GREATER NASHVILLE REGIONAL COUNCIL

MAX BAKER| NOVEMBER 7, 2023

Replica

ARE YOU EXPERIENCED?

STEREO
THE
Jimi Hendrix experience
reprise
Are You Experienced
reprise
STEREO

GNRC

GREATER NASHVILLE REGIONAL COUNCIL

A-Side: Audition

The Players

Replica

Checked almost every box

Streetlight

Lacked multimodal and demographic information

INRIX

Already use and are the source information for most options

What is Replica?

Places

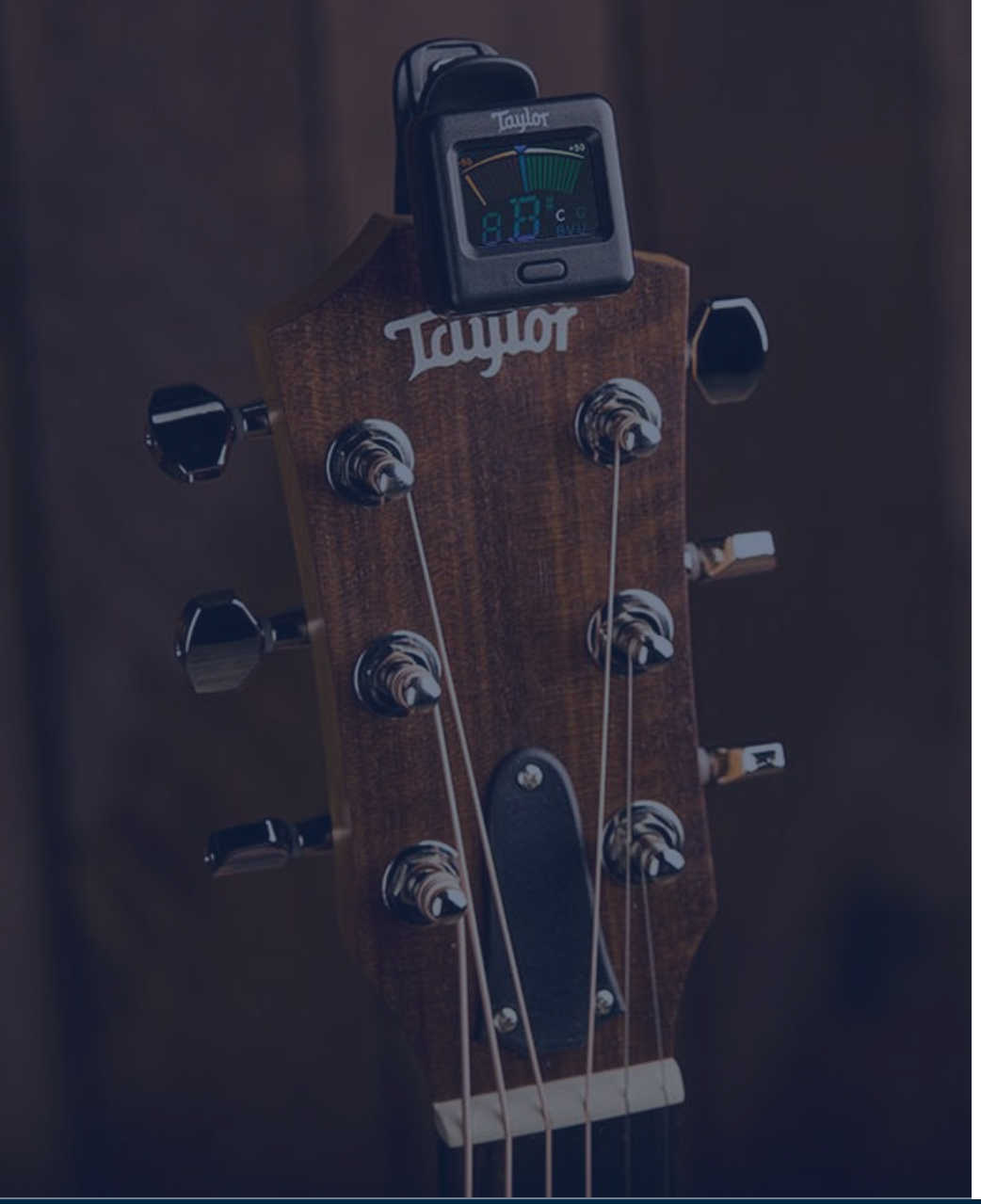
Interactive map with filters and summaries of trips and people for a modeled season

Trends

Weekly updates of O-Ds, VMT, and spending

Traffic Data

AADT, turning movements, volume and speed profiles



Can it be Trusted?

Replica utilizes most of the same data sources we are already using to create our regional travel demand model. “Big Data” observations are used to enhance the model.

- American Community Survey (ACS)
- Public Use Microdata Sample (PUMS)
- Longitudinal Employer-Household Dynamics Data (LEHD)
- Census Transportation Planning Product (CTPP)
- National Center for Education Statistics (NCES)
- OpenStreetMap (OSM)
- General Transit Feed Specification (GTFS)
- Counts (INRIX or supplied locally)
- Parcel and Building Footprints

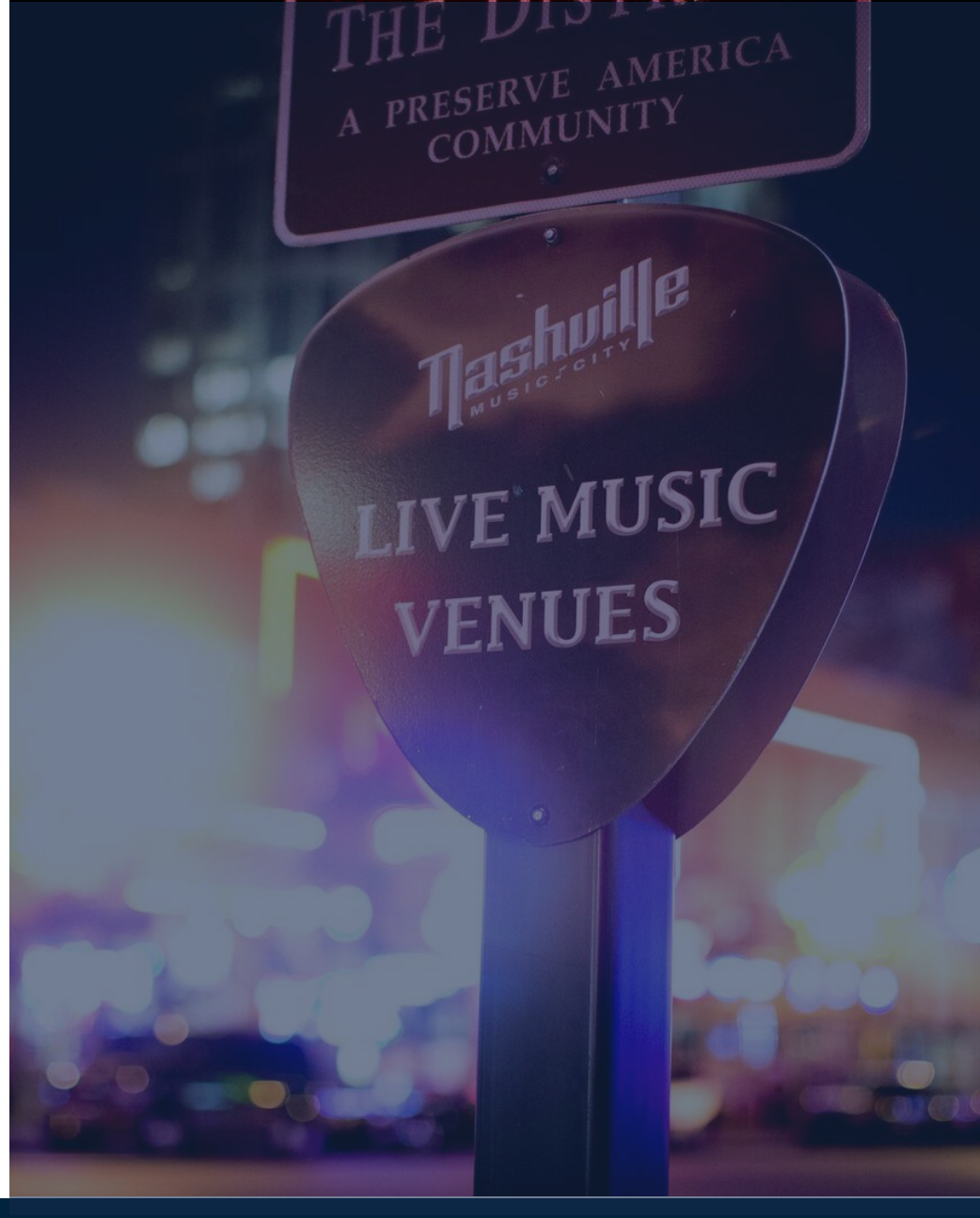
Plus

- Location-Based Services (LBS)
- Various Transaction Data

Replica Places

A seasonal activity based model for megaregions. It is available for the entire United States with models back to 2019. Each model provides multimodal output for typical weekday and weekend day.

- **Interactive map**
- **Filterable trips, persons, and geographies**
- **Summary information**
- **Loaded network for all modes**
- **Complete trip and person tables**



Create New Study

Study Name *

Data Source

Replica models activity-based travel for unique regions at specific points-in-time. Choose which region and timeframe you'd like to explore.
Learn More

Region

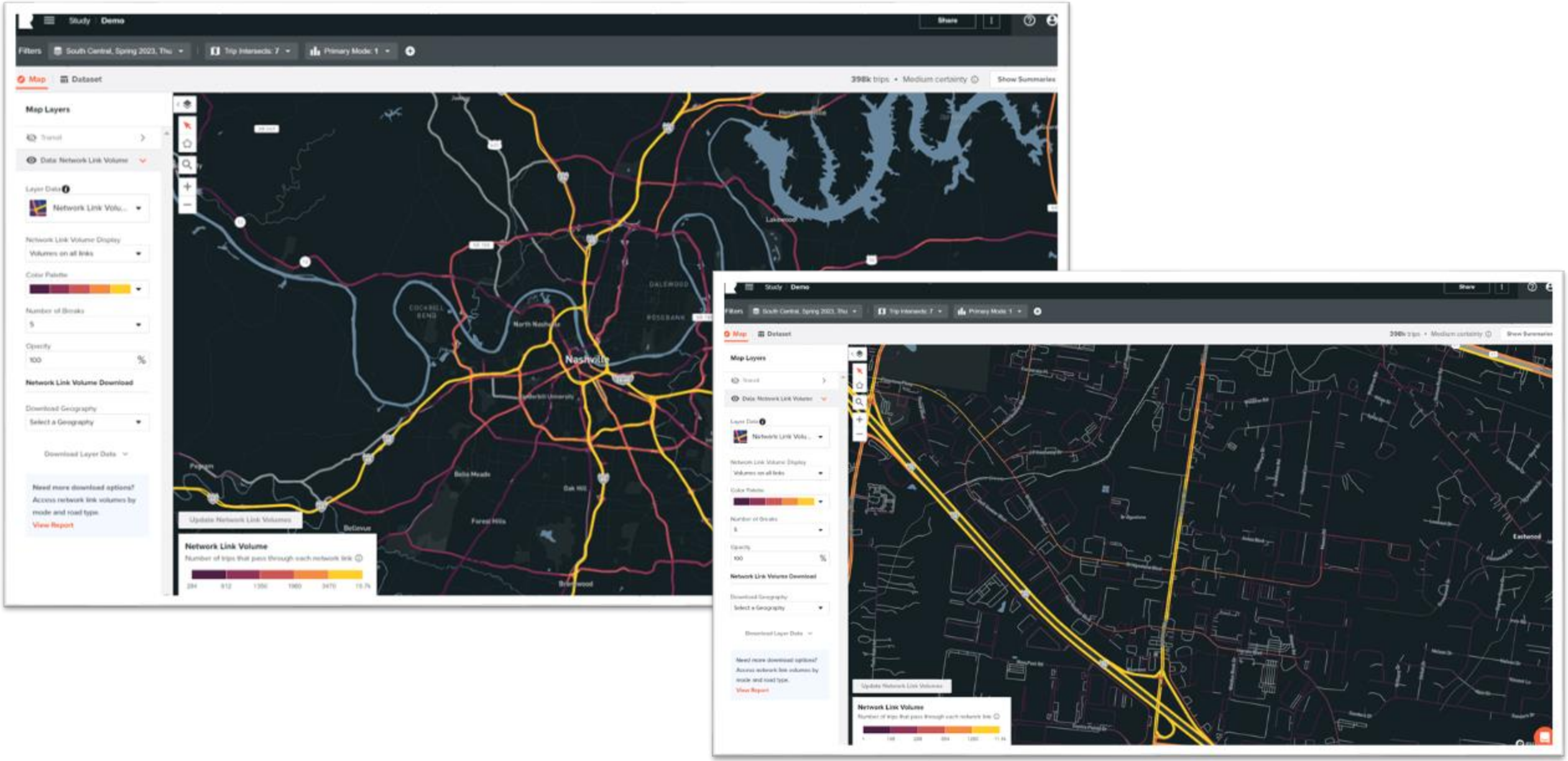
Choose a region...

Season

Choose a season...

Typical Day

GNRC


Study / Demo
Share
Filters
South Central, Spring 2023, Thu
Trip Intersects: 7
Primary Mode: 1
Map
Dataset
398k trips • Medium certainty
Show Summaries
Map Layers
Data: Network Link Volume
Layer Data
Network Link Volu...
Network Link Volume Display
Volumes on all links
Color Palette
Number of Breaks
5
Opacity
100
%
Network Link Volume Download
Download Geography
Select a Geography
Download Layer Data
Need more download options? Access network link volumes by mode and road type.
View Report
Update Network Link Volumes
Network Link Volume
Number of trips that pass through each network link
Nashville
North Nashville
Belle Meade
Forest Hills
Bellevue
Brentwood
Lakewood
Eastwood

GNRC

Person ID	Household ID	Age	Sex	Race and Ethnicity	Employment Status	Work From Home	Individual Income	Commute Mode	Household Size	Household Income	Private Auto Availability
1564242919640715883	6281900358062934699	13	male	white_not_hispanic_or_latino	under_16	unemployed_under_16_not_in_labor_force	0	other_travel_mode	3	81981	zero
1197648204544823563	6281900358062934699	46	female	white_not_hispanic_or_latino	employed	in_person	27327	private_auto	3	81981	zero
273626059254395102	12481959382387033839	82	female	white_not_hispanic_or_latino	not_in_labor_force	unemployed_under_16_not_in_labor_force	11958	other_travel_mode	1	11958	zero
1089535078634029985	5726297289015971922	12	female	white_not_hispanic_or_latino	under_16	unemployed_under_16_not_in_labor_force	0	other_travel_mode	5	46128	zero
1535103018487394571	5726297289015971922	5	female	white_not_hispanic_or_latino	under_16	unemployed_under_16_not_in_labor_force	0	other_travel_mode	5	46128	zero
1411086148008948253	5726297289015971922	32	female	white_not_hispanic_or_latino	employed	in_person	8744	private_auto	5	46128	zero
1803760025366945882	5726297289015971922	55	male	white_not_hispanic_or_latino	employed	in_person	218	private_auto	5	46128	zero
1362351479950567146	5726297289015971922	55	female	white_not_hispanic_or_latino	employed	employed_not_working	37165	private_auto	5	46128	zero
1744714380441995007	83688756977218565	55	male	white_not_hispanic_or_latino	employed	in_person	45909	private_auto	1	45909	zero
1181071339648715218	9885494896282422910	60	female	white_not_hispanic_or_latino	not_in_labor_force	unemployed_under_16_not_in_labor_force	9634	other_travel_mode	1	9634	zero
1623490963929365019	3537185929460655238	70	female	white_not_hispanic_or_latino	not_in_labor_force	unemployed_under_16_not_in_labor_force	40465	other_travel_mode	1	40465	zero
1385927592233685981	7331925188444076297	70	female	white_not_hispanic_or_latino	not_in_labor_force	unemployed_under_16_not_in_labor_force	40465	other_travel_mode	1	40465	zero
1937123935637232403	55										
1143687725029021200	12										
1194872856763514343	52										
1987992393772825244	14										

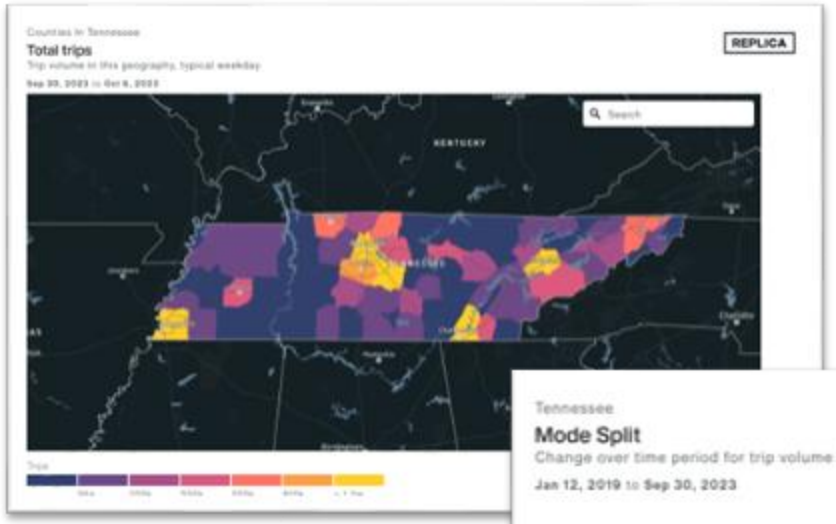
Activity ID	Trip Origin Block Group	Trip Origin Tract	Trip Origin County	Trip Origin State	Trip Destination Block Group	Trip Destination Tract	Trip Destination County	Trip Destination State	Primary Mode	Trip Purpose
5439085762582145824	1 (Tract 1001, Montgomery, TN)	1001 (Montgomery, TN)	Montgomery County, TN	Tennessee	Out of Region	Out of Region	Out of Region	Out of Region	other_travel_mode	social
1424257009824994015	1 (Tract 1004, Montgomery, TN)	1004 (Montgomery, TN)	Montgomery County, TN	Tennessee	2 (Tract 1004, Montgomery, TN)	1004 (Montgomery, TN)	Montgomery County, TN	Tennessee	auto_passenger	social
5788329003330036958	1 (Tract 1006.02, Montgomery, TN)	1006.02 (Montgomery, TN)	Montgomery County, TN	Tennessee	1 (Tract 1006.02, Montgomery, TN)	1006.02 (Montgomery, TN)	Montgomery County, TN	Tennessee	walking	work
1300595016590903257	1 (Tract 1018.04, Montgomery, TN)	1018.04 (Montgomery, TN)	Montgomery County, TN	Tennessee	1 (Tract 1001, Montgomery, TN)	1001 (Montgomery, TN)	Montgomery County, TN	Tennessee	other_travel_mode	maintenance
770141130358774892	1 (Tract 1019.03, Montgomery, TN)	1019.03 (Montgomery, TN)	Montgomery County, TN	Tennessee	4 (Tract 1017, Montgomery, TN)	1017 (Montgomery, TN)	Montgomery County, TN	Tennessee	other_travel_mode	home
1447325766872565041	1 (Tract 1019.03, Montgomery, TN)	1019.03 (Montgomery, TN)	Montgomery County, TN	Tennessee	1 (Tract 193, Davidson, TN)	193 (Davidson, TN)	Davidson County, TN	Tennessee	other_travel_mode	recreation
1722147040196634391	1 (Tract 1020.01, Montgomery, TN)	1020.01 (Montgomery, TN)	Montgomery County, TN	Tennessee	3 (Tract 1020.05, Montgomery, TN)	1020.05 (Montgomery, TN)	Montgomery County, TN	Tennessee	walking	shop
5479398832540517670	1 (Tract 1020.01, Montgomery, TN)	1020.01 (Montgomery, TN)	Montgomery County, TN	Tennessee	2 (Tract 1002, Montgomery, TN)	1002 (Montgomery, TN)	Montgomery County, TN	Tennessee	other_travel_mode	shop
2132568640804473600	1 (Tract 107.02, Davidson, TN)	107.02 (Davidson, TN)	Davidson County, TN	Tennessee	4 (Tract 153, Davidson, TN)	153 (Davidson, TN)	Davidson County, TN	Tennessee	private_auto	shop
1534935451913846961	1 (Tract 108.02, Davidson, TN)	108.02 (Davidson, TN)	Davidson County, TN	Tennessee	1 (Tract 108.02, Davidson, TN)	108.02 (Davidson, TN)	Davidson County, TN	Tennessee	walking	shop
2783726749118001476	1 (Tract 118, Davidson, TN)	118 (Davidson, TN)	Davidson County, TN	Tennessee	4 (Tract 114, Davidson, TN)	114 (Davidson, TN)	Davidson County, TN	Tennessee	auto_passenger	eat
1242263831725223972	1 (Tract 1305, Humphreys, TN)	1305 (Humphreys, TN)	Humphreys County, TN	Tennessee	3 (Tract 9631, Benton, TN)	9631 (Benton, TN)	Benton County, TN	Tennessee	auto_passenger	maintenance
1056955044965652734	1 (Tract 137, Davidson, TN)	137 (Davidson, TN)	Davidson County, TN	Tennessee	2 (Tract 195, Davidson, TN)	195 (Davidson, TN)	Davidson County, TN	Tennessee	on_demand_auto	recreation
1683343422011627261	1 (Tract 155.01, Davidson, TN)	155.01 (Davidson, TN)	Davidson County, TN	Tennessee	1 (Tract 137, Davidson, TN)	137 (Davidson, TN)	Davidson County, TN	Tennessee	auto_passenger	home
6206244181757312237	1 (Tract 156.15, Davidson, TN)	156.15 (Davidson, TN)	Davidson County, TN	Tennessee	3 (Tract 190.03, Davidson, TN)	190.03 (Davidson, TN)	Davidson County, TN	Tennessee	biking	home
989570398943712745	1 (Tract 156.26, Davidson, TN)	156.26 (Davidson, TN)	Davidson County, TN	Tennessee	2 (Tract 156.28, Davidson, TN)	156.28 (Davidson, TN)	Davidson County, TN	Tennessee	walking	home
1129341894656575184	1 (Tract 156.26, Davidson, TN)	156.26 (Davidson, TN)	Davidson County, TN	Tennessee	1 (Tract 402, Rutherford, TN)	402 (Rutherford, TN)	Rutherford County, TN	Tennessee	auto_passenger	shop
1791491621319795008	1 (Tract 158.03, Davidson, TN)	158.03 (Davidson, TN)	Davidson County, TN	Tennessee	2 (Tract 158.04, Davidson, TN)	158.04 (Davidson, TN)	Davidson County, TN	Tennessee	walking	home

Replica Trends

A weekly model for monitoring. It is available for the entire United States with models back to 2019. Each model provides output for typical weekday and weekend day.

- **Origins-Destinations**
- **Mode Share**
- **Trip Start Time**
- **Residential Vehicle Miles Traveled (VMT)**
- **Spend by Merchant and Home Location**
- **Spend by Online and Brick and Mortar**

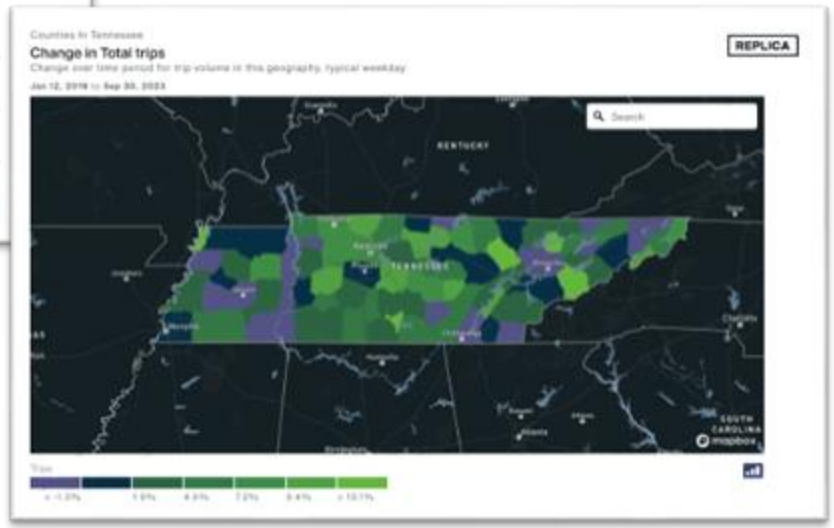
GNRC


Total trips
REPLICA

Tennessee
Total Trips
Trips in this geography, typical weekday
Jan 12, 2019 to Sep 30, 2023
REPLICA
28m
21m
14m
7.0m
0
Feb 2019
Nov 2019
Aug 2020
May 2021
Feb 2022
Nov 2022
Aug 2023
Total

Tennessee
Mode Split
Change over time period for trip volume in this geography, typical weekday
Jan 12, 2019 to Sep 30, 2023
+100%
+50%
Baseline
-50%
-100%
Feb 2019
Nov 2019
Aug 2020
May 2021
Feb 2022
Nov 2022
Aug 2023
Private Auto
Transit
Auto Passenger
Walking
Biking

Tennessee
Trip Start Time
Trips starting in this geography, average hour
Jan 12, 2019 to Sep 30, 2023
20%
15%
10%
5%
0%
12AM
4AM
8AM
12PM
4PM
8PM
Jan 12, 2019
Sep 30, 2023


Change in Total trips
REPLICA

GNRC

Trips by Origin

Initiate Download

Options: Williamson County, TN & 6 others | 09/30/2023 - 10/06/2023 | Typical Weekday | Counties

Metrics: (•) Trip Count ( ) Mode Split ( ) Trip Start Time

Showing first 7 of all 7 rows

Week Starting	Trip Count	Origin Geo Id	Origin Geo Name	Origin Population
2023-09-30	805515	47187	Williamson County, TN	225329
2023-09-30	327804	47119	Maury County, TN	91958
2023-09-30	2810177	47037	Davidson County, TN	687257
2023-09-30	458339	47189	Wilson County, TN	136614
2023-09-30	1166704	47149	Rutherford County, TN	315740
2023-09-30	229168	47147	Robertson County, TN	70246
2023-09-30	603573	47165	Sumner County, TN	183397

Spend by Merchant Location

Initiate Download

Options: Williamson County, TN & 6 others | 10/07/2023 - 10/13/2023 | Weekdays | Counties

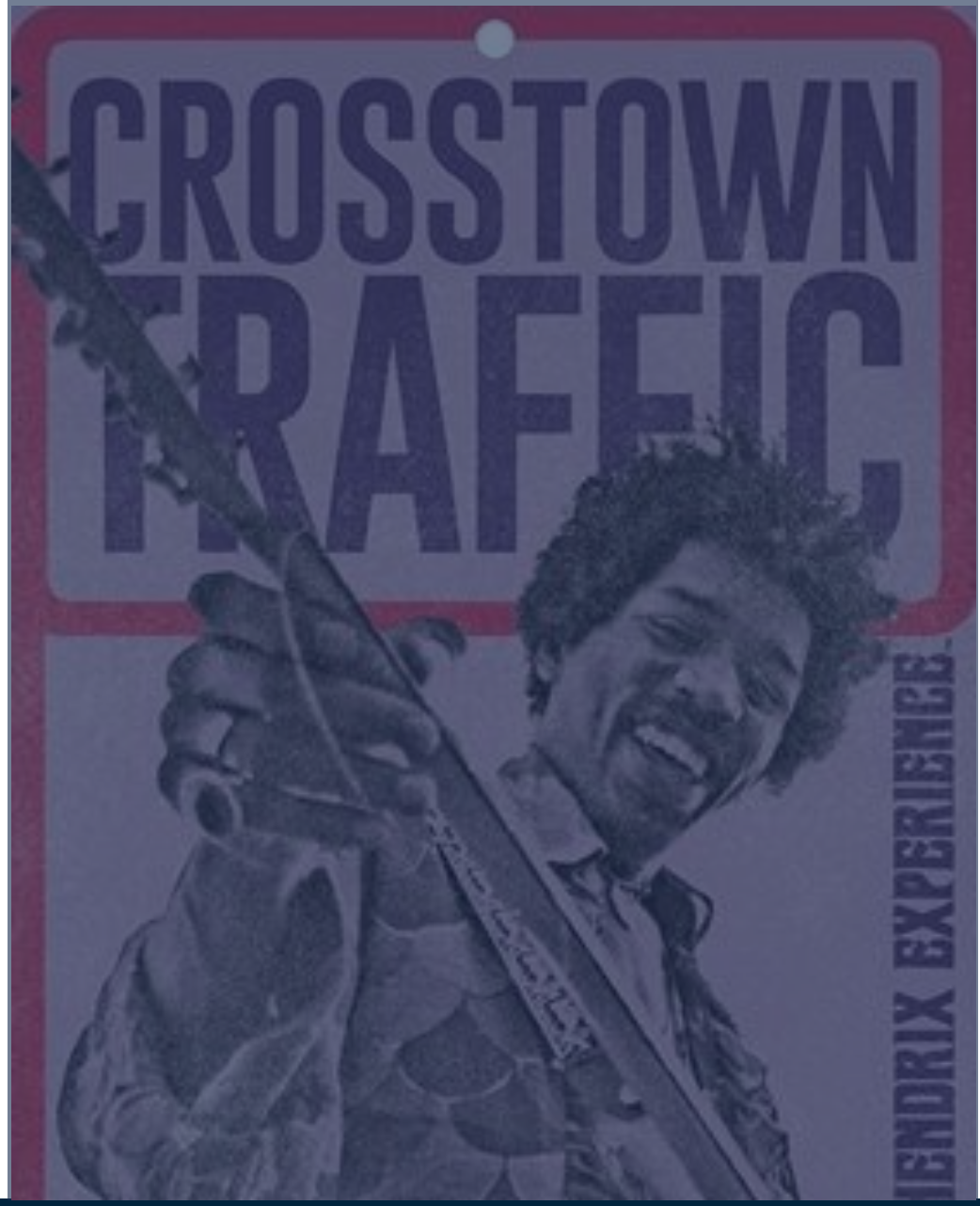
Showing first 7 of all 7 rows

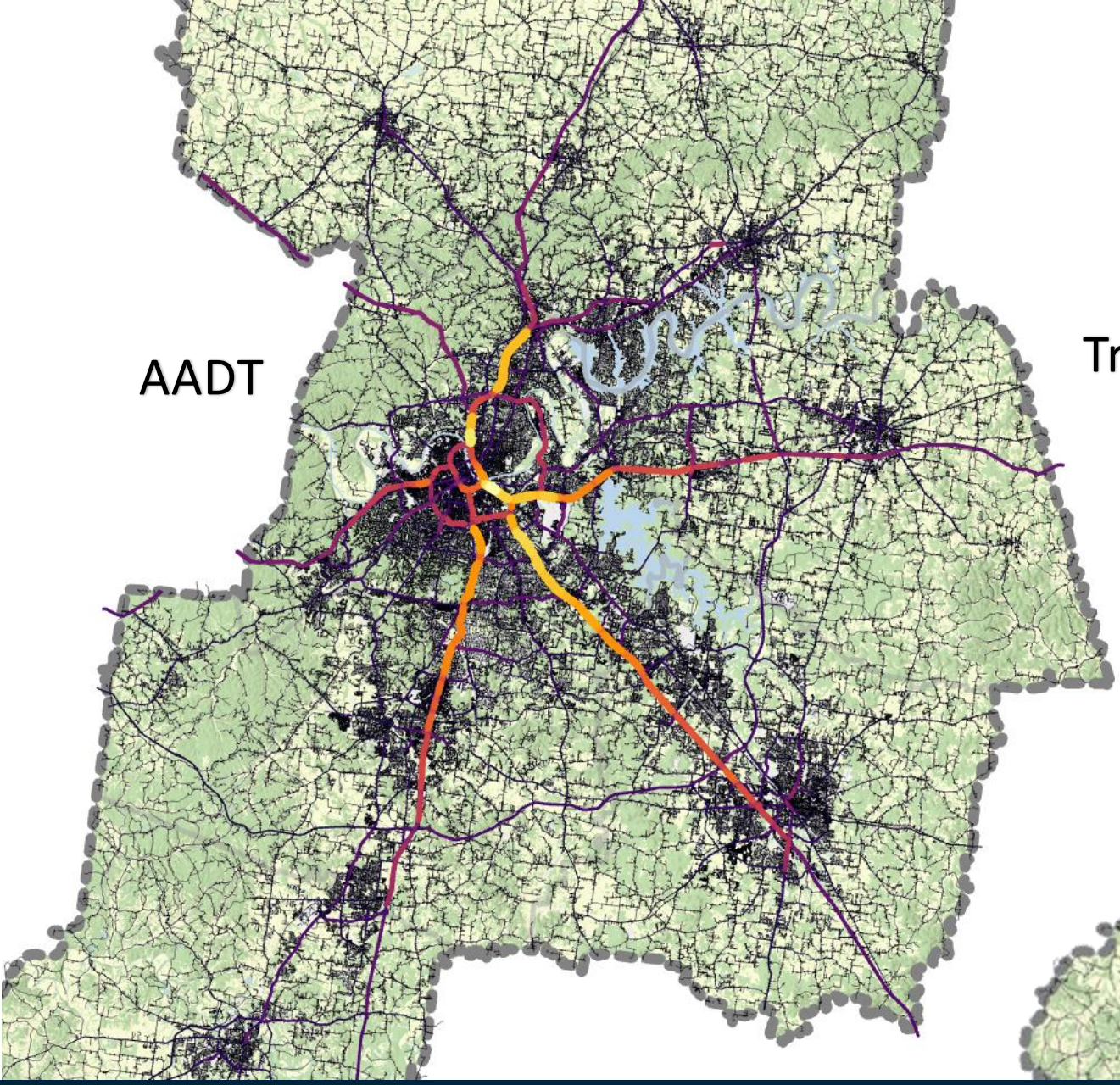
Week Starting	Geo Id	Geo Name	Population	Airline Hospitality Car Rental Spend	Entertainment Recreation Spend	Gas Stations Parking Taxis Tolls Spend	Grocery Stores Spend	Restaurants Bars Spend	Retail Spend
2023-10-07	47165	Sumner County, TN	183397	982965.32	930269.62	7139116.77	5965408.65	7101315.21	24443694.81
2023-10-07	47189	Wilson County, TN	136614	1469775.2	340687.95	7076730.31	4914712.77	5415424.67	27743338.42
2023-10-07	47037	Davidson County, TN	687257	16368371.76	5394082.18	25605354.52	26314053.65	35781422.34	126994921.76
2023-10-07	47147	Robertson County, TN	70246	215248.14	241039.93	4088308.73	3511730.35	2594724.21	13493350.16
2023-10-07	47149	Rutherford County, TN	315740	2260416.01	2099473.54	13432175.52	9721913.03	11351770.31	53728797.3
2023-10-07	47119	Maury County, TN	91958	675203.18	413798.24	6109084.11	3836052.67	3361380.41	17910416.89
2023-10-07	47187	Williamson County, TN	225329	2662464.24	2027487.45	7406942.8	6854531.15	9196798.59	37276504.25

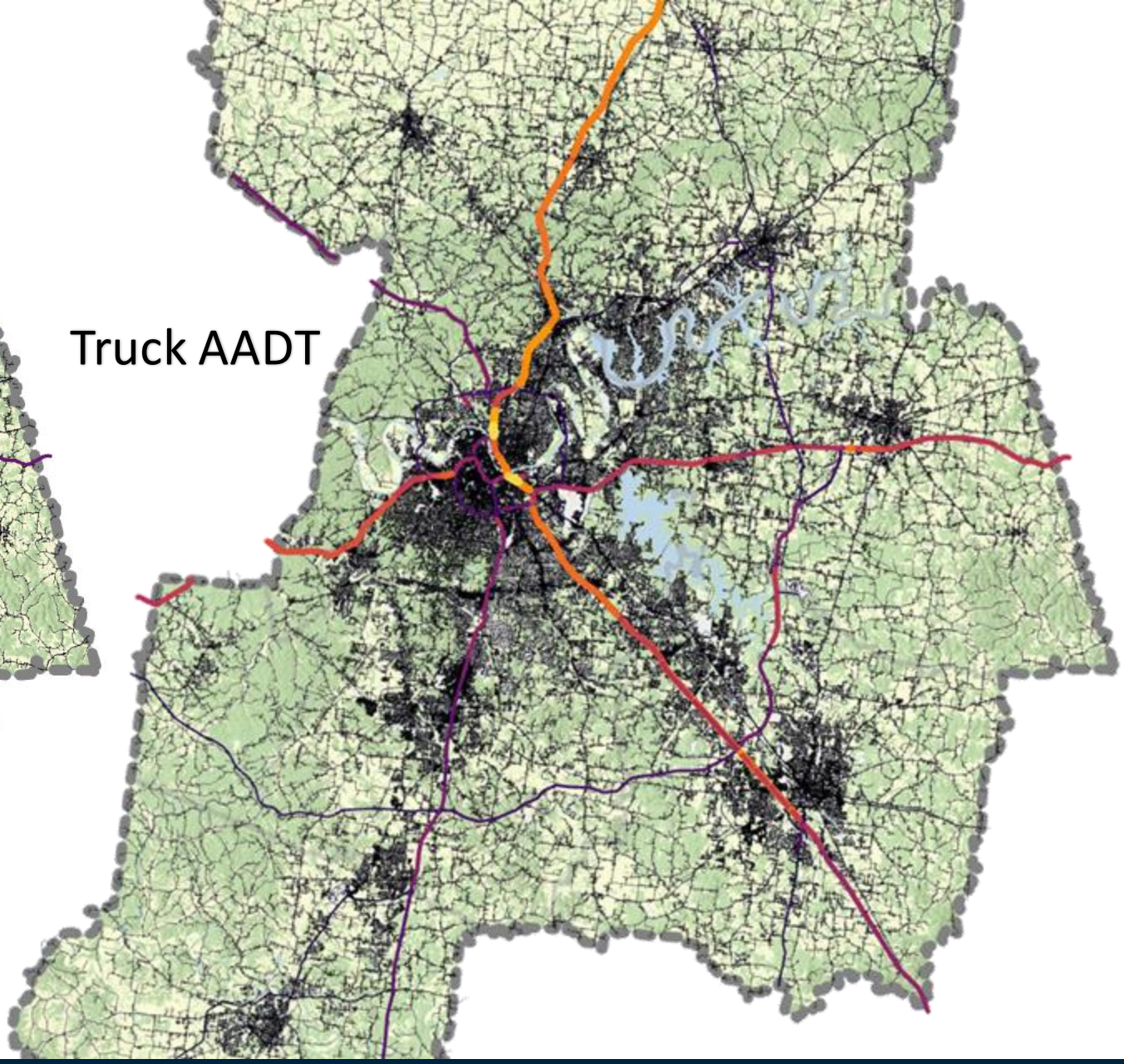
Replica Traffic Data

Annual model for monitoring and reference. It is available for the entire United States with models back to 2019. Aside from AADT, each model provides output for typical weekday and weekend day.

- **Annual Average Daily Traffic (AADT)**
- **Free Flow Speeds**
- **Hourly Auto Volume Profile**
- **Quarter Hourly Speeds Profile**
- **Turning Movement Counts**




AADT


Truck AADT

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B-Side: Samples

Fans (60+ users)

GNRC Staff

Travel demand and land use models, monitoring congestion, comprehensive plans, economic development, aging and disability, local and media inquiries

Transit Agencies

System analysis, identification of potential expansion, better understanding of roadway conditions

Local Governments and Consultants

Safety analysis, active transportation demand, impact analysis, monitoring of congestion, better understanding of mobility needs

How Have We Been Using Replica?

Updating Travel Demand Model

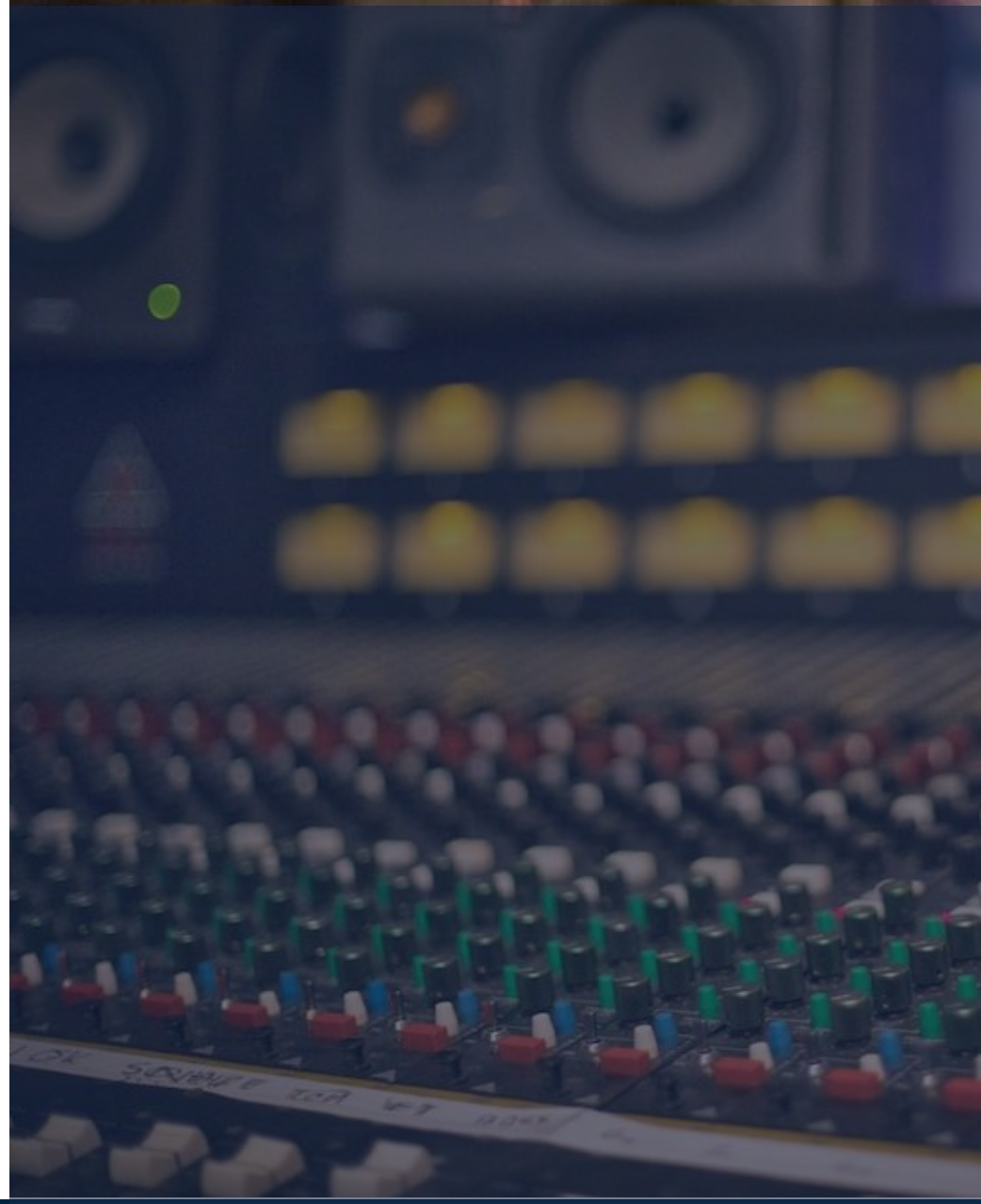
Reference data as model input and modeled data in calibration

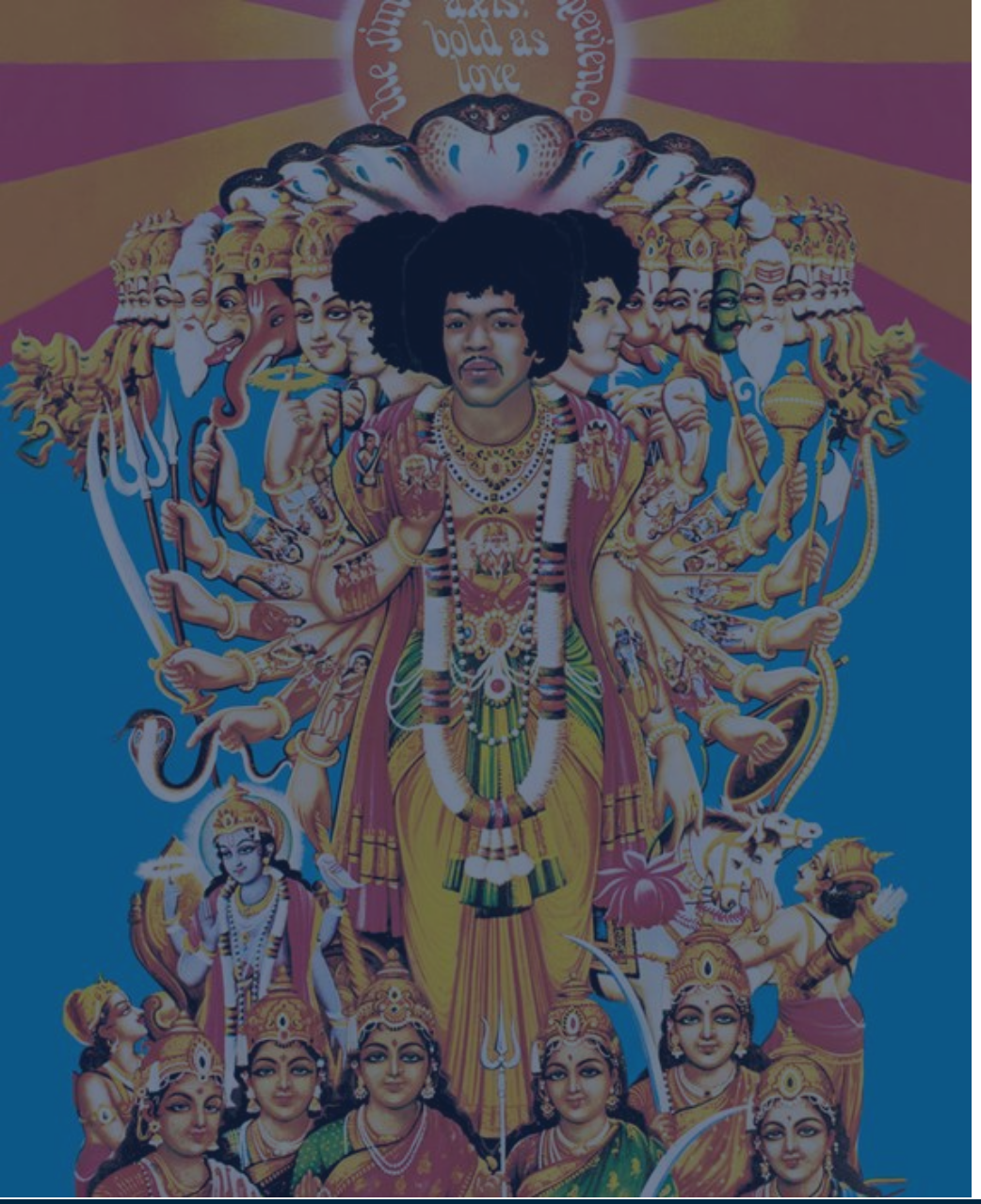
Locating Potential Transit Riders

Finding transit dependent populations

Profiling a Corridor

How should a roadway be designed based on its users





How Else Can Replica be Used?

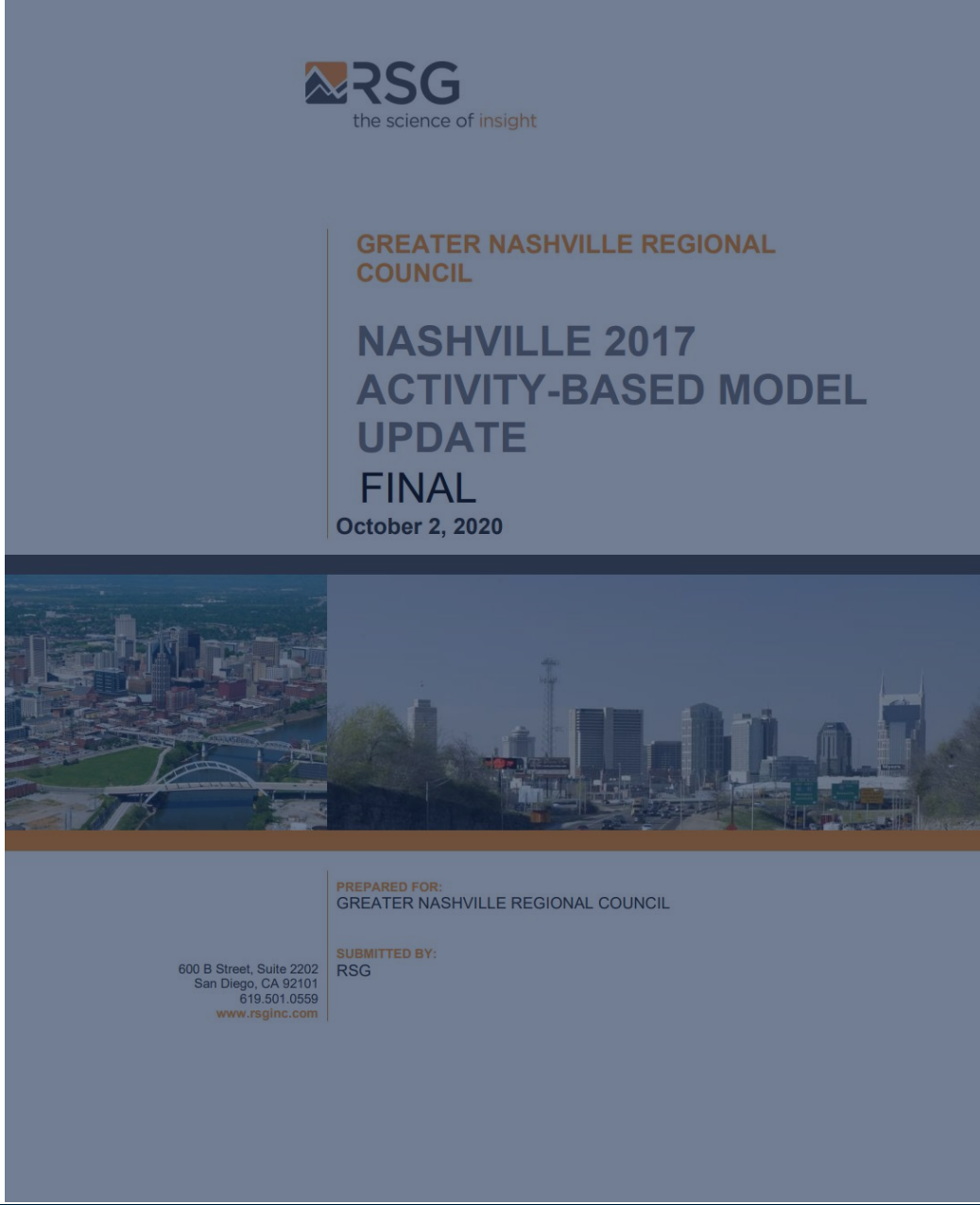
Replica provides detailed outputs that can be used beyond traditional regional transportation planning.

- Peer Analysis
- Market Characteristics
- Land Use and Built Environment
- Safety
- Freight
- Parking
- Economic Impact
- Traffic Impact
- Workforce
- Electric Vehicle
- Transportation Network Company (TNCs)
- Housing
- Equity
- Transit Demand

Updating TDM

GNRC is using Replica to update assumptions in travel behaviors to supplement an outdated household travel survey. Also provides significant time savings on data collection and processing.

- **Origins-Destinations**
- **Mode Share**
- **Trip/tour Purposes**
- **Trip Length and Time**
- **Time of Day Distribution**
- **Freight Movements**
- **Telecommuting**



Resident Summary

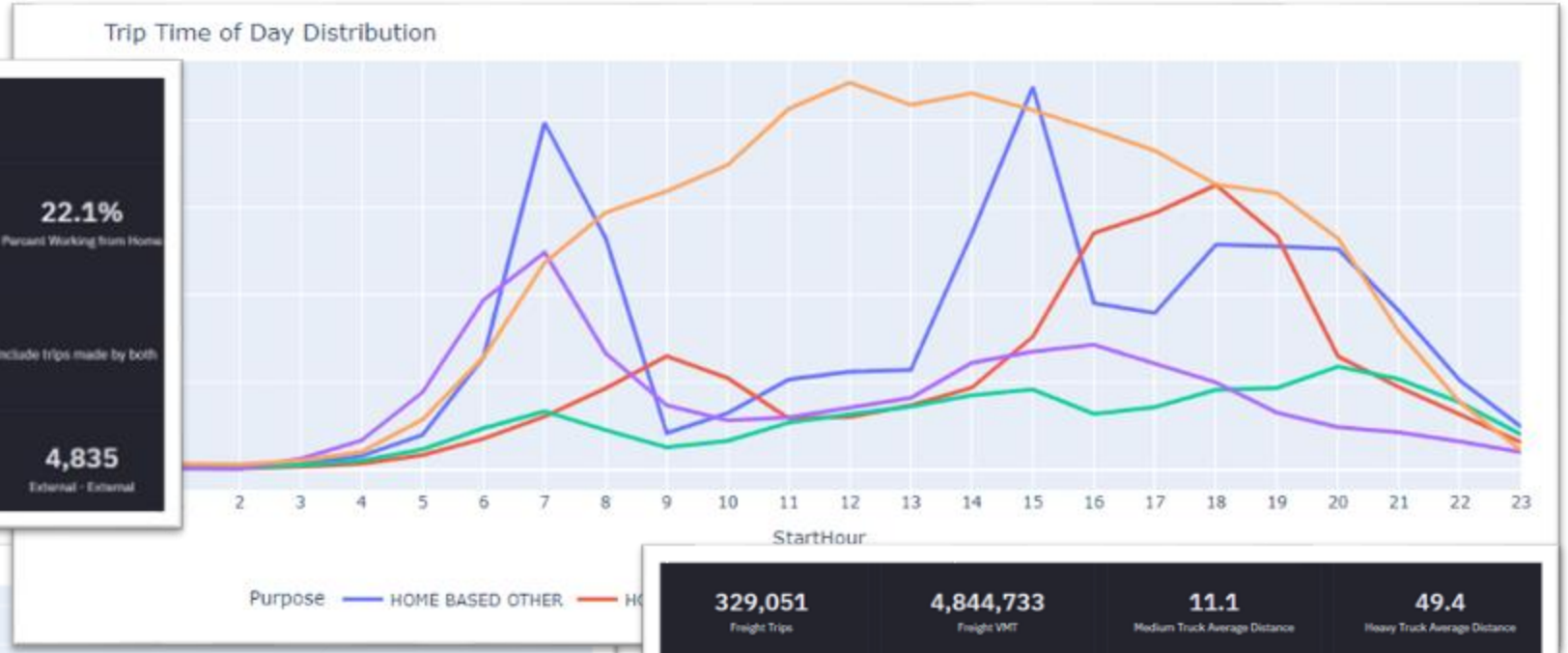
This section summarizes the resident population of the region

725,870	1,795,284	952,306	22.1%
Households	Population	Employed Residents	Percent Working from Home

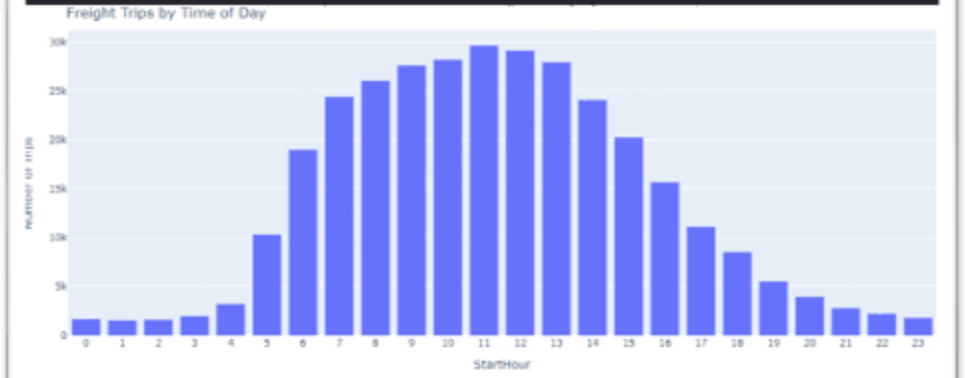
Mobility Pattern

The cells below show daily trips broken down by Internal-Internal, Internal-External, External-Internal and External-External. These include trips made by both residents and non-residents.

7,071,741	87,878	84,872	4,835
Internal - Internal	Internal - External	External - Internal	External - External



329,051	4,844,733	11.1	49.4
Freight Trips	Freight VMT	Medium Truck Average Distance	Heavy Truck Average Distance
298,261	3,324,711	30,790	1,520,022
Medium Truck Trips	Medium Truck VMT	Heavy Truck Trips	Heavy Truck VMT

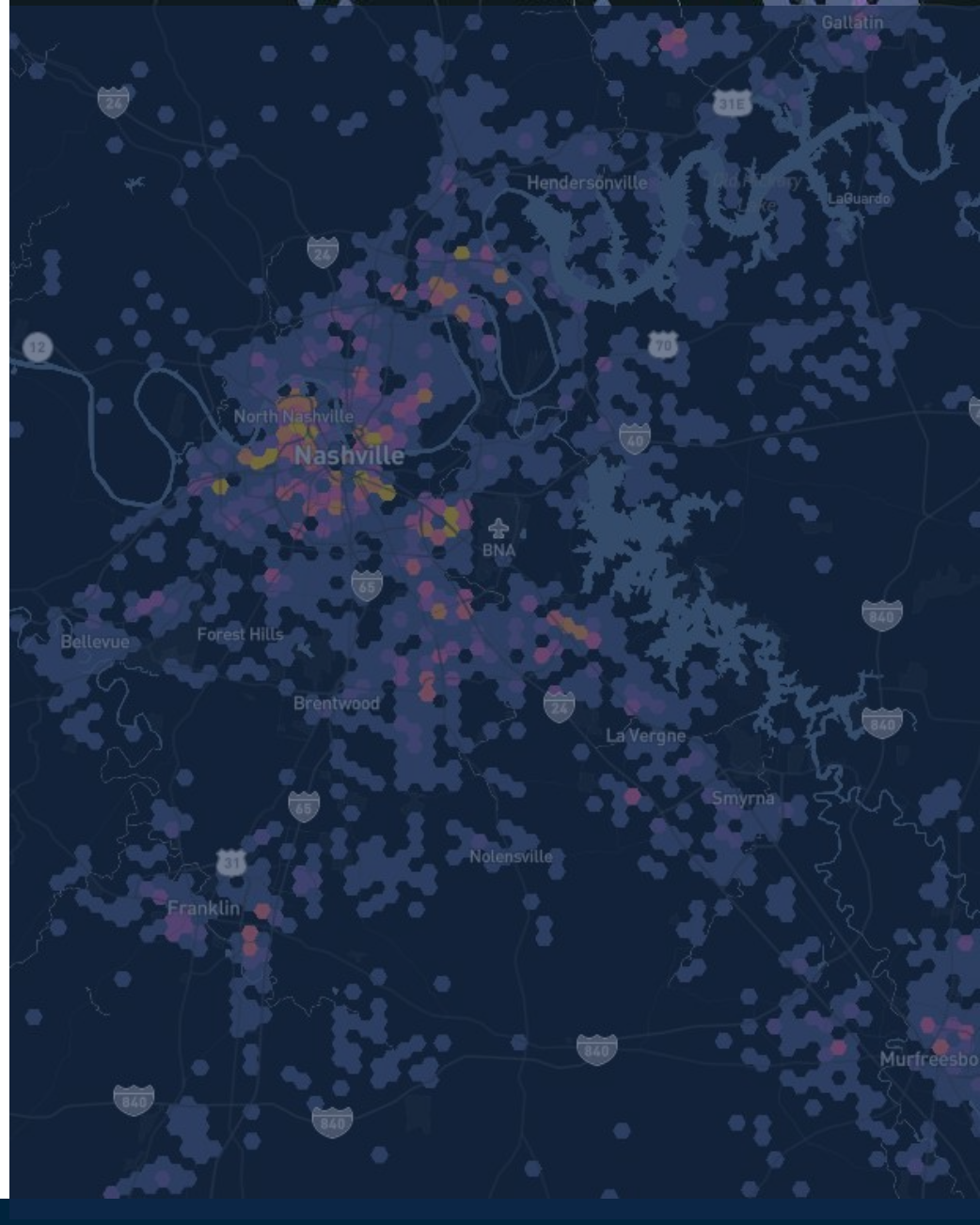


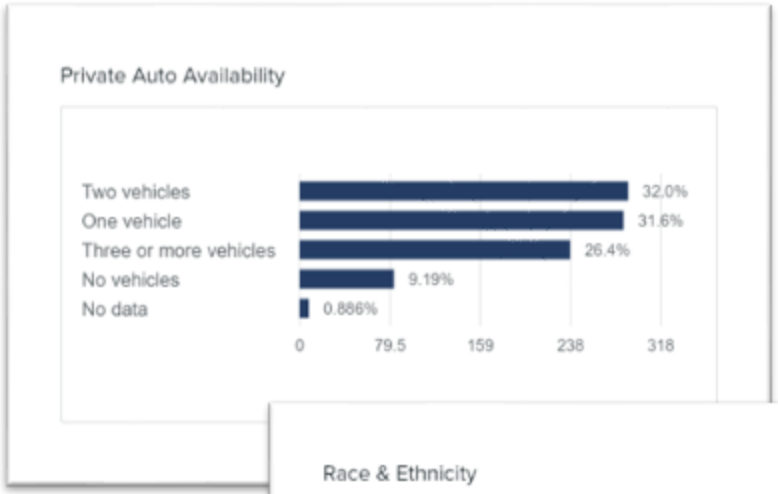
GNRC

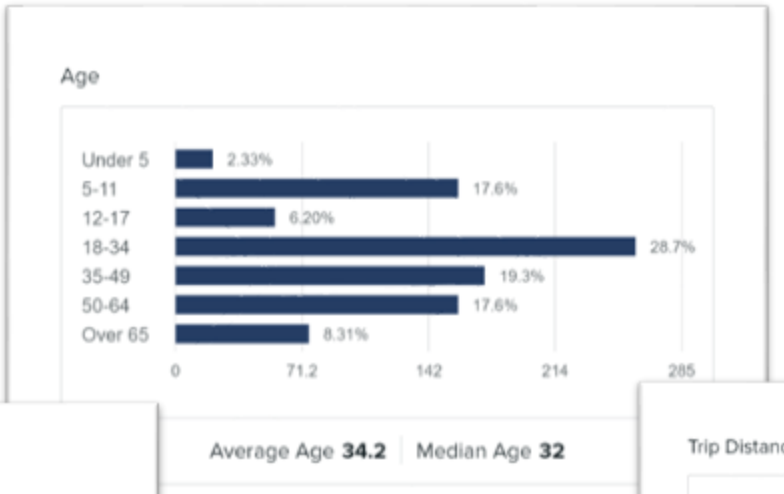
Locating Potential Transit Riders

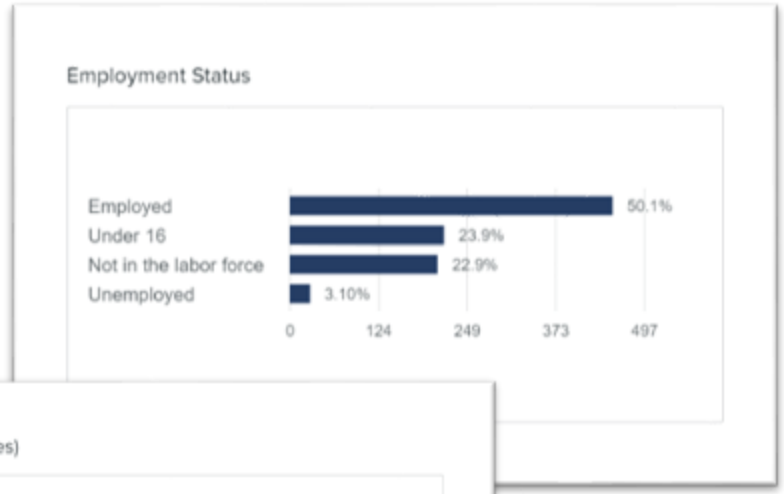
Transit agencies are using Replica to identify new markets for potential service expansion. By understanding where transit dependent populations live and work, services can be tailored for efficiency.

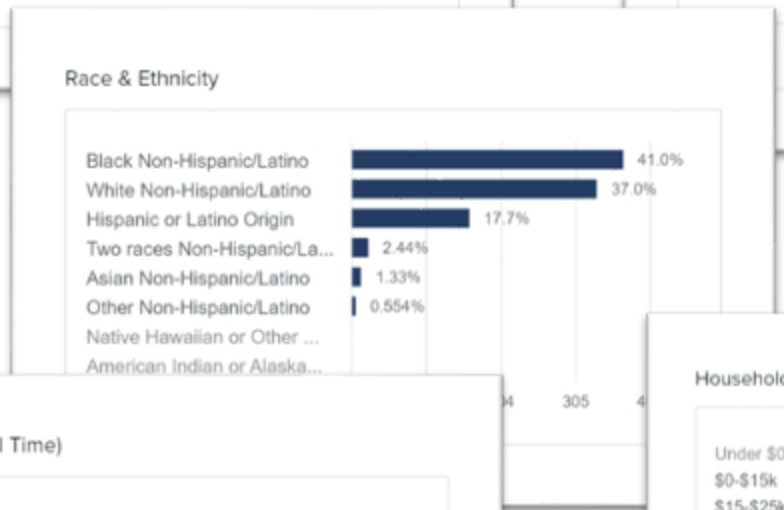
- **Income**
- **Auto Ownership**
- **Trip Purpose**
- **Time of Commute**
- **Existing Ridership**
- **Travel Times**

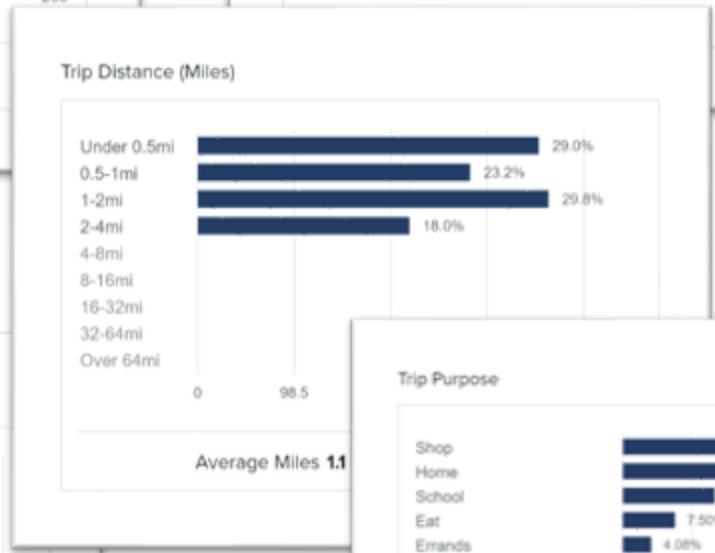


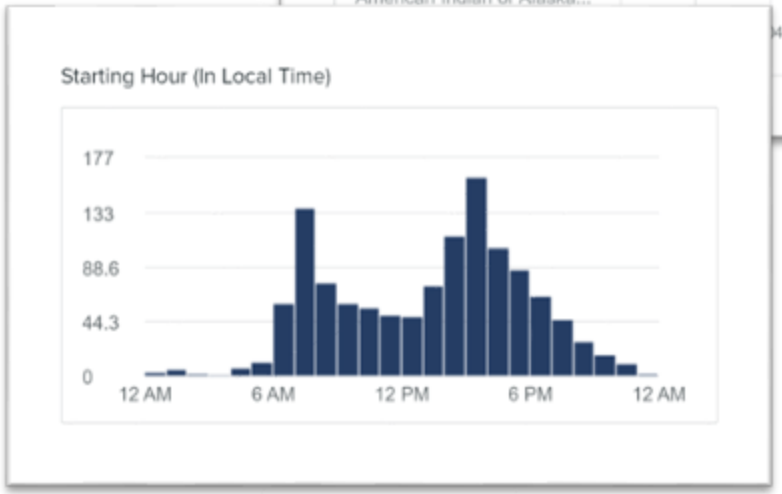

Private Auto Availability
Two vehicles 32.0%
One vehicle 31.6%
Three or more vehicles 26.4%
No vehicles 9.19%
No data 0.886%
0 79.5 159 238 318


Age
Under 5 2.33%
5-11 17.6%
12-17 6.20%
18-34 28.7%
35-49 19.3%
50-64 17.6%
Over 65 8.31%
0 71.2 142 214 285
Average Age 34.2 | Median Age 32

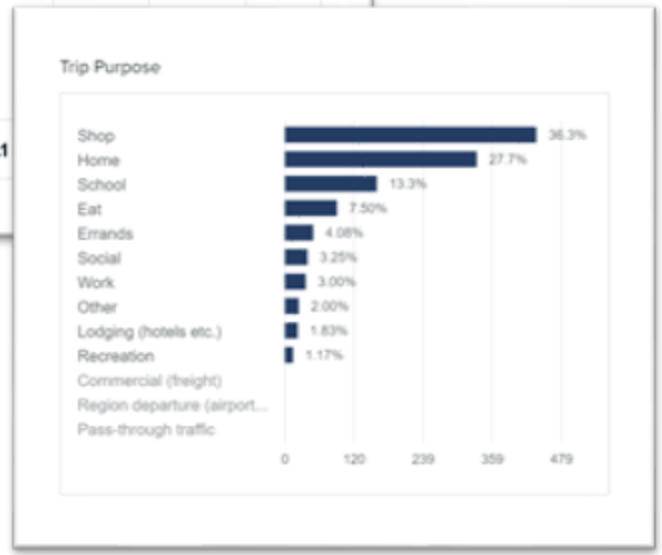

Employment Status
Employed 50.1%
Under 16 23.9%
Not in the labor force 22.9%
Unemployed 3.10%
0 124 249 373 497


Race & Ethnicity
Black Non-Hispanic/Latino 41.0%
White Non-Hispanic/Latino 37.0%
Hispanic or Latino Origin 17.7%
Two races Non-Hispanic/La... 2.44%
Asian Non-Hispanic/Latino 1.33%
Other Non-Hispanic/Latino 0.554%
Native Hawaiian or Other ...
American Indian or Alaska...
305


Trip Distance (Miles)
Under 0.5mi 29.0%
0.5-1mi 23.2%
1-2mi 29.8%
2-4mi 18.0%
4-8mi
8-16mi
16-32mi
32-64mi
Over 64mi
0 98.5
Average Miles 1.1


Starting Hour (In Local Time)
177
133
88.6
44.3
0
12 AM 6 AM 12 PM 6 PM 12 AM

Household Income
Under $0
$0-$15k 9.97%
$15-$25k 9.97%
$25k-$50k 20.4%
$50k-$75k 23.5%
$75k-$100k 13.4%
$100k-$150k 14.3%
$150k-$200k 4.32%
Over $200k 4.21%
0 58.3 117 175 233
Average Income $75.5k | Median Income $59.0k

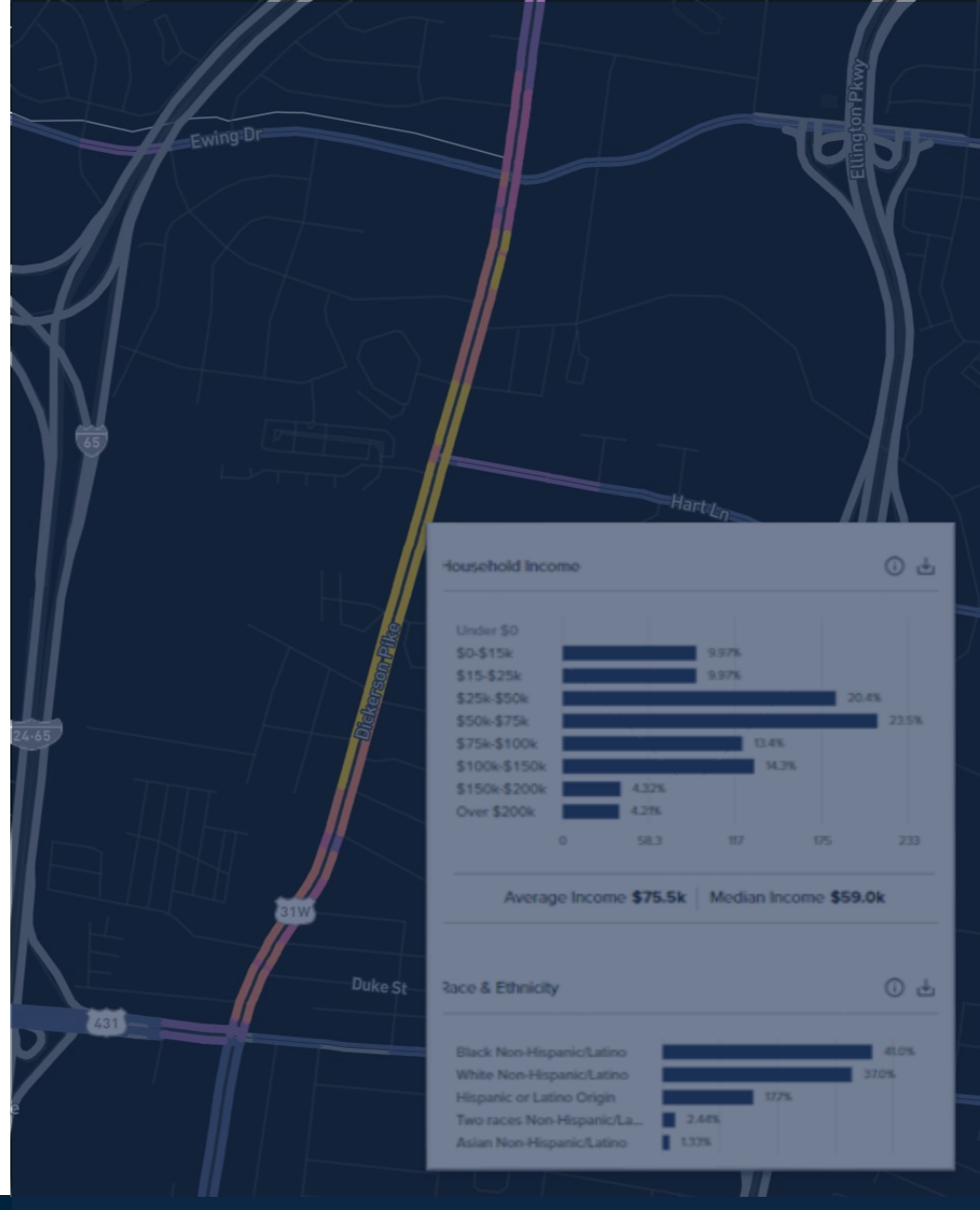

Trip Purpose
Shop 36.3%
Home 27.7%
School 13.3%
Eat 7.50%
Errands 4.08%
Social 3.25%
Work 3.00%
Other 2.00%
Lodging (hotels etc.) 1.83%
Recreation 1.17%
Commercial (freight)
Region departure (airport...
Pass-through traffic
0 120 239 359 479

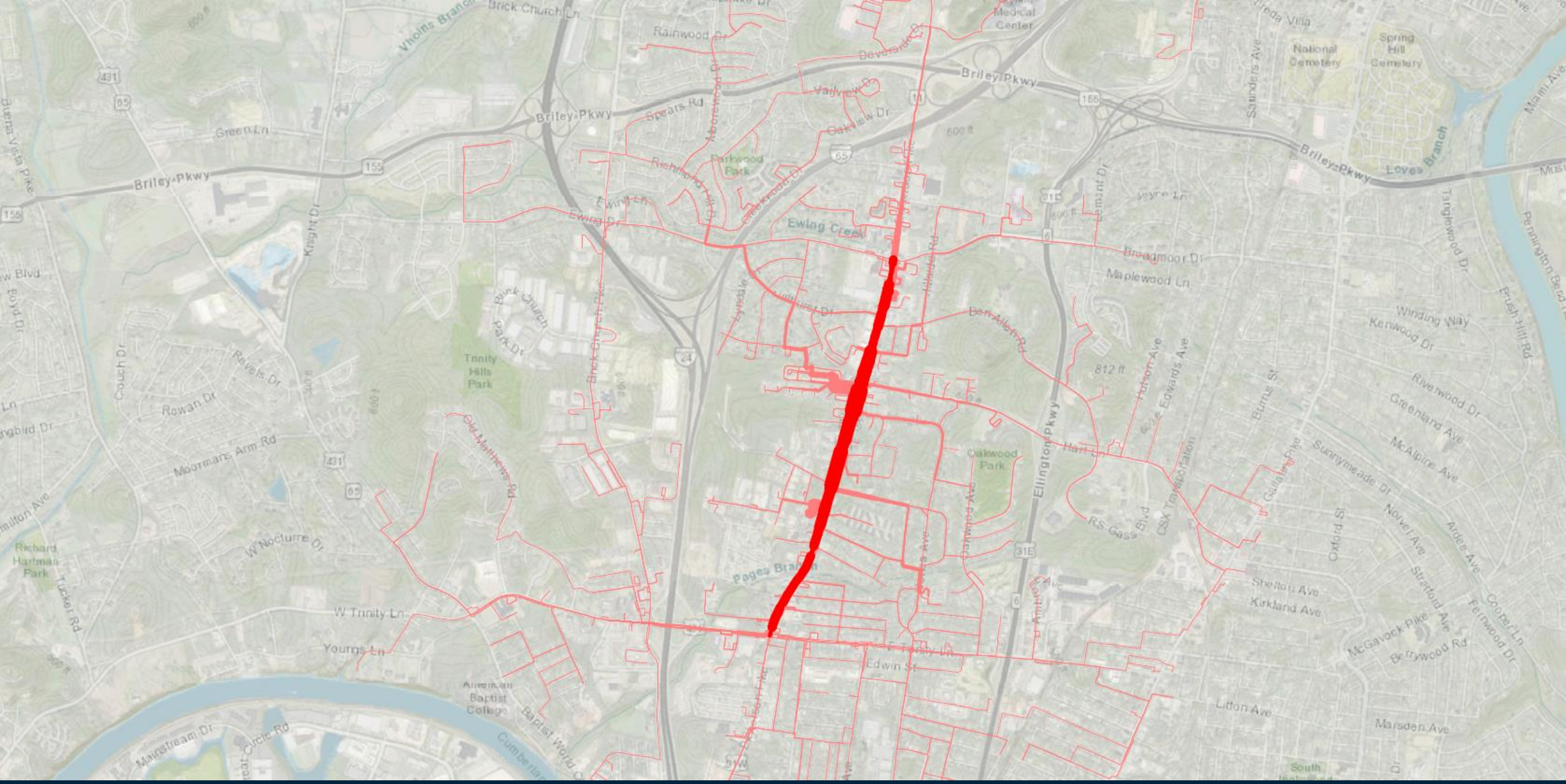
GNRC

Profiling a Corridor

Local agencies are using Replica understand the users of a corridor of interest. By having a clear picture of who is using a roadway segment, it can be designed to best serve its users.

- **Demographics**
- **Mode**
- **Trip Purpose**
- **Origins and Destinations**
- **Loaded Network with Local Streets**
- **Time of Day**




Briley Pkwy
Ewing Creek
Pages Branch
Trinity Hills Park
Oakwood Park
Parkwood Park
Ellington Pkwy
Brick Church Pike
Edwin St
W Trinity Ln
Maplewood Ln
Broadmoor Dr
Ben Allen Rd
Moormans Arm Rd
Rowan Dr
Couch Dr
Knight Dr
Green Ln
Spears Rd
Rainwood Dr
Oakview Dr
Ewing Dr
Park Church Park Dr
Old Matthews Rd
W Nocturne Dr
Tucker Rd
Richard Hartman Park
Youngs Ln
American Baptist College
Baptist World Ctr
Mainstream Dr
Great Circle Rd
Cumberland River
Loves Branch
Saunders Ave
National Cemetery
Spring Hill Cemetery
Vanderbilt Medical Center
Lemont Dr
Winding Way
Kenwood Dr
Greenland Ave
McAlpine Ave
Sunnymeade Dr
Norvet Ave
Arden Ave
Stratford Ave
Cooper Ln
Fernwood Dr
Berrywood Rd
McGavock Pike
Shelton Ave
Kirkland Ave
Litton Ave
Marsden Ave
Oxford St
Burns St
Hilson Ave
Gale Edwards Ave
Tanglewood Dr
Ensley Hill Rd
Vaughns Branch
Brick Church Ln
Valleyview Dr
Cedarwood Dr
Meadowood Dr
Deverdale Dr
Lynnbrook Rd
Ensley Dr
Lynnhurst Dr
Boyd Dr
Revels Dr
Mill Creek
Trinity Ln
Edwin St
Ellington Pkwy
Old Hickory Blvd
Briley Pkwy
Loves Branch
Miami Ave
Vienda Villa
Maplewood Ln
Broadmoor Dr
Kenwood Dr
Riverwood Dr
Greenland Ave
McAlpine Ave
Sunnymeade Dr
Norvet Ave
Arden Ave
Stratford Ave
Cooper Ln
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Oxford St
Burns St
Hilson Ave
Gale Edwards Ave
Tanglewood Dr
Ensley Hill Rd

GNRC

GREATER NASHVILLE REGIONAL COUNCIL

Liner Notes

Is Replica a One Hit Wonder?

Provides Speed, Volumes, and Turning Movements

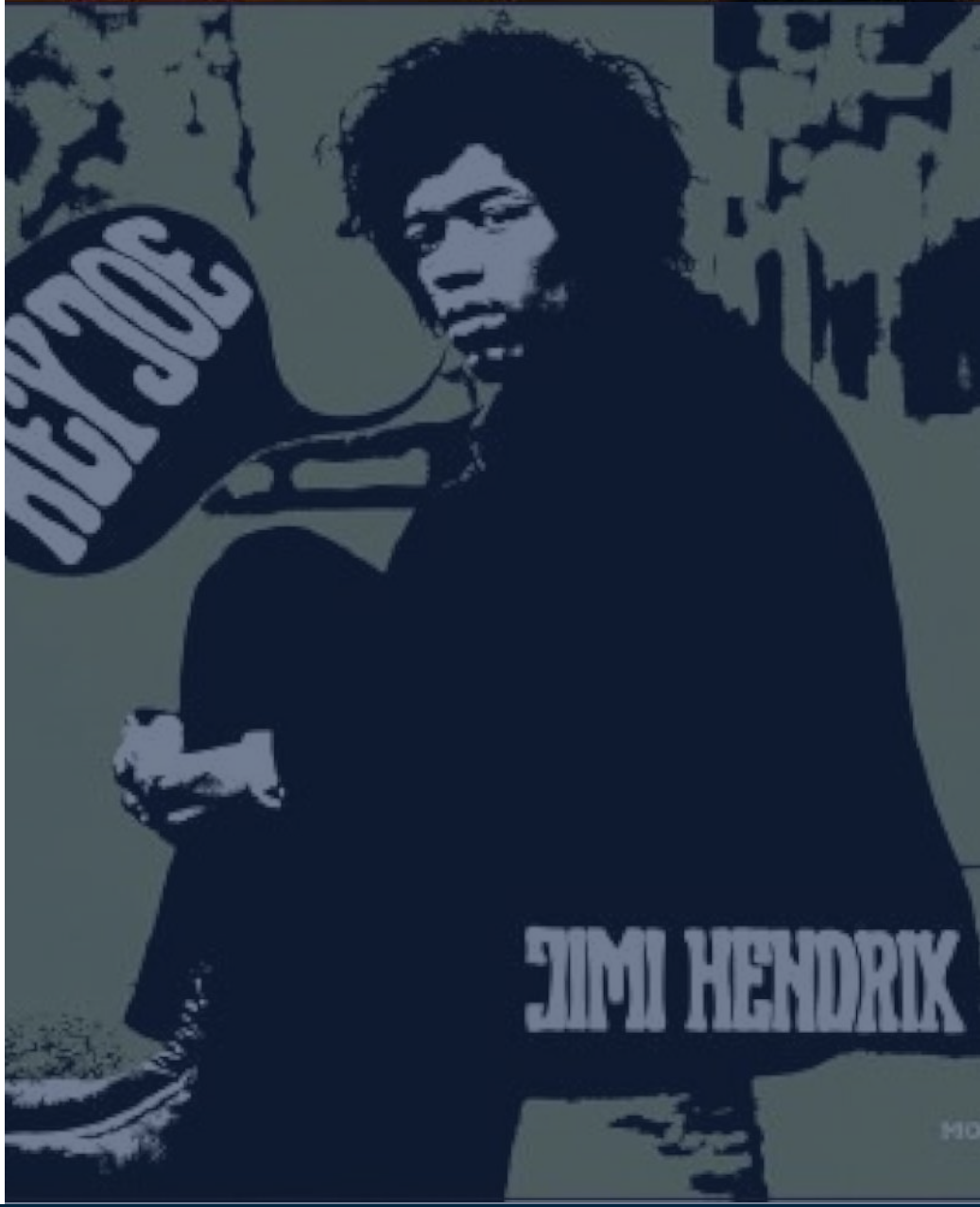
Similar to INRIX through RITIS platform currently using for system monitoring. Multimodal volumes and turning movements previously unavailable will improve prioritization tools and studies.

Demographic, Spend and Trip Data

Understanding of users and how they traverse the transportation system without effort and time involved to update regional TDM.

Always Adding Features

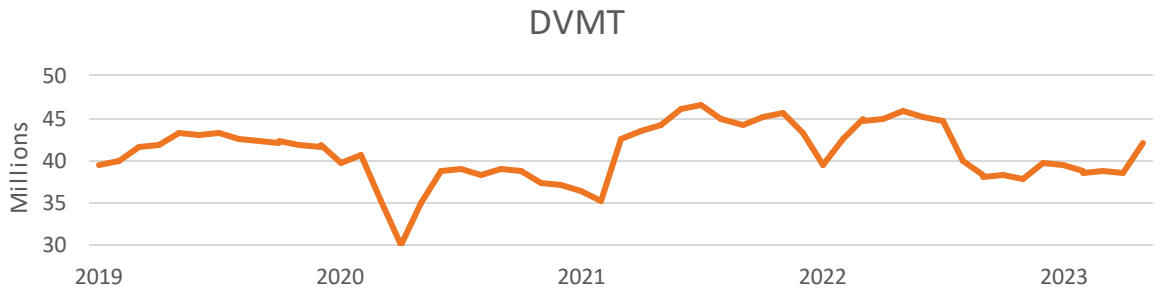
Replica is ever evolving to create new features and functions

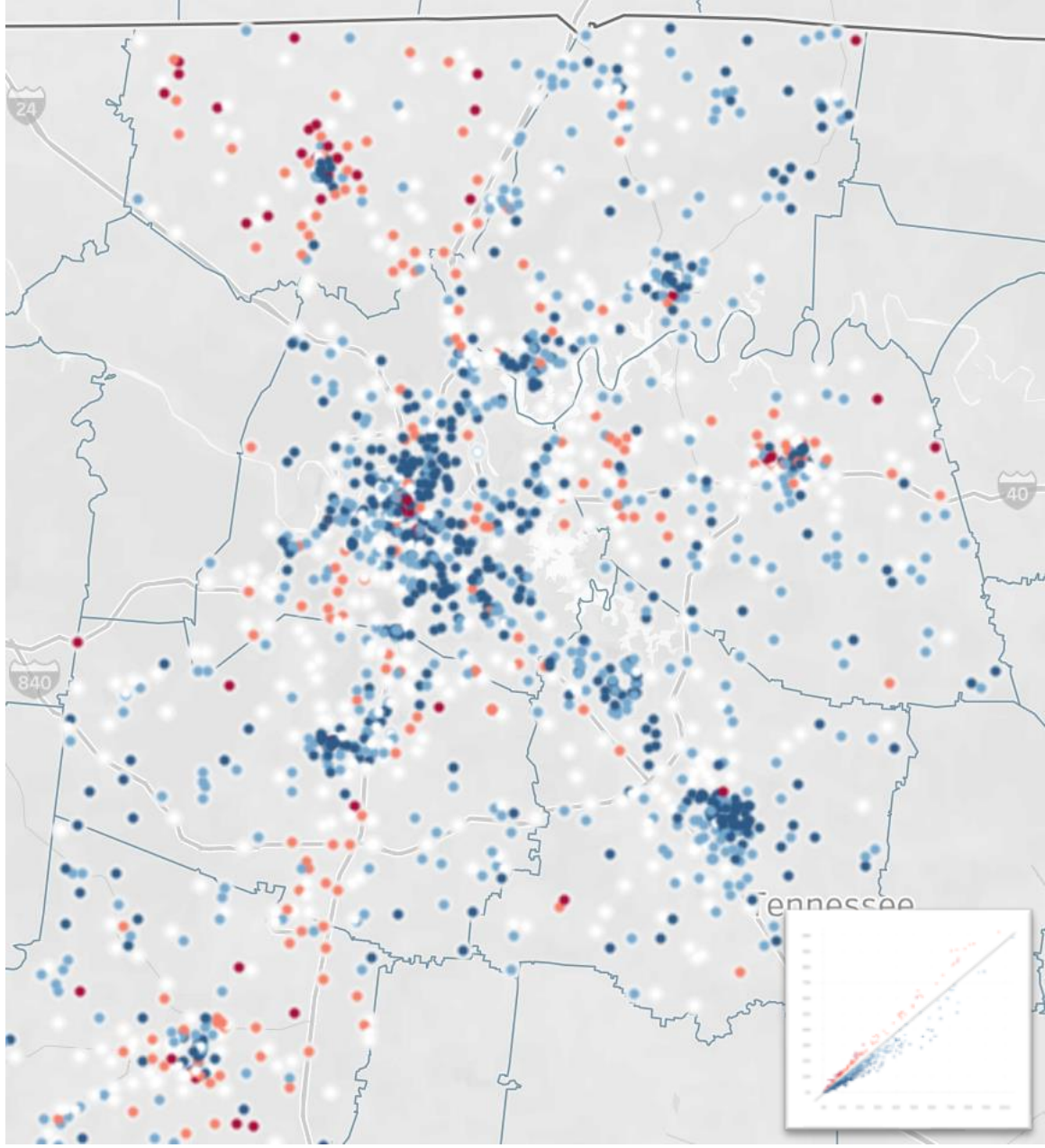


Performance

Overall, the performance of Replica has been acceptable. Urban areas seem to be underestimated and rural areas tend to be overestimated. We also noted several locations where counts appeared significantly different.

- **Compared TDOT AADT to Replica 2022 AADT**
- **AADT R^2 = 0.952**
- **Replica count incorrectly tagged bidirectional**
- **Historic TDOT counts indicate that many counts are possible**
- **DVMT undercount by 4.5M or -7.6%**

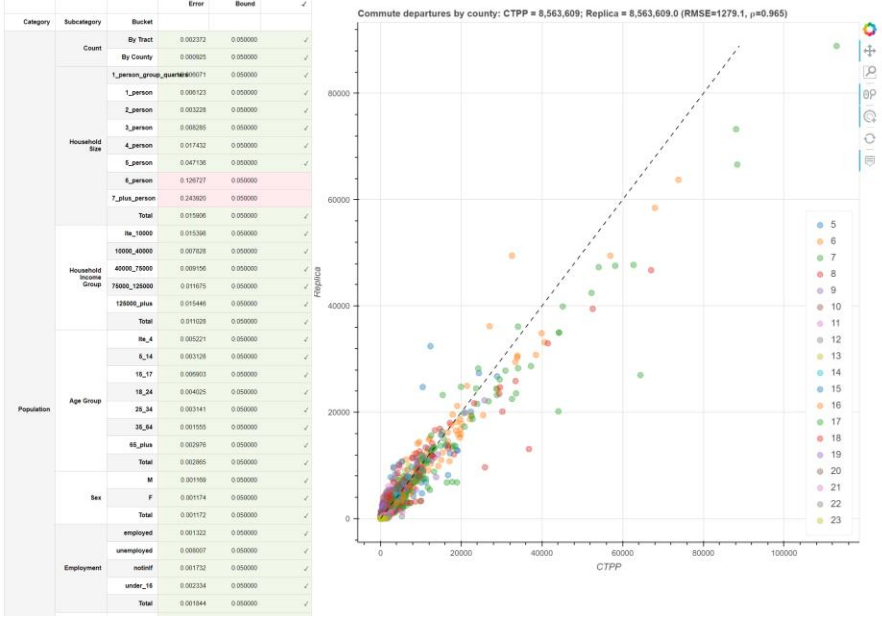


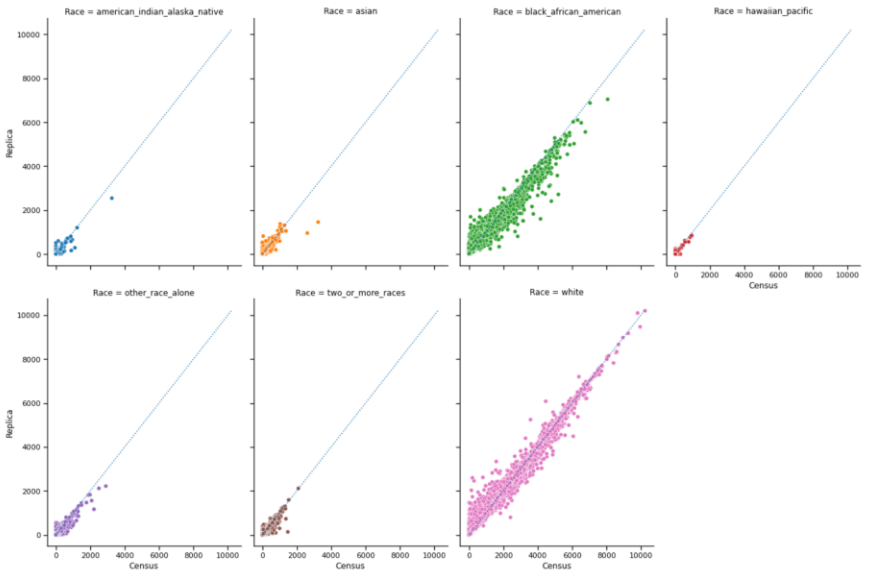


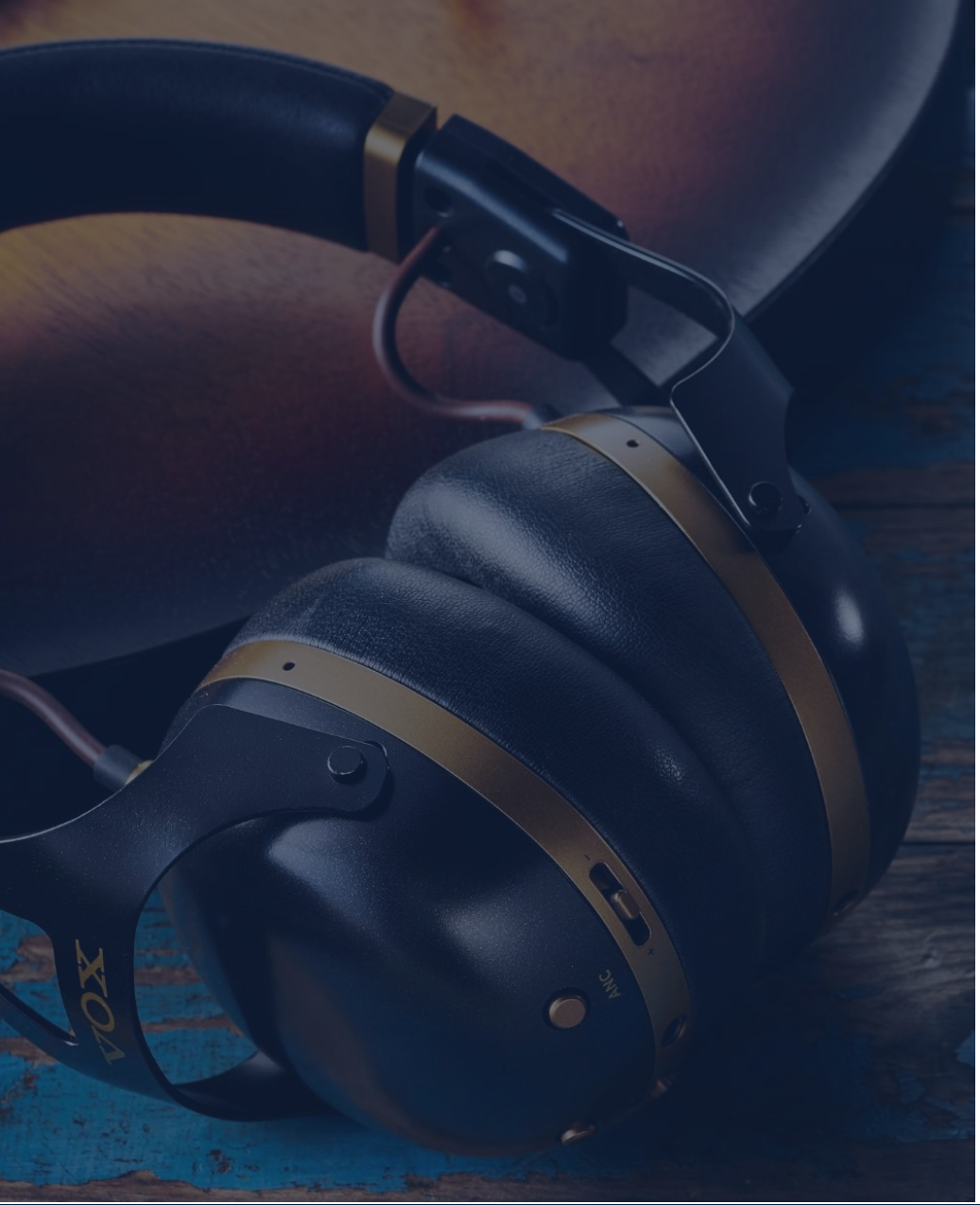
Performance

Resources and documentation of results:

- **Seasonal Quality Reports**
  (http://help.replicahq.com/en/articles/5503665-south-central-quality-reports)
- **GNRC AADT Validation – Segments**
  (https://public.tableau.com/app/profile/gnrc/viz/ReplicaValidationv2/Dashboard1)
- **GNRC AADT Validation – Ramps**
  (https://public.tableau.com/app/profile/gnrc/viz/ReplicaValidationRamp/Dashboard1)







Can Quality Improve?

Improve Local Data

Every seasonal model can improve by submitting local data. This could be counts, turning movements, transit feeds, speed profiles, editing OSM.

Export Data

Mapping and summaries can be limiting. Exporting data to display and analyze is sometimes necessary.

Brainstorm with Replica

If an issue is identified or you would find a feature helpful, the Replica team is willing to discuss anything to improve their product.

Are you experienced?

Have you ever been experienced?

Well, I have

Jimi Hendrix

CONNECTING COMMUNITIES
GN
RC
EMPOWERING PEOPLE