

# How Many People Live Within Walking Distance to a Bus Stop?



# Thinking About Mode Choice

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Whether it's down a sidewalk or across a parking lot, all transit trips require a discrete duration of active locomotion (e.g. walking) to access the public transportation network. When a typical traveler determines their preferred mode of travel, time to destination often dominates any other factor. In this regard, fixed-route transit is at a disadvantage to driving as it usually consumes more time. Even in the most advantageous of circumstances, each minute of additional time walking to transit stops broadens transit's handicap.

How much walking time do residents need to account for to access the current transit system?



# Steps To An Estimate

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- 1. Constrict Block Group Geometry to Residential Parcels**
- 2. Build a Transit Network Dataset Connected to Bus Stops**
- 3. Perform a Service Area Analysis to Generate Walking Time Bands**
- 4. Overlay and Proportionally Aggregate Block Groups and Time Bands**



# Thinking About Population

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**Block Group is the most granular offering offered by the Census Bureau. However, It's not granular enough to answer the question we are asking.**

**What's smaller than block group that is readily available?**  
**Parcels**

**Data Sources:**

**GISMO for Parcel Data**

**gismo.GISSDE.PCL\_PARCEL\_P**

**"APN" JOIN "PARCEL"**

**gismo.GISSDE.PCL\_AOEXT**



# Resident Parcels Step 1

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The following Structured Query Language (SQL) statement goes a long ways toward isolating residential parcels. It selects plats and condos.

**(Label\_Class = 701 Or Label\_Class = 703 Or Label\_Class = 704 Or  
Label\_Class = 705 Or Label\_Class = 803 Or Label\_Class = 807 Or  
Label\_Class = 811) And PARCELTYPE <> 2**

**701 = "Acreage 200"**

**703 = "Sub/Platted Parcel 200"**

**704 = "Sub/Platted Parcel 800"**

**705 = "Residential Condo Boundary 200"**

**803 = "Commercial Condo Unit 200"**

**807 = "Commercial Ground 200"**

**811 = "Sub/Platted Acreage Parcel 200"**

**2 = "Air Rights"**

**<> = "Is Not Equal To"**



# Resident Parcels Step 2

The following SQL statement removes remaining parcels that otherwise wouldn't house any population (golf course, etc.) by referencing single family residential, multi-residential land use codes.

```
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '30.120' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '31.110' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '32.100' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '32.130' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '32.140' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '32.140.C' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '33.100' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '33.150' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '34.150' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '35.180' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '36.100' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '37.100' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '39.100' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '20.110' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '21.150.C' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '21.170.C' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '22.110' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '23.185' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '23.188' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '24.150' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '24.150.C' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '24.160' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '24.160.C' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '26.110' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '27.100' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '27.195' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '28.199' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '28.710' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE = '29.110' Or  
gismo.GISSDE.PCL_AOEXT.STATELANDUSE IS NULL
```



# Resident Parcels Step 3

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Use the Simplify Polygon Tool on the remaining parcels to reduce vertice count. This helps speed up processing time.

Clip block groups with the now simplified residential parcels. This restricts the total area of block groups to the areas more relevant to population statistics. This improves the validity of overlay estimates.

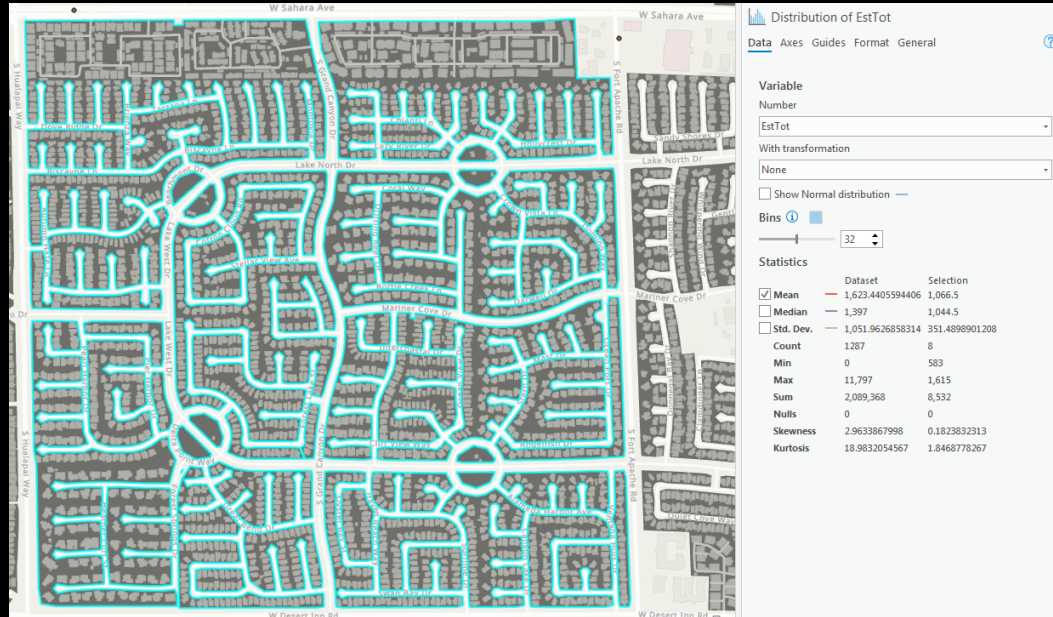
Join Census Population to Block Groups

ACS\_17\_5YR\_B25008

[Pop In Occupied Housing Units](#)



# Resident Parcels Result





# Transit Network Functionality

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## What's new and improved in ArcGIS Pro 2.4 (released on June 27th, 2019).

- You can now perform network analysis using [public transit data](#). To do this, configure your network dataset to include public transit stops, lines, and schedules in the format defined in the new [public transit data model](#). Configure a cost attribute on the network dataset to use the [Public Transit evaluator](#), which calculates the travel time along a public transit line segment based on the scheduled public transit service.
- Create and populate the public transit data model feature classes and tables from GTFS public transit data by running the [GTFS to Network Dataset Transit Sources](#) and [Connect Network Dataset Transit Sources to Streets](#) geoprocessing tools.
- Requires network analyst license.



# Transit Network Data Inputs

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**GTFS Data – Open Mobility Data Website**  
**10 March 2019 - 7 December 2019**

**GISMO Street Center Lines**  
**SCL\_Streets\_L**

**After reviewing the data, it is of fairly high quality and suitable for use with the tool. However, In order for our street center lines to be compatible with ESRI's public transit data model, two fields are required to be calculated: "ROAD\_CLASS" and "RestrictPedestrians".**



# Road\_Class Python Function

reclass(!STRCLASS!)

def reclass(STRCLASS):

```
    if STRCLASS == "Tributary":
        return 1
    elif STRCLASS == "Local":
        return 1
    elif STRCLASS == "Access":
        return 1
    elif STRCLASS == "4WD High Clearance":
        return 2
    elif STRCLASS == "Rural Travel":
        return 2
    elif STRCLASS == "Emerg Vehicles Only":
        return 2
    elif STRCLASS == "Interstate":
        return 2
    elif STRCLASS == "State Highway":
        return 2
    elif STRCLASS == "County Highway":
        return 2
    elif STRCLASS == "US Highway":
        return 2
    elif STRCLASS == "Collector":
        return 6
    elif STRCLASS == "Major Street":
        return 6
    elif STRCLASS == "Ramp":
        return 3
    else:
        return 99
```

Road class value	Type of road class	Example directions text
1	Local roads	Turn left on Main St.
2	Highways	Go east on I-55.
3	Ramps	Take ramp and go on US-59 N.
4	Ferries	Take Lake Expy ferry.
5	Roundabouts	Take roundabout and proceed south on Main St.
6	Major roads	Turn left on Redlands Blvd.
10	Walkways	Turn left.
11	Turning arcs	Turn left and go through M1w Hallway.
12	Stairs	Take the stairs up.
13	Escalator	Take the escalator up.
14	Elevator	Take the elevator up.
15	Pedestrian Ramp	Take the ramp up to level 2.



# RestrictPedestrians SQL Statement

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**RestrictPedestrians = "Y"**

**STRCLASS = 'Ramp' Or**

**STRCLASS = 'County Highway' Or**

**STRCLASS = 'US Highway' Or**

**STRCLASS = 'Interstate' Or**

**STRCLASS = 'State Highway' Or**

**STREET LIKE '%Summerlin Pkwy%' Or**

**STREET LIKE '%Airport N Connector%' Or**

**STREET LIKE '%Airport S Connector %' Or**








**STREET LIKE '%W Boulder City Pkwy%' Or**

**STREET LIKE '%E Boulder City Pkwy%'**



# Transit Network Creation

[Tutorial Link](#)

 Run	 Import Facilities		Mode:	<input type="text" value="Walking Impedance Time"/>	<input type="text" value="min"/>		Day of Week	<input type="text" value="8:00 AM"/>	 Polygons	High Precision
			Direction:	 Towards Facilities			<input type="text" value="Wednesday"/>	Dissolve		
			Cutoffs:	<input type="text" value="2, 5, 10, 15, 20, 40, 60, 120,"/>				Rings		
Analysis	Input Data		Travel Settings				Arrive/Depart Time			Output Geometry



# Add Walking Only Travel Mode

Network Dataset Properties: TransitNetwork\_ND

General  
Source Settings  
Traffic  
**Travel Attributes**

**Travel Modes** Costs Restrictions Descriptors Time Zone Hierarchy

These are the available travel modes of the network dataset.

Walking Impedance Time

Description  
Walking Only!

1011 characters remaining

Type  
Walking

Costs

Impedance  
WalkTime minutes

Time Cost  
WalkTime minutes

Distance Cost  
Length meters

Cost Parameters

Attribute	Parameters
PublicTransitTime	<null>, <null>, <null>, False, False
WalkTime	83.3333

Restrictions

These are the available restrictions of the network dataset. Choose the restrictions to apply to this travel mode.

Attribute	Parameters
<input checked="" type="checkbox"/> PedestrianRestriction	Prohibited
<input type="checkbox"/> WheelchairRestriction	Prohibited

U-Turns

Choose the types of street junctions where u-turns are allowed when traveling between locations.

All

Advanced

[Learn more about travel mode settings](#)

OK Cancel

# Service Area Analysis Results

## Drawing Order

- ☒ Map
- ☒ Stops
  -
- ☒ Streets
- ☐ GovCenter Transit PM
- ☐ GovCenter Transit AM
- ☒ Walking Impedance Time Service Area
  - ☐ Facilities
  - ☐ Point Barriers
  - ☐ Lines
  - ☒ Line Barriers
  - ☒ Polygons
  - Cutoff
    - 120
    - 60
    - 40
    - 20
    - 15
    - 10
    - 5
    - 2
- ☒ Polygon Barriers
- ☐ Walking Impedance Length
- ☐ BlockGroupClarkCounty18
- ☐ StopsOnStreets
- ☐ StopConnectors



# TransCAD Overlay Analysis

Inputs: Block Group Shapefile & Service Area Shapefile

The screenshot displays the TransCAD (Licensed to RTC) interface. The main map window, titled 'Map1 - WalkTimeToStopsServiceArea', shows a green-shaded area representing the service area. The 'Display Manager' on the left lists two layers: 'WalkTimeToStopsServiceArea' and 'BlockGroupClarkCounty18Resident'. The 'Overlay Attributes' dialog box is open, showing a table of attributes for the 'WalkTimeToStopsServiceArea' layer. The table has columns for Field, Copy, Add, Highest, Lowest, Std Dev, Average, and Weight by. The 'EstTot' field is selected, and its 'Weight by' is set to 'None'. The 'Choose Attributes' section at the bottom shows a table with checkboxes for 'Copy', 'Add', 'Highest', 'Lowest', 'Std Dev', 'Average', and 'Weight by'. The 'Add' checkbox is checked. The 'Filter' field is empty. The 'Overlay (Layer: WalkTimeToStopsServiceArea)' dialog box is also open, showing the 'Overlay' dropdown set to 'All Features (8)', 'Buffer size' set to '0 Miles', 'With' layer set to 'BlockGroupClarkCounty18Resident', 'Include' set to 'All Features (1,287)', and 'Count the Number of Features' checked. The 'Reporting' section shows 'Create a Report' checked, with a title of 'Overlay Report'.

Field	Copy	Add	Highest	Lowest	Std Dev	Average	Weight by
[Id:1]							None
GEOID_1							None
Geography							None
EstTot		◆				◆	None
MoeTot		•				•	None
EstTotOwn		•				•	None
MoeTotOwn		•				•	None
EstTotRent		•				•	None
MoeTotRent		•				•	None
Shape_Leng		•				•	None
Shape_Area		•				•	None

Choose Attributes:	Copy	Add	Highest	Lowest	Std Dev	Average	Weight by
	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	None



# TransCAD Overlay Analysis Results

Clark County Population in Occupied Housing Units - 2,089,601; ACS 17 5yr

ToBreak	WalkTimeToStopsServiceArea.Shape_Leng	WalkTimeToStopsServiceArea.Shape_Area	BlockGroupClarkCounty18Reside.ID	[N BlockGroupClarkCounty18Resident]	ALAND	[Avg ALAND]	AWATER	[Avg AWATER]	OBJECTID_1	[Avg OBJECTID_1]	EstTot	[Avg EstTot]	MoeTot
120.0000000000	1205175.9642500000	978736433.84300005000	1	55	574587434.45	20790405.64	928810.97	33607.34	30658.67	1109.33	77062.20	2788.36	10126.42
60.0000000000	1552085.58636000010	743701322.96899998000	2	104	470547310.37	12924190.87	82624.89	2269.40	29894.51	821.09	83704.51	2299.05	15017.90
40.0000000000	2987023.61443000010	1704228995.55000000000	3	256	529614366.07	5222253.47	306801.79	3025.21	80563.43	794.39	203492.51	2006.53	37686.94
20.0000000000	3724540.69558000010	844669611.48399997000	4	364	131883267.98	1943569.99	43832.13	645.96	50279.18	740.97	127999.75	1886.34	24649.97
15.0000000000	6638961.13946000020	1472083194.08999990000	5	721	212793524.93	1295385.82	82029.97	499.36	116257.57	707.72	283035.63	1722.99	61633.57
10.0000000000	10523299.81810000000	2650998009.53000020000	6	1073	371405188.87	892153.33	94238.96	226.37	251019.59	602.97	641706.95	1541.45	157291.94
5.0000000000	10709933.95800000100	1822834065.80000000000	7	1015	208111950.33	669405.18	26303.20	84.61	164947.32	530.56	441448.48	1419.95	114889.50
2.0000000000	5732684.53871999960	1224566835.96000000000	8	950	70261708.75	622437.36	14732.59	130.51	58004.93	513.86	157250.78	1393.06	41888.54

TimeBreakMins	EstPopWithin	EstPopUnder	EstPctUnder
60 - 120	77,062	2,015,701	96%
40 - 60	83,705	1,938,639	93%
20 - 40	203,493	1,854,934	89%
15 - 20	128,000	1,651,442	79%
10 - 15	283,036	1,523,442	73%
5 - 10	641,707	1,240,406	59%
2 - 5	441,448	598,699	29%
0 - 2	157,251	157,251	8%



# Spot Validity Check, Windmill & Jones

