)'
- In 'Default Breaks' option, put 10 for creating10 minutes driving area
- For the time of the day 8 am was selected
- Tuesday was selected as 'Day of Week'
- Click on 'Solve' as shown in Figure 26 (g) and new 10 minute driving area was created
- For further estimation procedure, 10 minute driving area data need to be export (See Figure 26 (h))
- Figure 27 represents the 10 minutes case area around all SunRail stations

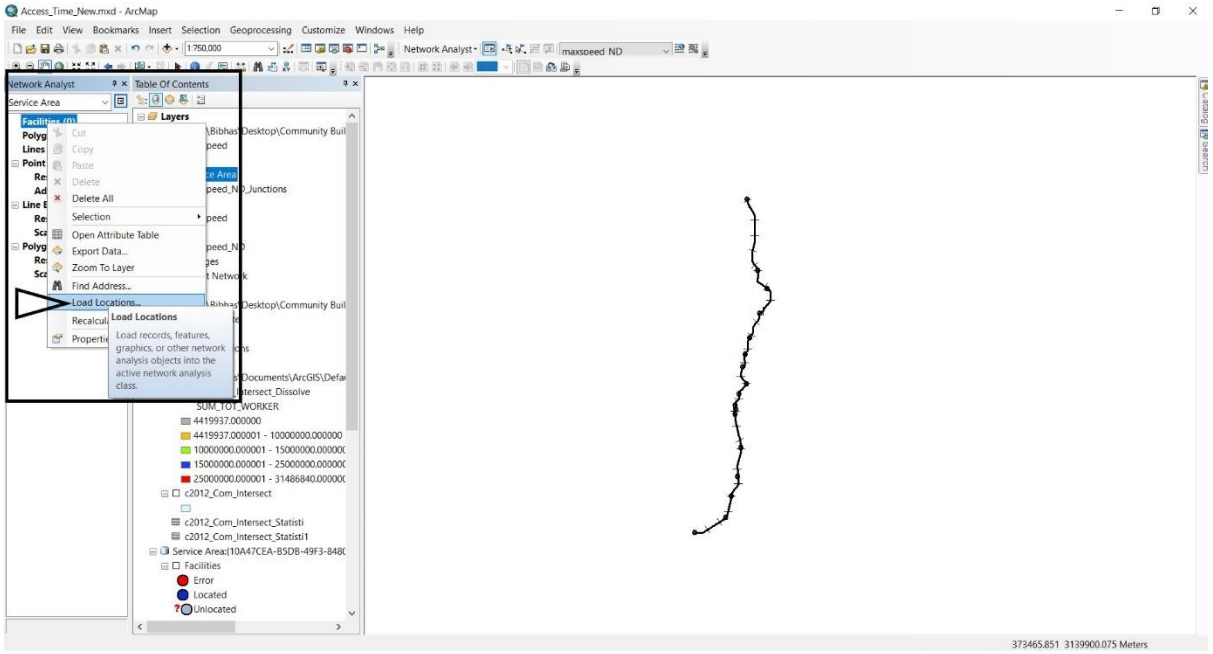
[3] Create drive time areas in ArcGIS (https://doc.arcgis.com/en/arcgis-online/analyze/create-drive-time-areas.htm)


Access_Time_New.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Network Analyst
New Route
New Service Area
New Service Area
Create a Service Area analysis layer.
The service area solver generates polygons or lines that encompass all edges within a given distance, travel time, or other impedance unit from a facility.
Disabled if a network dataset layer is not in the table of contents.
Table Of Contents
Layers
maxspeed
Service Area
maxspeed_ND_Junctions
maxspeed_ND
Edges
Street Network
Sunrail Route
Sunrail Stations
c2012_Com_Intersect_Dissolve
SUM_TOT_WORKER
4419937.000000
4419937.000001 - 10000000.000000
10000000.000001 - 15000000.000000
15000000.000001 - 25000000.000000
25000000.000001 - 31486840.000000
c2012_Com_Intersect
c2012_Com_Intersect_Statisti
c2012_Com_Intersect_Statisti1
SunRail Stations
Error
Located
Unlocated
377860.874 3219504.549 Meters

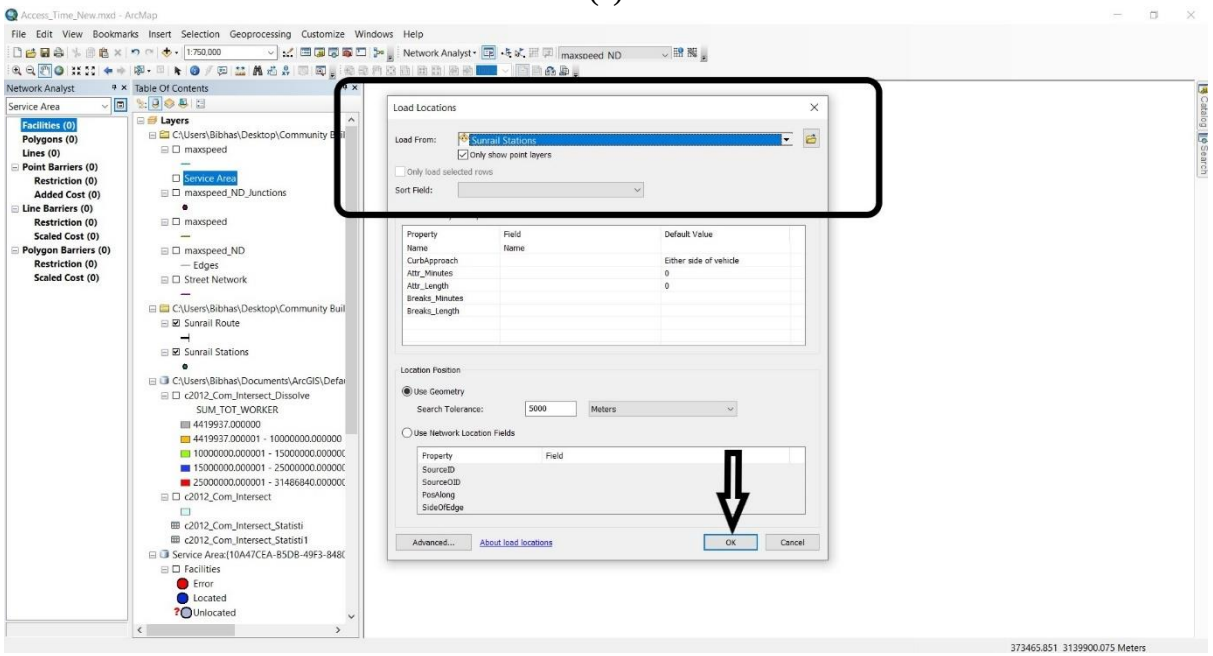
(a)


Access_Time_New.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Network Analyst
Service Area
Facilities (0)
Polygons (0)
Lines (0)
Point Barriers (0)
Restriction (0)
Added Cost (0)
Line Barriers (0)
Restriction (0)
Scaled Cost (0)
Polygon Barriers (0)
Restriction (0)
Scaled Cost (0)
Table Of Contents
Layers
Service Area
Click
370925.846 3156410.108 Meters

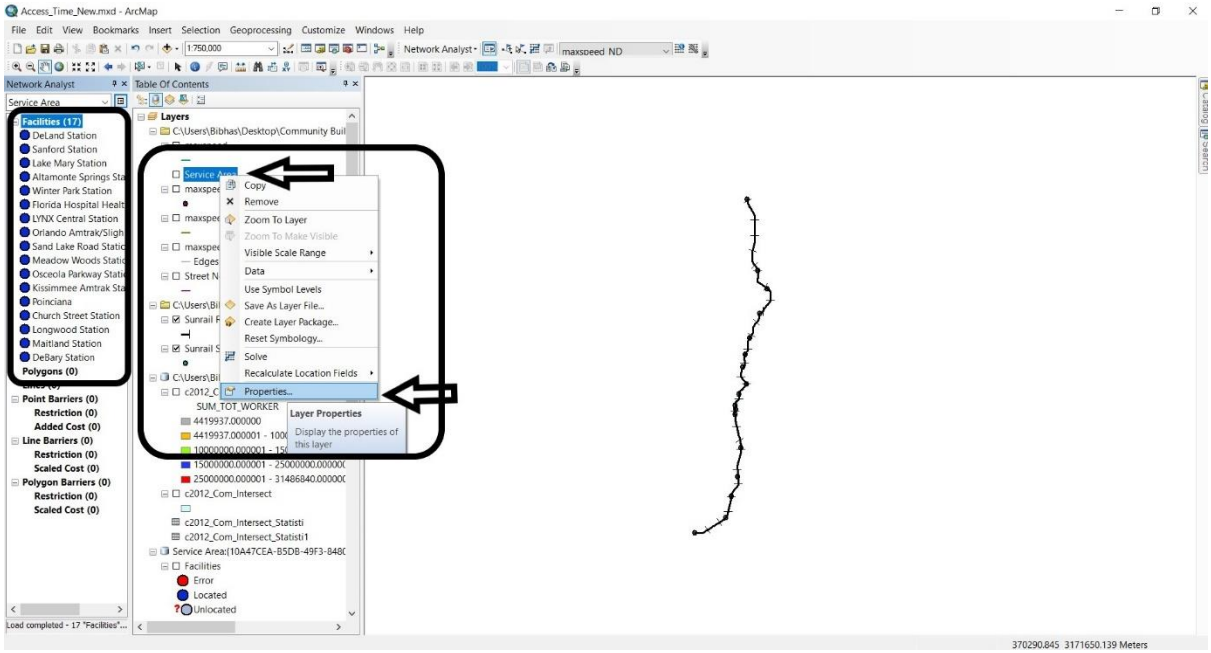
(b)


Access_Time_New.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Network Analyst
Service Area
Table Of Contents
Layers
Cut
Copy
Paste
Delete
Delete All
Selection
Open Attribute Table
Export Data...
Zoom To Layer
Find Address...
Load Locations...
Load Locations
Load records, features, graphics, or other network analysis objects into the active network analysis class.
Facilities
Error
Located
Unlocated
373465.851 3139900.075 Meters

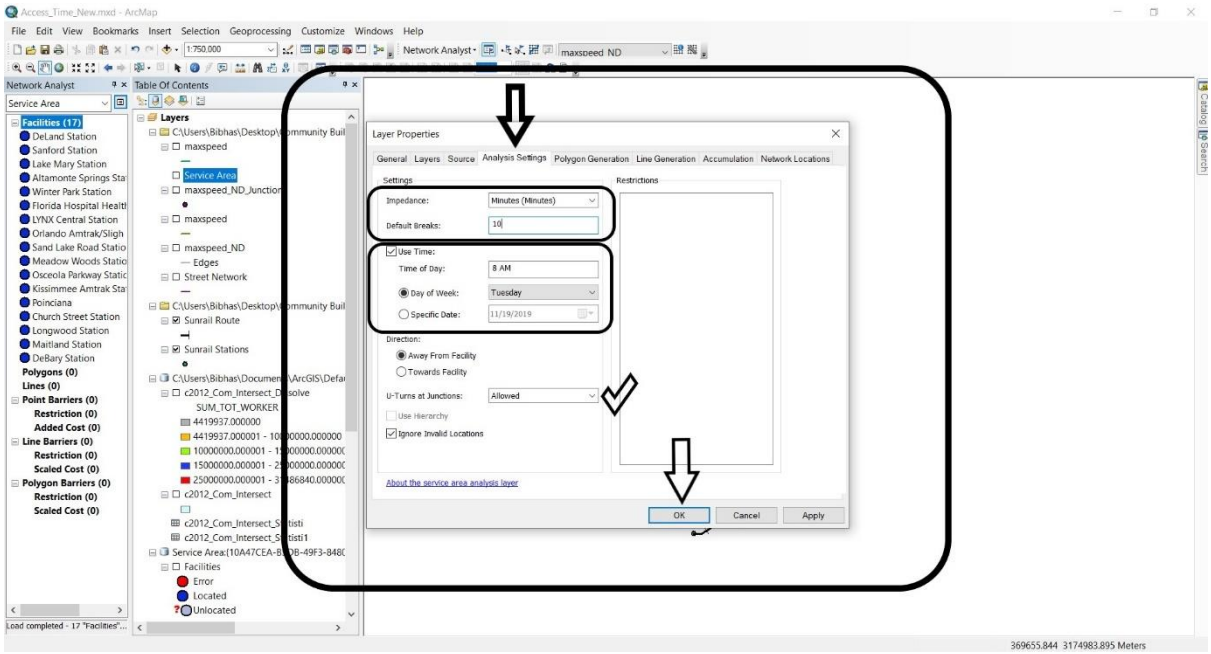
(c)


Access_Time_New.mxd - ArcMap
Load Locations
Load From:
Sunrail Stations
Only show point layers
Only load selected rows
Sort Field:
Property
Field
Default Value
Name
CurbApproach
Either side of vehicle
Attr_Minutes
Attr_Length
Breaks_Minutes
Breaks_Length
Location Position
Use Geometry
Search Tolerance:
5000
Meters
Use Network Location Fields
SourceID
SourceOID
PosAlong
SideOfEdge
Advanced...
About load locations
OK
Cancel
373465.851 3139900.075 Meters

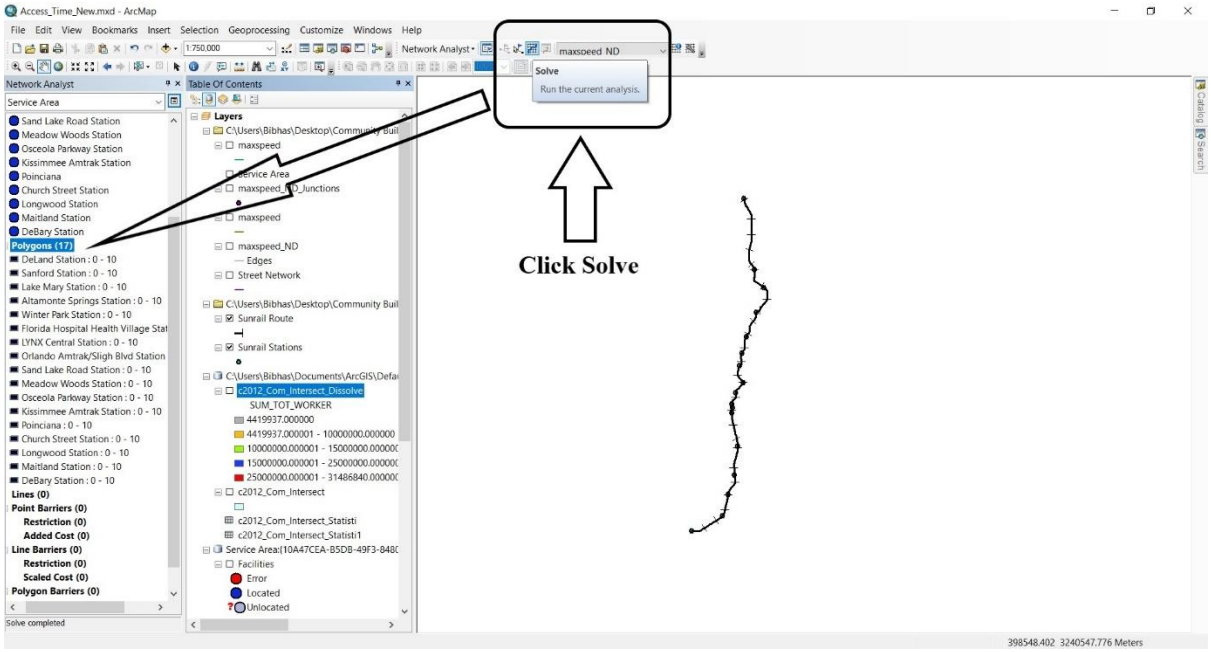
(d)


Access_Time_New.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Network Analyst
Table Of Contents
Facilities (17)
DeLand Station
Sanford Station
Lake Mary Station
Winter Park Station
Florida Hospital Health
LYNX Central Station
Orlando Amtrak/Sligh
Sand Lake Road Static
Meadow Woods Static
Osceola Parkway Static
Kissimmee Amtrak Sta
Poinciana
Church Street Station
Longwood Station
Maitland Station
DeBary Station
Polygons (0)
Point Barriers (0)
Restriction (0)
Added Cost (0)
Line Barriers (0)
Restriction (0)
Scaled Cost (0)
Polygon Barriers (0)
Restriction (0)
Scaled Cost (0)
Layers
Service Area
Copy
Remove
Zoom To Layer
Zoom To Make Visible
Visible Scale Range
Data
Use Symbol Levels
Save As Layer File...
Create Layer Package...
Reset Symbology...
Solve
Recalculate Location Fields
Properties...
Layer Properties
Display the properties of this layer
SUM_TOT_WORKER
c2012_Com_Intersect
Facilities
Error
Located
Unlocated
370290.845 3171650.139 Meters

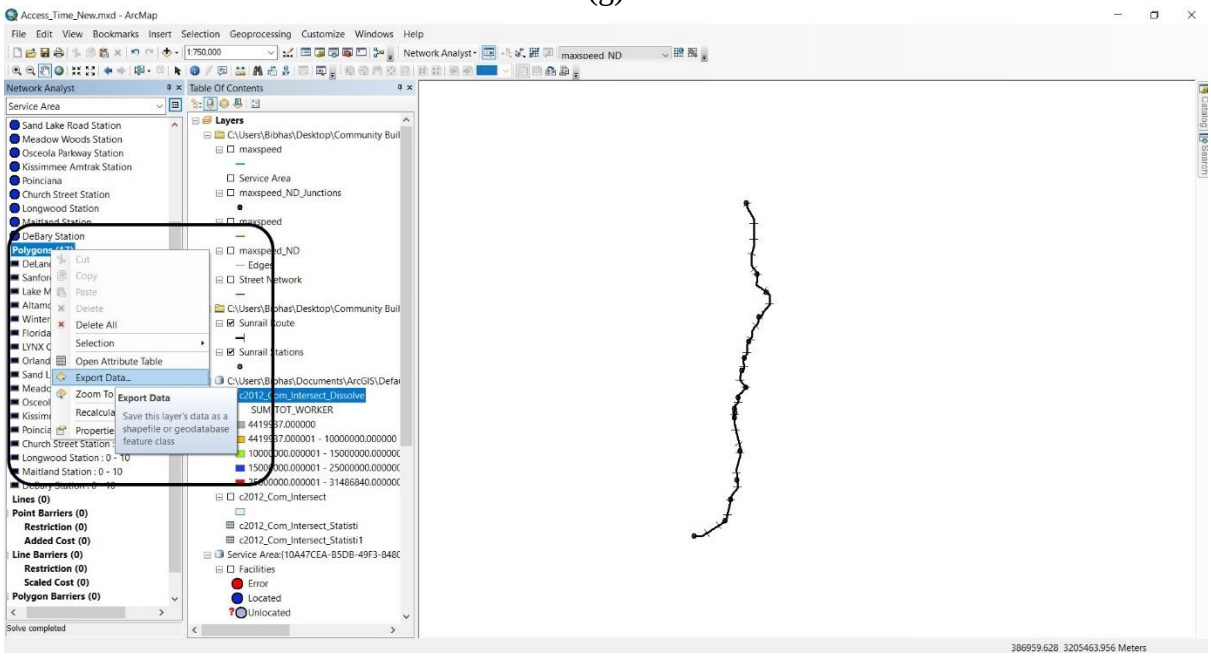
(e)


Access_Time_New.mxd - ArcMap
Layer Properties
General Layers Source Analysis Settings Polygon Generation Line Generation Accumulation Network Locations
Settings
Restrictions
Impedance:
Minutes (Minutes)
Default Breaks:
10
Use Time:
Time of Day:
8 AM
Day of Week:
Tuesday
Specific Date:
11/19/2019
Direction:
Away From Facility
Towards Facility
U-Turns at Junctions:
Allowed
Use Hierarchy
Ignore Invalid Locations
About the service area analysis layer
OK
Cancel
Apply
369655.844 3174983.895 Meters

(f)



(g)



(h)

Figure 26: Network Driving Area

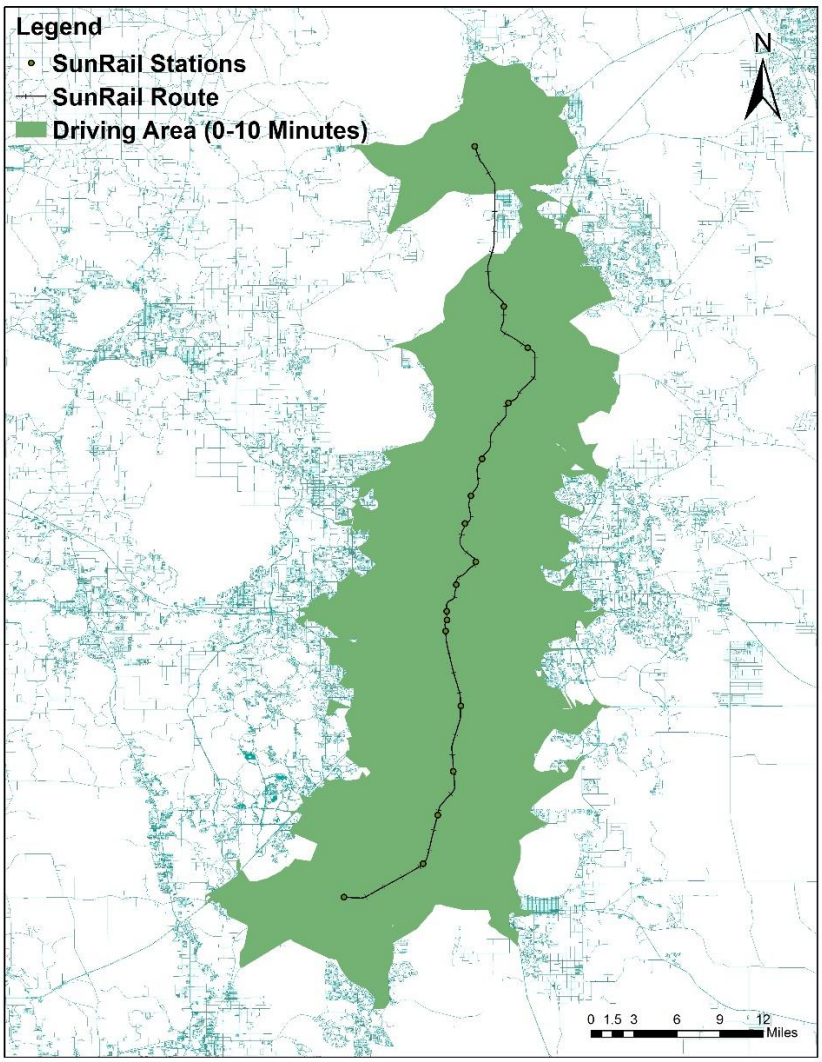


Figure 27: Driving Network Area Across SunRail Stations

3.1.2 Control Area Selection

- To examine the economic impact of SunRail commuter system with respect to number of employed persons, control areas were selected using following procedure: First, we draw a 10 minutes car driving area around the stations.
- We select 20-30 minutes car driving time as our control threshold. Second, the census tracts located within this 10 minute threshold area (between 20 and 30 minutes) were selected to be the candidate control.
- Control area selection procedure is almost same as case area. We put 20 and 30 minutes in 'Default Breaks' option instead of 10 for case area (see Figure 28).
- Figure 29 represents the control area around all SunRail stations.

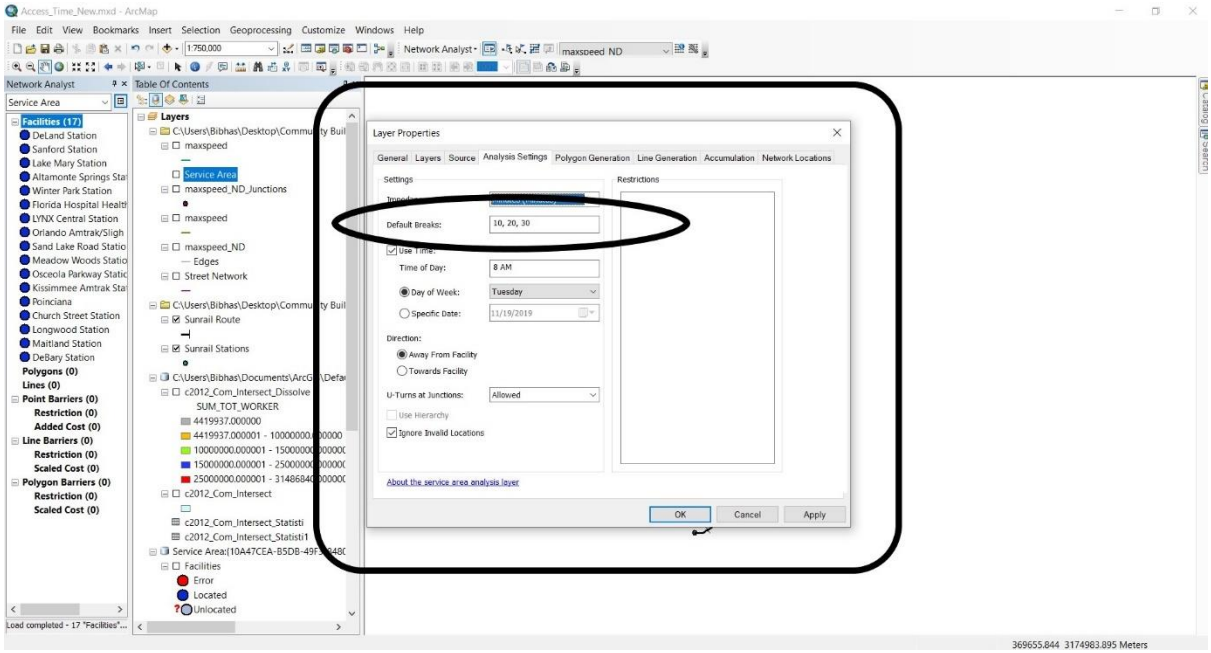


Figure 28: Control Area

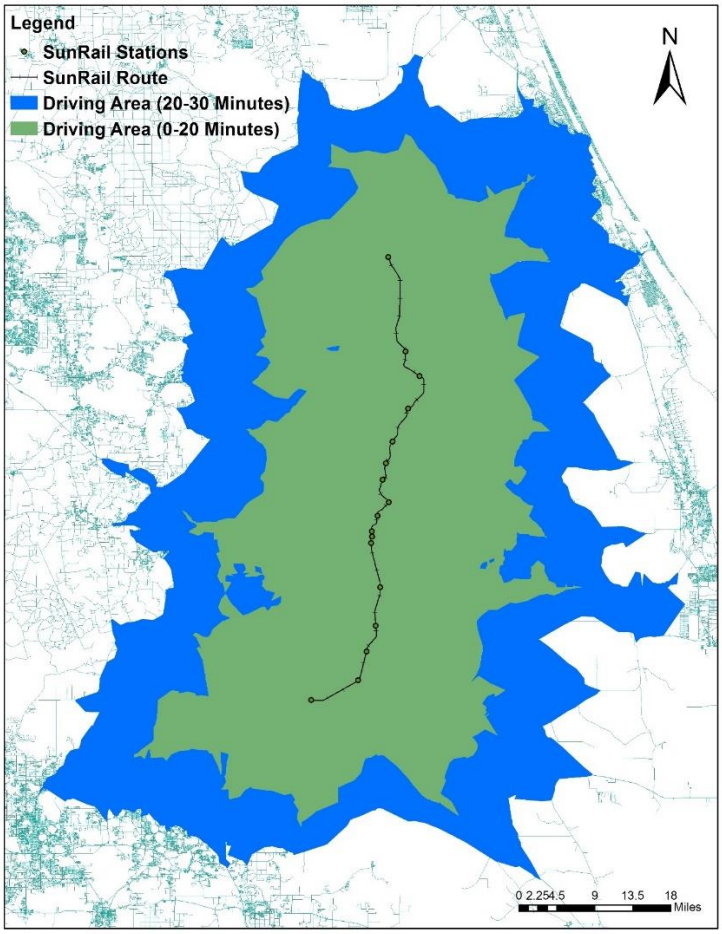


Figure 29: Control Area Across SunRail Station

3.1.3 Accessible Job Estimation

After case and control area selection, all other procedure is quite similar to property value estimation. The employment (number of workers in the labor force) data was drawn from American Community Survey (ACS) was used instead of parcel data for property value.

4 COMMUTING TIME

The whole procedure is similar to property value estimation except average commuting time data (journey to work in minutes) per census tract of Florida drawn from American Community Survey (ACS) were used as an alternative of parcel data.

5 LAND USE CHANGE

The same parcel data similar to property value was used to estimate land use change. After case and control area selection, SPSS file was used to estimate the total area change from vacant to various land use type.

6 TRAVEL PATTERN FOR ZEO CAR HOUSEHOLDS

The means of transportation to work by household vehicle fleet size data at the census tract level for 2011-2016 was extracted from American Community Survey (ACS) was used to estimate the percentage of trip number by various modes for zero car households. The estimation procedure is similar to property value estimation.

APPENDIX A: DOR BASED LAND USE CODE

001 = Single Family Residential
002 = Mobile Homes
003 = Multi-family - 10 units or more
004 = Condominiums
005 = Cooperatives
006 = Retirement Homes not eligible for exemption.
007 = Miscellaneous Residential (migrant camps, boarding homes, etc.)
008 = Multi-family - less than 10 units
009 = Residential Common Elements / Areas
010 = Vacant Commercial
011 = Stores One-Story
012 = Mixed use - store and office or store and residential or residential combination
013 = Department Stores
014 = Supermarkets
015 = Regional Shopping Centers
016 = Community Shopping Centers
017 = Office buildings, non-professional service buildings, one story
018 = Office buildings, non-professional service buildings, multi-story
019 = Professional Service Buildings
020 = Airports (private or commercial), bus terminals, marine terminals, piers, marinas.
021 = Restaurants, Cafeterias
022 = Drive-in Restaurants
023 = Financial institutions (banks, saving and loan companies, mortgage companies, credit services)
024 = Insurance Company Offices
025 = Repair service shops (excluding automotive), radio and T.V. repair, refrigeration service, electric repair, laundries, laundromats.
026 = Service Stations
027 = Auto sales, auto repair and storage, auto service shops, body and fender shops, commercial garages, farm and machinery sales and services, auto rental, marine equipment, trailers and related equipment, mobile home sales, motorcycles, construction vehicle sales.
028 = Parking lots (commercial or patron) mobile home parks.
029 = Wholesale outlets, produce houses, manufacturing outlets.
030 = Florist, greenhouses
031 = Drive-in theaters, open stadiums
032 = Enclosed theaters, enclosed auditoriums
033 = Nightclubs, cocktail lounges, bars
034 = Bowling alleys, skating rinks, pool halls, enclosed arenas
035 = Tourist attractions, permanent exhibits, other entertainment facilities, fairgrounds (privately owned).
036 = Camps

037 = Race tracks; horse, auto or dog
038 = Golf courses, driving ranges
039 = Hotels, motels
040 = Vacant Industrial
041 = Light manufacturing, small equipment manufacturing plants, small machine shops, instrument manufacturing printing plants.
042 = Heavy industrial, heavy equipment manufacturing, large machine shops, foundries, steel fabricating plants, auto or aircraft plants
043 = Lumber yards, sawmills, planing mills
044 = Packing plants, fruit and vegetable packing plants, meat packing plants
045 = Canneries, fruit and vegetable, bottlers and brewers distilleries, wineries
046 = Other food processing, candy factories, bakeries, potato chip factories
047 = Mineral processing, phosphate processing, cement plants, refineries, clay plants, rock and gravel plants
048 = Warehousing, distribution terminals, trucking terminals, van and storage warehousing
049 = Open storage, new and used building supplies, junk yards, auto wrecking, fuel storage, equipment and material storage
050 = Improved agricultural
051 = Cropland soil capability Class I
052 = Cropland soil capability Class II
053 = Cropland soil capability Class III
054 = Timberland - site index 90 and above
055 = Timberland - site index 80 to 89
056 = Timberland - site index 70 to 79
057 = Timberland - site index 60 to 69
058 = Timberland - site index 50 to 59
059 = Timberland not classified by site index to Pines
060 = Grazing land soil capability Class I
061 = Grazing land soil capability Class II
062 = Grazing land soil capability Class III
063 = Grazing land soil capability Class IV
064 = Grazing land soil capability Class V
065 = Grazing land soil capability Class VI
066 = Orchard Groves, Citrus, etc.
067 = Poultry, bees, tropical fish, rabbits, etc.
068 = Dairies, feed lots
069 = Ornamentals, miscellaneous agricultural
070 = Vacant, with or without extra features
071 = Churches
072 = Private schools and colleges
073 = Privately owned hospitals
074 = Homes for the aged

075 = Orphanages, other non-profit or charitable services
076 = Mortuaries, cemeteries, crematoriums
077 = Clubs, lodges, union halls
078 = Sanitariums, convalescent and rest homes
079 = Cultural organizations, facilities
080 = Vacant Governmental
081 = Military
082 = Forest, parks, recreational areas
083 = Public county schools - include all property of Board of Public Instruction
084 = Colleges
085 = Hospitals
086 = Counties (other than public schools, colleges, hospitals) including non-municipal government.
087 = State, other than military, forests, parks, recreational areas, colleges, hospitals
088 = Federal, other than military, forests, parks, recreational areas, hospitals, colleges
089 = Municipal, other than parks, recreational areas, colleges, hospitals
090 = Leasehold interests (government owned property leased by a non-governmental lessee)
091 = Utility, gas and electricity, telephone and telegraph, locally assessed railroads, water and sewer service, pipelines, canals, radio/television communication
092 = Mining lands, petroleum lands, or gas lands
093 = Subsurface rights
094 = Right-of-way, streets, roads, irrigation channel, ditch, etc.
095 = Rivers and lakes, submerged lands
096 = Sewage disposal, solid waste, borrow pits, drainage reservoirs, waste land, marsh, sand dunes, swamps
097 = Outdoor recreational or parkland, or high-water recharge subject to classified use assessment.
098 = Centrally assessed
099 = Acreage not zoned agricultural with or without extra features
100 = Parcels with no values.
995 = No Data Available (Water)
999 = No Data Available