

West Main Street Analysis - 1861928

Created by: bergstromn@kalamazoo.org

Created on: 2024-12-13

Organization: City of Kalamazoo

Analysis ID: 1861928

Analysis Type: Corridor Studies

Unit of Measurement: Miles

Mode of Travel: All Vehicles

Zone Library Type(s): OSM (Feb 2023)

Output Type: StL All Vehicles Volume

Data Periods: Jan 01, 2022 - Dec 31, 2023

Total Traffic Volume: 3,687,000

Python Imports

Study Location Map

Python GeoPandas Library

```
<class 'geopandas.geodataframe.GeoDataFrame'>
RangeIndex: 53 entries, 0 to 52
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype  
---  --          -----          ----- 
 0   id          53 non-null    object  
 1   segment_id  53 non-null    int32  
 2   name         53 non-null    object  
 3   segment_ty  53 non-null    object  
 4   geometry     53 non-null    geometry
dtypes: geometry(1), int32(1), object(3)
memory usage: 2.0+ KB
```

Reproject to Web Mercator for use with basemap

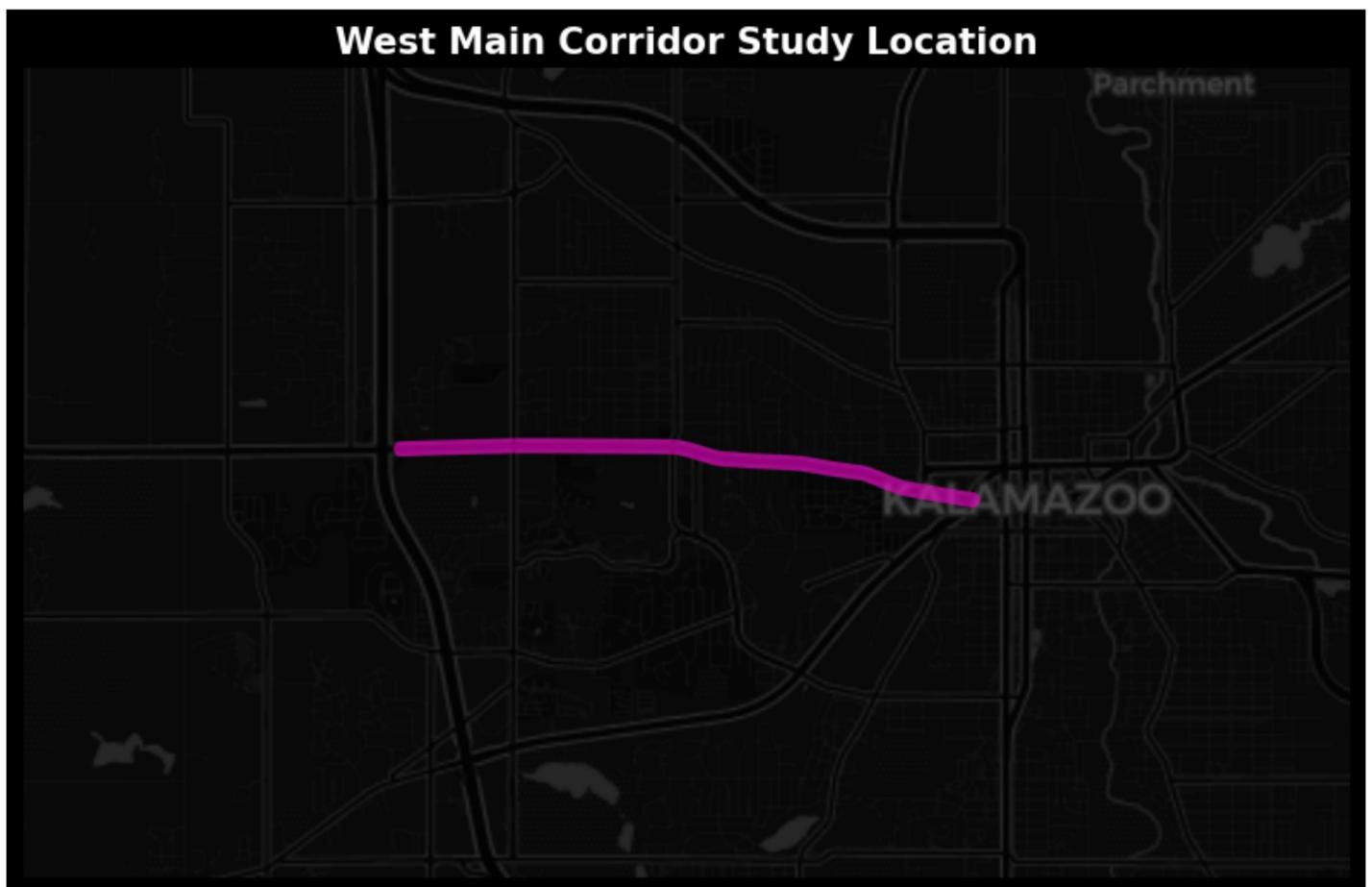
```
Out[3]: array([-9535805.17429403,  5204747.15539218, -9528239.97866332,
 5205463.82515336])
```

New Coordinate System for West Main Corridor

```
Out[4]: <Projected CRS: EPSG:3857>
Name: WGS 84 / Pseudo-Mercator
Axis Info [cartesian]:
- X[east]: Easting (metre)
- Y[north]: Northing (metre)
Area of Use:
- name: World between 85.06°S and 85.06°N.
- bounds: (-180.0, -85.06, 180.0, 85.06)
Coordinate Operation:
- name: Popular Visualisation Pseudo-Mercator
- method: Popular Visualisation Pseudo Mercator
Datum: World Geodetic System 1984 ensemble
- Ellipsoid: WGS 84
- Prime Meridian: Greenwich
```

Create buffer from Lines and merge for better display

Use GeoPandas .plot() to display map



West Main Corridor CSV Data

First 10 records in streetlight CSV file

Data Periods,Mode of Travel,Zone ID,Zone Name,Road Classification,Line Zone Length (Miles),Zone Is Pass Thru
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112
 "Jan 01, 2022 - Dec 31, 2023",All Vehicles - StL All Vehicles Volume,1111503841,West Main Street / 111568112

Data Analysis

Load West Main Traffic data into Pandas Dataframe

4770 Records with basic statistics for all attributes

Out[8]:

	Line Zone Length (Miles)	Zone Direction (degrees)	Average Daily Segment Traffic (StL Volume)	Avg Segment Speed (mph)	Avg Segment Travel Time (sec)	Free Flow Speed (mph)	Vehicle Miles of Travel (StL Volume)	Travel Time Index	85th Speed Percentile
count	4770.0	4770.0	4770.0	4770.0	4770.0	4770.0	4770.0	4770.0	4770.0
mean	0.1	96.4	1212.9	37.7	6.5	43.2	83.8	1.2	45.2
std	0.1	5.9	2299.5	4.4	5.7	3.8	230.9	0.1	3.2
min	0.0	88.0	21.0	19.0	1.0	21.8	0.4	1.0	30.0
25%	0.0	92.0	228.0	36.0	3.0	42.9	9.5	1.1	44.0
50%	0.1	94.0	647.0	39.0	5.0	43.8	25.8	1.1	45.0
75%	0.1	100.0	905.8	40.0	8.0	44.8	64.9	1.2	47.0
max	0.3	112.0	17452.0	46.0	33.0	47.4	4593.1	1.6	53.0

30 Different categories for Day Part attribute

Filtering for only 'All Day (12am-12am)'

This should show traffic volumes for the entire day and eliminate duplicate entries

```
Out[9]: array(['00: All Day (12am-12am)', '01: 12am (12am-1am)',  

   '02: Early AM (12am-6am)', '03: 1am (1am-2am)',  

   '04: 2am (2am-3am)', '05: 3am (3am-4am)', '06: 4am (4am-5am)',  

   '07: 5am (5am-6am)', '08: 6am (6am-7am)', '09: Peak AM (6am-10am)',  

   '10: 7am (7am-8am)', '11: 8am (8am-9am)', '12: 9am (9am-10am)',  

   '13: 10am (10am-11am)', '14: Mid-Day (10am-4pm)',  

   '15: 11am (11am-12noon)', '16: 12pm (12noon-1pm)',  

   '17: 1pm (1pm-2pm)', '18: 2pm (2pm-3pm)', '19: 3pm (3pm-4pm)',  

   '20: 4pm (4pm-5pm)', '21: Peak PM (4pm-8pm)', '22: 5pm (5pm-6pm)',  

   '23: 6pm (6pm-7pm)', '24: 7pm (7pm-8pm)', '25: 8pm (8pm-9pm)',  

   '26: Late PM (8pm-12am)', '27: 9pm (9pm-10pm)',  

   '28: 10pm (10pm-11pm)', '29: 11pm (11pm-12am)'], dtype=object)
```

We now have reduced 4770 records to 53

This represents one record per road segment/Zone ID

Let's drop some of the extraneous columns for the analysis

```
Out[10]: Data Periods      53
Mode of Travel      53
Zone ID      53
Zone Name      53
Road Classification      53
Line Zone Length (Miles)      53
Zone Is Pass Through      53
Zone Direction (degrees)      53
Zone Cardinal Direction      53
Zone is Bi-Direction      53
Day Type      53
Day Part      53
Average Daily Segment Traffic (StL Volume)      53
Avg Segment Speed (mph)      53
Avg Segment Travel Time (sec)      53
Free Flow Speed (mph)      53
Vehicle Miles of Travel (StL Volume)      53
Travel Time Index      53
Congested Segment      53
85th Speed Percentile      53
dtype: int64
```

First 5 records with some columns removed

	Zone ID	Line Zone Length (Miles)	Day Type	Average Daily Segment Traffic (StL Volume)	Avg Segment Speed (mph)	Free Flow Speed (mph)	85th Speed Percentile
Zone ID							
1111503841	1111503841	0.031	0: All Days (M-Su)	11509	40	44.303	45
1111754274	1111754274	0.017	0: All Days (M-Su)	11450	37	42.516	43
1111871475	1111871475	0.062	0: All Days (M-Su)	12575	34	43.484	45
1112032394	1112032394	0.031	0: All Days (M-Su)	11558	39	44.121	45
1112161013	1112161013	0.190	0: All Days (M-Su)	16557	33	44.298	45

Traffic Data Summary

Raw Traffic Data - Non-Filtered - All 4770 Records

Rename attribute columns

```
[(0, 'Data Periods'), (1, 'Mode of Travel'), (2, 'Zone ID'), (3, 'Zone Name'), (4, 'Road Classification'), (5,
```

Out[13]:

West Main All Segments/Day Part Stats

	COUNT	MEAN	STD	MIN	MAX
Zone Length (mi)	4,770.00	0.07	0.05	0.01	0.29
Avg Daily Seg Traffic	4,770.00	1,212.85	2,299.47	21.00	17,452.00
Avg Seg Spd (mph)	4,770.00	37.67	4.44	19.00	46.00
Free Flow Spd (mph)	4,770.00	43.24	3.76	21.80	47.42
85th Spd PCTL	4,770.00	45.18	3.20	30.00	53.00

Filtered Traffic Data - Day Part = 'All Day (12am-12am)'

Out[15]:

West Main Filtered - Day Part - Stats

	MEAN	STD	MIN	MAX
Zone Length (mi)	0.07	0.05	0.01	0.29
Avg Daily Seg Traffic	12,565.70	1,747.09	9,173.00	16,557.00
Avg Seg Spd (mph)	36.66	4.22	19.00	43.00
Free Flow Spd (mph)	43.24	3.80	21.80	47.42
85th Spd PCTL	44.55	2.93	32.00	50.00

Free Flow Speed Outliers

Here we see there are a few Free Flow Spd (mph) values much lower than the others

These are the most easterly segments of West Main, as traffic slows into the Michikal/Stadium intersection

Free Flow Speed (mph) Standard Dev: 3.8 - Mean: 43.243 - Min: 21.8 - Max: 47.42

Removing Free Flow outliers beyond 2X std dev

Min is now 38.6 vs 21.8

This will yield a better visualization for Free Flow Speed

Free Flow Speed (mph) Standard Dev: 1.806 - Mean: 43.87 - Min: 38.6 - Max: 47.4

Out[18]:

West Main Filtered - No Outliers - Stats

	MEAN	STD	MIN	MAX
Zone Length (mi)	0.07	0.06	0.01	0.29
Avg Daily Seg Traffic	12,453.27	1,683.08	9,173.00	16,557.00
Avg Seg Spd (mph)	37.20	3.19	27.00	43.00
Free Flow Spd (mph)	43.87	1.81	38.56	47.42
85th Spd PCTL	44.94	2.11	39.00	50.00

Traffic Data Visualization

Table with inline bar plots for each segment

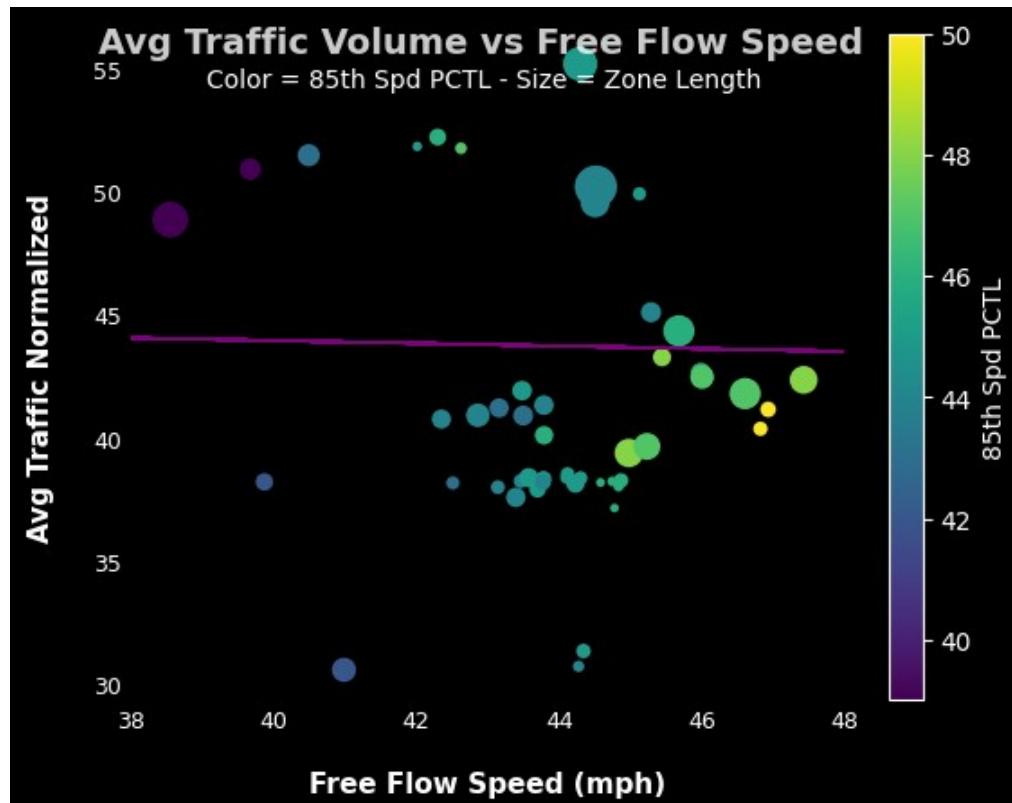
Colors also vary as values increase

Out[22]:

	Zone Length (mi)	Avg Daily Seg Traffic	Avg Seg Spd (mph)	Free Flow Spd (mph)	85th Spd PCTL
Zone ID					
1111503841	0.03	11,509	40	44.30	45
1111754274	0.02	11,450	37	42.52	43
1111871475	0.06	12,575	34	43.48	45
1112032394	0.03	11,558	39	44.12	45
1112161013	0.19	16,557	33	44.30	45
1112668374	0.03	11,473	38	43.47	44
1112849422	0.05	11,463	33	39.88	42
1113019695	0.02	11,408	39	44.84	46
1113040226	0.06	12,398	37	43.79	44
1114146198	0.06	12,229	37	42.35	44
1114616731	0.14	14,863	34	44.51	44
1116305198	0.21	14,658	27	38.56	39
1117249985	0.01	11,455	39	44.58	46
1117696275	0.03	9,402	38	44.34	45
1117701695	0.03	11,519	39	44.11	45
1117920679	0.03	12,110	43	46.82	50
1118270723	0.06	11,514	38	43.58	45
1118430784	0.09	12,275	37	42.87	44
1119017295	0.03	11,507	39	43.80	45
1119597017	0.07	12,790	31	45.99	46
1120280176	0.05	11,442	38	44.23	45
1121660005	0.03	11,450	37	42.52	43
1122981272	0.04	12,346	43	46.93	50
1124281992	0.05	15,664	38	42.30	46
1124989429	0.01	11,145	38	44.78	46
1124999038	0.09	12,741	37	46.00	47
1125207370	0.01	11,469	38	44.74	46
1125243663	0.06	12,364	36	43.16	43
1126486182	0.16	13,303	38	45.68	46
1127547849	0.29	15,060	34	44.52	44
1127555409	0.03	11,399	38	43.15	44
1127606933	0.12	12,706	42	47.42	48
1128083955	0.03	11,507	39	43.78	45
1128322303	0.05	12,982	41	45.44	48

Zone ID	Zone Length (mi)	Avg Daily Seg Traffic	Avg Seg Spd (mph)	Free Flow Spd (mph)	85th Spd PCTL
1128411227	0.16	12,539	40	46.60	47
1128420335	0.07	15,273	31	39.68	39
1128916291	0.13	11,815	41	44.98	48
1129287098	0.03	14,973	35	45.13	45
1129532305	0.06	12,271	33	43.50	43
1130343371	0.04	11,372	36	43.70	45
1131598426	0.04	11,462	38	43.78	44
1131761198	0.01	15,551	38	42.02	45
1131825456	0.02	9,215	38	44.27	44
1132064737	0.02	15,528	39	42.63	47
1133022259	0.08	15,443	36	40.50	43
1134093812	0.12	11,895	41	45.23	47
1134603067	0.07	13,530	35	45.29	44
1135387927	0.06	12,031	40	43.79	46
1135510752	0.09	9,173	31	40.99	42
1136121957	0.06	11,274	37	43.40	44
1136197293	0.03	11,481	39	44.87	46

Free Flow Spd vs Avg Traffic Volume Scatterplot



Spatial Data Visualization

Load west_main_corridor.geojson using GeoData library

	id	segment_id	name	segment_ty	geometry
0	0	1111503841	West Main Street / 111568112 / 7	primary	LINESTRING (-85.61777 42.29486, -85.61716 42.2...
1	1	1111754274	West Main Street / 727695179 / 1	primary	LINESTRING (-85.62555 42.2955, -85.62523 42.29...
2	2	1111871475	West Main Street / 264373332 / 7	primary	LINESTRING (-85.63055 42.29619, -85.62977 42.2...

Data for Each record with Zone ID as Identifier:

```
Out[88]: {'Zone ID': 1111503841,
'Zone Length (mi)': 0.031,
'Day Type': '0: All Days (M-Su)',
'Avg Daily Seg Traffic ': 11509,
'Avg Seg Spd (mph)': 40,
'Free Flow Spd (mph)': 44.303,
'85th Spd PCTL': 45}
```

Join traffic data to segments using Zone ID/segment_id

Display attributes for new joined record

```
Out[93]: {'id': '0',
'type': 'Feature',
'properties': {'id': '0',
'segment_id': 1111503841,
'name': 'West Main Street / 111568112 / 7',
'segment_ty': 'primary',
'Zone ID': 1111503841,
'Zone Length (mi)': 0.031,
'Day Type': '0: All Days (M-Su)',
'Avg Daily Seg Traffic ': 11509,
'Avg Seg Spd (mph)': 40,
'Free Flow Spd (mph)': 44.303,
'85th Spd PCTL': 45},
'geometry': {'type': 'LineString',
'coordinates': [[[-85.61777353286743, 42.29485583305359],
[-85.61715984344482, 42.29484176635742]]]}}
```

Create new GeoData object with joined Data

Convert Coorindate Reference System for creating map

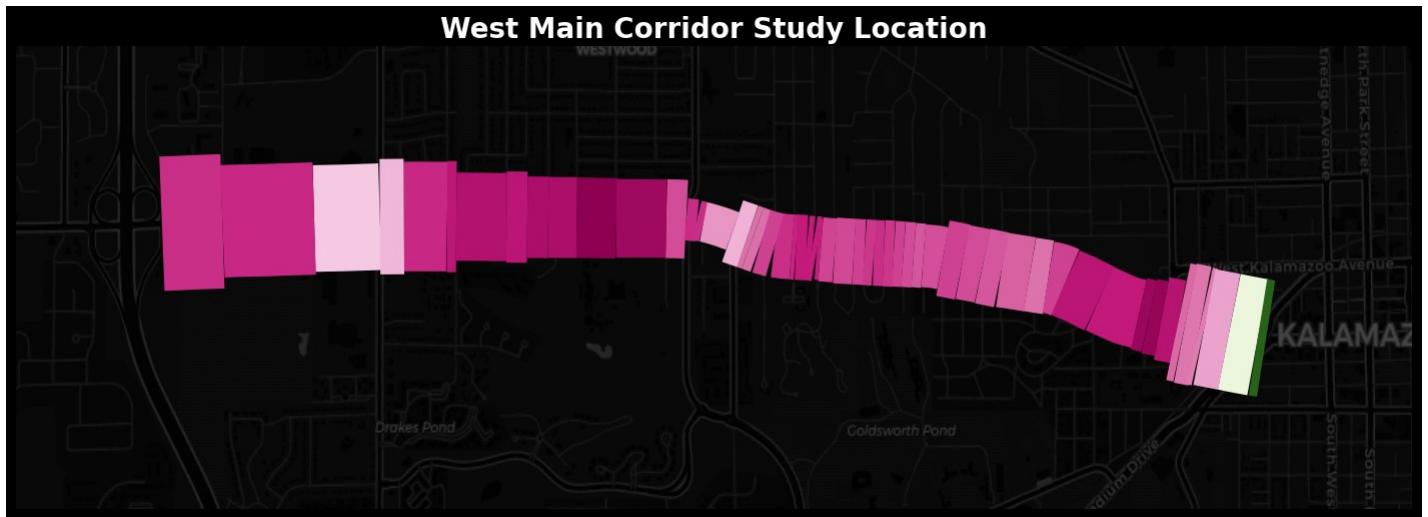
```
Out[97]: array([-9535805.17429403,  5204747.15539218, -9528239.97866332,
 5205463.82515336])
```

First Traffic Volume/Speed Map

Segment width = Avg Traffic Volume

Color = Free Flow Speed

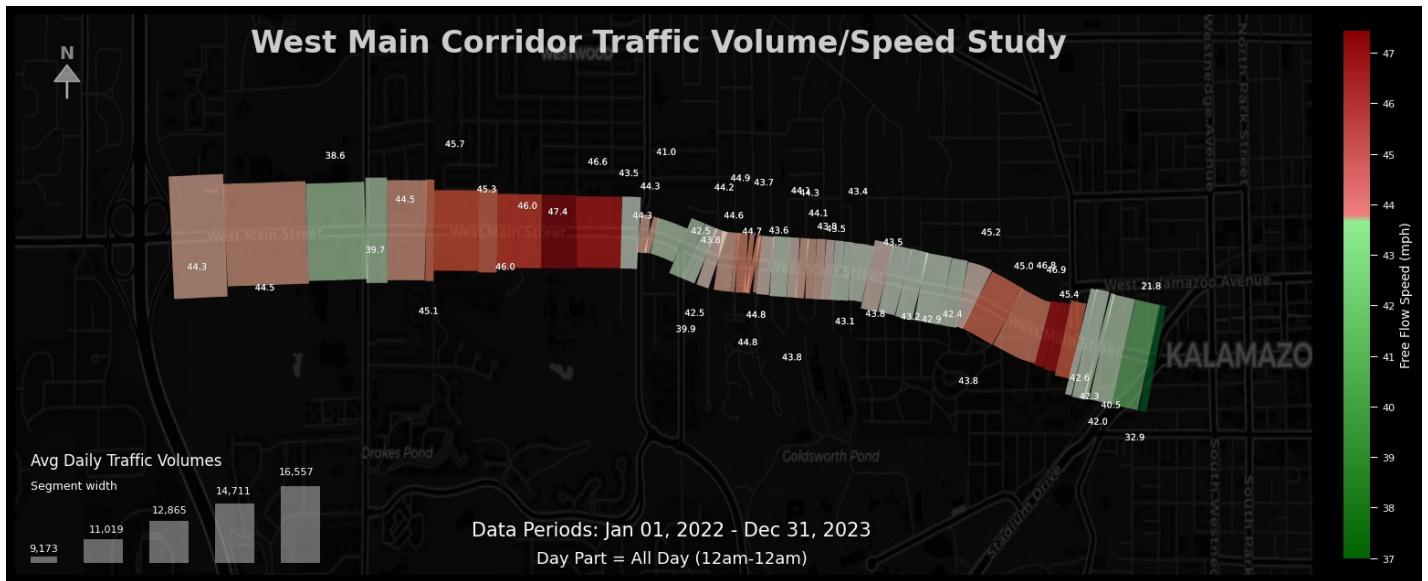
Green < (SLOW) - (FAST) > Red



FINAL MAP

Legends & Segment Labels for Free Flow Speed

(SLOW) Dark Green -> Light Green -> Light Red -> Dark Red (FAST)



Notes:

Filtered Data by Day Part is showing differing values for Avg Speed and 85th Percentile Speed.

Free Flow Speed matches for both filtered and non-filtered, which was target attribute for analysis.

Future analysis could review if any data is omitted from the 12am-12pm Day Part.