Technical Memorandum

To:	Patricia Macchi, STV
From:	Karlynn Kerney, STV
Date:	09/22/2022
CC:	
2022 BIP Grant	**RCE Durham REPAIR Grant**
Subject:	At-Grade Crossings Replica Data for Trip Purpose

To produce the requested trip metrics for each existing at-grade rail crossing, network link(s) were selected representative of trips crossing the rail tracks rather than selecting a group of TAZs or Tracts. The data source for this technical memorandum is REPLICA (https://replicahq.com/). The available data collected for each link was generated from both 2019 Fall and 2021 Spring midweek data and include the following:

- Number of trips
- Trip mode
- Trip distance and duration
- Trip purpose.

Trip purpose was the only data separated by directional northbound and southbound trips . **Figure 1**, **Figure 2**, and **Figure 3** depict the network links selected for Plum Street, Driver Street, and Ellis Road, respectively.

Figure 1 – Selected Link for Plum Street

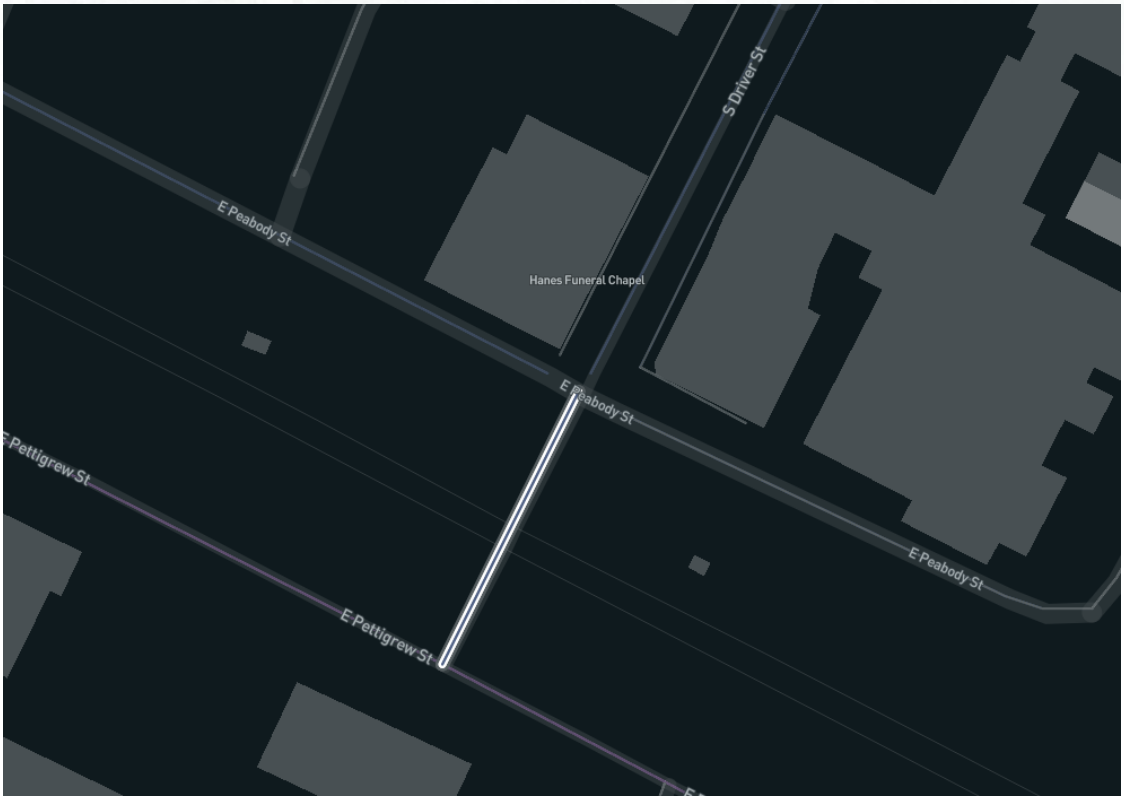

Figure 2 – Selected Link for Driver Street

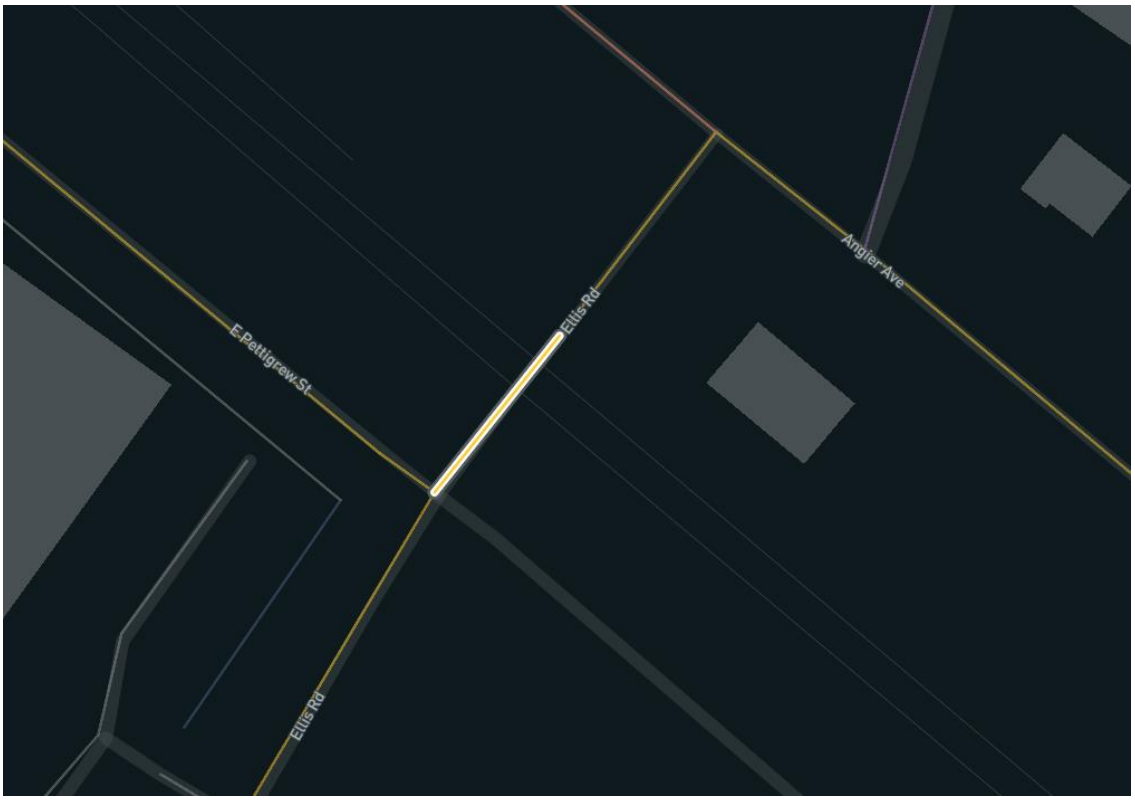

Figure 3 – Selected Link for Ellis Road

With each link separately selected, a summary of the number of trips were generated. Each dataset is represented below:

- Plum Street:
  - 2019 Fall midweek data set produced ≈ 1,500 trips by ≈ 860 people.
  - 2021 Spring midweek data set produced ≈ 1,400 trips by ≈ 800 people.

- Driver Street
  - 2019 Fall midweek data set produced ≈ 6,200 trips by ≈ 4,700 people.
  - 2021 Spring midweek data set produced ≈ 5,800 trips by ≈ 4,600 people.

- Ellis Road
  - 2019 Fall midweek data set produced ≈ 12,100 trips by ≈ 9,600 people.
  - 2021 Spring midweek data set produced ≈ 13,100 trips by ≈ 10,400 people.

In general, there's been a decrease in the number of trips along Plum Street and Driver Street between 2019 and 2021 as opposed to the increase in trips along Ellis Road from 2019 to 2021.

Table 1, **Table 2**, and **Table 3** summarize the primary mode of each of the above trips for Plum Street, Driver Street and Ellis Road, respectively.

Table 1 – Trip Mode at the Plum Street At-Grade Rail Crossing

Plum Street				
Trip Mode	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Private auto[1]	1,046	70.1%	823	58.0%
Auto passenger[2]	236	15.8%	359	25.3%
Commercial vehicle (freight)	59	4.0%	120	8.5%
Taxi/TNC	49	3.3%	1	0.1%
Walking	90	6.0%	85	6.0%
Biking	13	0.9%	32	2.3%
Public transit	0	0.0%	0	0.0%
Other	0	0.0%	0	0.0%
TOTAL	**1,493**	**100.0%**	**1,420**	**100.0%**

Table 2 – Trip Mode at the Driver Street At-Grade Rail Crossing

Driver Street				
Trip Mode	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Private auto[1]	4,026	65.1%	3,944	67.5%
Auto passenger[2]	1,388	22.4%	1,432	24.5%
Commercial vehicle (freight)	517	8.4%	320	5.5%
Taxi/TNC	106	1.7%	27	0.5%
Walking	74	1.2%	61	1.0%
Biking	30	0.5%	37	0.6%
Public transit	47	0.8%	21	0.4%
Other	0	0.0%	0	0.0%
TOTAL	**6,188**	**100.0%**	**5,842**	**100.0%**

Table 3 – Trip Mode at the Ellis Road At-Grade Rail Crossing

Ellis Road				
Trip Mode	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Private auto[1]	8,002	66.2%	9,472	72.6%
Auto passenger[2]	3,636	30.1%	3,188	24.4%
Commercial vehicle (freight)	214	1.8%	245	1.9%
Taxi/TNC	147	1.2%	49	0.4%
Walking	65	0.5%	57	0.4%
Biking	22	0.2%	44	0.3%
Public transit	0	0.0%	0	0.0%
Other	0	0.0%	0	0.0%
TOTAL	**12,086**	**100.0%**	**13,055**	**100.0%**

Notes:
[1] **Private auto:** Trips made by drivers in private auto vehicles. This is equivalent to the number of private auto vehicle movements.
[2] **Auto passenger:** Trips made by passengers in private auto vehicles. Combine this number with the number of private auto trips to get the number of people who traveled in private autos.
School buses are not capture in this analysis.

As summarized above, the primary mode choice for trips is private auto, followed by auto passenger. all three locations. At Plum Street, 6.0% of trips are pedestrians in 2019 and 2021. It should be noted, bicycle trips increased at all three locations from 2019 to 2021, while Taxi trips decreased.

Table 4, **Table 5**, and **Table 6** summarize the calculated total duration for each of the trips for Plum Street, Driver Street and Ellis Road, respectively.

Table 4 – Trip Duration at the Plum Street At-Grade Rail Crossing

Plum Street				
Trip Duration	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Under 5 min	223	14.9%	203	14.3%
5-10 min	377	25.3%	311	21.9%
10-20 min	525	35.2%	515	36.3%
20-40 min	219	14.7%	253	17.8%
40-80 min	126	8.4%	123	8.7%
Over 80 min	23	1.5%	15	1.1%
TOTAL	**1,493**	**100.0%**	**1,420**	**100.0%**

Table 5 – Trip Duration at the Driver Street At-Grade Rail Crossing

Driver Street				
Trip Duration	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Under 5 min	228	3.7%	176	3.0%
5-10 min	823	13.3%	834	14.3%
10-20 min	2,692	43.5%	2,419	41.4%
20-40 min	1,688	27.3%	1,601	27.4%
40-80 min	508	8.2%	527	9.0%
Over 80 min	249	4.0%	285	4.9%
TOTAL	**6,188**	**100.0%**	**5,842**	**100.0%**

Table 6 – Trip Duration at the Ellis Road At-Grade Rail Crossing

Ellis Road				
Trip Duration	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Under 5 min	105	0.9%	156	1.2%
5-10 min	1,193	9.9%	1,339	10.3%
10-20 min	6,644	55.0%	7,625	58.4%
20-40 min	3,633	30.1%	3,411	26.1%
40-80 min	415	3.4%	409	3.1%
Over 80 min	96	0.8%	115	0.9%
TOTAL	**12,086**	**100.0%**	**13,055**	**100.0%**

Table 7, **Table 8**, and **Table 9** summarize the calculated total distance for each of the trips for Plum Street, Driver Street and Ellis Road, respectively.

Table 7 – Trip Distance at the Plum Street At-Grade Rail Crossing

Plum Street				
Trip Distance	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Under 0.5 mi	23	1.5%	27	1.9%
0.5-1 mi	47	3.1%	42	3.0%
1-2 mi	211	14.1%	175	12.3%
2-4 mi	325	21.8%	280	19.7%
4-8 mi	414	27.7%	382	26.9%
8-16 mi	211	14.1%	215	15.1%
16-32 mi	127	8.5%	172	12.1%
32-64 mi	112	7.5%	107	7.5%
Over 64 mi	23	1.5%	20	1.4%
TOTAL	**1,493**	**100.0%**	**1,420**	**100.0%**

Table 8 – Trip Distance at the Driver Street At-Grade Rail Crossing

Driver Street				
Trip Distance	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Under 0.5 mi	14	0.2%	7	0.1%
0.5-1 mi	52	0.8%	47	0.8%
1-2 mi	237	3.8%	185	3.2%
2-4 mi	577	9.3%	553	9.5%
4-8 mi	1,250	20.2%	1,064	18.2%
8-16 mi	2,099	33.9%	1,983	33.9%
16-32 mi	1,227	19.8%	1,184	20.3%
32-64 mi	460	7.4%	496	8.5%
Over 64 mi	272	4.4%	323	5.5%
TOTAL	**6,188**	**100.0%**	**5,842**	**100.0%**

Table 9 – Trip Distance at the Ellis Road At-Grade Rail Crossing

Ellis Road				
Trip Distance	**2019**		**2021**	
	Count	**Percent**	**Count**	**Percent**
Under 0.5 mi	16	0.1%	19	0.1%
0.5-1 mi	43	0.4%	45	0.3%
1-2 mi	64	0.5%	92	0.7%
2-4 mi	537	4.4%	559	4.3%
4-8 mi	3,757	31.1%	3,767	28.9%
8-16 mi	6,100	50.5%	6,492	49.7%
16-32 mi	1,173	9.7%	1,633	12.5%
32-64 mi	305	2.5%	313	2.4%
Over 64 mi	91	0.8%	135	1.0%
TOTAL	**12,086**	**100.0%**	**13,055**	**100.0%**

Table 10, **Table 11**, and **Table 12** summarize the directional trip purpose for each of the trips for Plum Street, Driver Street and Ellis Road, respectively.

Table 10 – Trip Purpose at the Plum Street At-Grade Rail Crossing

Plum Street								
Trip Purpose	**2019**				**2021**			
	Northbound		**Southbound**		**Northbound**		**Southbound**	
	Count	**Percent**	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
Home	260	35.9%	155	20.2%	202	28.0%	158	22.6%
Work	47	6.5%	330	43.0%	54	7.5%	182	26.1%
School	33	4.6%	21	2.7%	28	3.9%	36	5.2%
Eat	70	9.7%	1	0.1%	78	10.8%	3	0.4%
Shop	114	15.7%	50	6.5%	164	22.7%	142	20.3%
Social	66	9.1%	84	10.9%	60	8.3%	51	7.3%
Recreation	21	2.9%	5	0.7%	14	1.9%	4	0.6%
Errands	73	10.1%	72	9.4%	41	5.7%	70	10.0%
Pass-through traffic	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Lodging (hotels etc.)	2	0.3%	0	0.0%	0	0.0%	0	0.0%
Region departure (airport etc.)	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Commercial (freight)	17	2.3%	42	5.5%	68	9.4%	52	7.4%
Other	22	3.0%	8	1.0%	13	1.8%	0	0.0%
TOTAL	**725**	**100%**	**768**	**100%**	**722**	**100%**	**698**	**100%**

Table 11 – Trip Purpose at the Driver Street At-Grade Rail Crossing

Driver Street								
Trip Purpose	2019				2021			
	Northbound		Southbound		Northbound		Southbound	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Home	1,563	45.8%	523	18.8%	1,396	41.1%	520	21.3%
Work	229	6.7%	696	25.1%	261	7.7%	447	18.3%
School	116	3.4%	116	4.2%	123	3.6%	108	4.4%
Eat	244	7.1%	146	5.3%	261	7.7%	186	7.6%
Shop	385	11.3%	359	12.9%	544	16.0%	449	18.4%
Social	394	11.5%	251	9.0%	314	9.2%	167	6.8%
Recreation	12	0.4%	59	2.1%	43	1.3%	79	3.2%
Errands	131	3.8%	203	7.3%	163	4.8%	219	9.0%
Pass-through traffic	0	0.0%	1	0.0%	0	0.0%	0	0.0%
Lodging (hotels etc.)	1	0.0%	2	0.1%	3	0.1%	6	0.2%
Region departure (airport etc.)	0	0.0%	0	0.0%	0	0.0%	1	0.0%
Commercial (freight)	243	7.1%	274	9.9%	184	5.4%	136	5.6%
Other	95	2.8%	145	5.2%	104	3.1%	128	5.2%
TOTAL	**3,413**	**100%**	**2,775**	**100%**	**3,396**	**100%**	**2,446**	**100%**

Table 12 – Trip Purpose at the Ellis Road At-Grade Rail Crossing

Ellis Road								
Trip Purpose	2019				2021			
	Northbound		Southbound		Northbound		Southbound	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Home	2,814	54.2%	1,013	14.7%	2,797	48.7%	1,289	17.6%
Work	435	8.4%	2,227	32.3%	439	7.7%	1,718	23.5%
School	76	1.5%	543	7.9%	95	1.7%	450	6.2%
Eat	205	3.9%	580	8.4%	399	7.0%	688	9.4%
Shop	500	9.6%	947	13.7%	995	17.3%	1,556	21.3%
Social	496	9.6%	532	7.7%	375	6.5%	478	6.5%
Recreation	110	2.1%	165	2.4%	98	1.7%	206	2.8%
Errands	375	7.2%	568	8.2%	344	6.0%	604	8.3%
Pass-through traffic	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Lodging (hotels etc.)	4	0.1%	11	0.2%	13	0.2%	9	0.1%
Region departure (airport etc.)	0	0.0%	0	0.0%	1	0.0%	0	0.0%
Commercial (freight)	117	2.3%	97	1.4%	116	2.0%	129	1.8%
Other	59	1.1%	212	3.1%	66	1.2%	190	2.6%
TOTAL	**5,191**	**100%**	**6,895**	**100%**	**5,738**	**100%**	**7,317**	**100%**

In general, most northbound trips are typically destinated for home, while the majority of other purposes (work, eat, shop, etc.) are southbound trips. It should be noted, pass-through trips for each at-grade rail crossing is consistently low. It may be assumed that the majority of these trips are local. Definitions of these purposes are next for further description.

Trip Purpose

The Trip Purpose module shows the number of trips for each purpose. The trip purpose is determined by the destination type of the trip. For example: If a person is traveling to work, the purpose of the trip is 'Work'. If a person is traveling to a restaurant, the purpose is 'Eat'.

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Errands includes trips to hairdressers, auto shops, banks, and a variety of other locations.

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Recreation includes trips to recreational destinations such as parks and swimming pools. Replica does not include looping trips without a destination, such as walking the dog, or jogging.

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Commercial refers to trips by medium and heavy trucks for deliveries and other commercial purposes.

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Lodging refers to trips by visitors to overnight accommodation such as a hotel.

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Region departure refers to trips by visitors to a "port-of-exit", such as an airport, or major train station.

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Pass-through traffic refers to trips made by non-residents that start and end outside the region. These trips can include short stopovers within the region.

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Select a purpose to filter the Replica Activity Table to include only trips for that purpose.

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How the data is generated

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Trips are generated using our modeling tools. We use de-identified mobile phone location data and other data sources to create behavioral models of how people move. We then apply these models to a synthetic population. Movements are calibrated against observed, ground-truth data.