Memorandum

To: Neil Cronin
City of Newton

Date: April 9, 2020

Project #: 10865.03

From: Randall C. Hart, Principal

Matthew Duranleau, EIT

Re: Riverside Redevelopment
Program Modification Traffic Generation
Newton, Massachusetts

VHB, on behalf of Mark Development (The Proponent) has prepared a traffic generation memorandum to reflect some minor changes to the development program of the proposed redevelopment project at Riverside Station. While the size of the overall project has not changed, the breakdown of uses has shifted slightly as the interior design of of each building has become more defined.

VHB submitted a full Traffic Impact and Access Study for the proposed project in December 2019 analyzing the project-related impacts at all study area intersections and identifying proposed mitigation measures. On February 6, 2020, a follow-up memorandum by VHB titled "Project Modification Traffic Generation/Analysis (Key Locations)" was submitted to the City of Newton summarizing the changes in trip generation, build condition traffic volume networks, and intersection capacity analyses at key locations due to a change in the building program. Since that time, the building program has again changed slightly as the plans have become more defined and this April 9, 2020 Program Modification Traffic Generation memorandum will supersede the February 6, 2020 Program Modification Traffic Generation memorandum.

The proposed Project will include approximately 1,025,000 square feet (sf) of new development on the existing site of the MBTA Riverside station parking lot and the Hotel Indigo. The total size of the development has not changed since the December 2019 TIAS or the February 6, 2020 memorandum. The Project as of February 2020 was to consist of approximately 243,388 sf of new office space, 617 residential units, 43,241 sf of retail/restaurant, and a 150-key hotel. Since that time, the site buildings have been refined and now includes 246,328 sf of new office space, 582 residential units, 38,895 sf of retail/restaurant space, and a 150-key hotel. It should be noted that the office square footages do not include an addition 7,500 sf of office space to be used by the MBTA that will replace existing MBTA office space that is on-site today.

Since the overall size of the development is not changing and since the changes in the breakdown of different uses is relatively minor and reflects the continued developed of the interior building designs, a full update of the TIAS is not warranted and therefore the analyses and traffic volume networks presented in the December 2019 TIAS and the February 6, 2020 memorandum are not being updated. However, for the benefit of understanding the magnitude of the building program modifications, this supplemental memorandum has been prepared summarizing the anticipated traffic generation characteristics of the revised building program.

The proposed changes in the building program are summarized in Table 1.

Table 1 Riverside Redevelopment Changes in Building Program

Land Use	Existing Site	December 2019 TIAS Building Program [a]	February 6, 2020 Memo Building Program [b]	April 2020 Updated Building Program	Change in Building Program (Dec 2019 TIAS to Memo)
Hotel	194 rooms	150 rooms	150 rooms	**150 rooms**	**n/a**
Office [c]	n/a	280,000 sf	243,388 sf	**246,328 sf**	**+ 2,940 sf**
Residential	n/a	600 units	617 units	**582 units**	**- 35 units**
Retail/Restaurant	n/a	52,000 sf	43,241 sf	**38,895 sf**	**- 4,346 sf**
Parking Spaces	960 [d]	2,038 spaces	2,038 spaces	**2,030 spaces**	**- 8 spaces**

a Building Program as outlined in December 2019 TIAS for the Station at Riverside Development.
b Building Program as outlined in February 6, 2020 Program Modification Traffic Generation memo for the Station at Riverside Development.
c Does not include approximately 10,000 sf of office space for MBTA uses on-site today and 7,500 sf of office space for MBTA uses included in the future development.
d Existing parking space count only includes MBTA parking spaces.

As shown in Table 1, the revised building program results in approximately 2,940 more square feet of total proposed office space, 35 fewer proposed residential units, and 4,346 less square feet of proposed retail/restaurant space on-Site than previously proposed in the February 6, 2020 memorandum.

An analysis of the revised program is presented below:

Trip Generation Summary

To assess the changes that would be expected as a result of the program modifications, traffic generation projections have been prepared for the revised program. The rate at which any development generates traffic is dependent upon the size, location, and concentration of surrounding developments. As mentioned previously, the Project is comprised of office, residential, hotel, and retail use. The ITE *Trip Generation Manual*[1] categorizes these land uses and provides weekday daily, weekday morning peak hour, weekday evening peak hour, Saturday daily, and Saturday midday peak hour unadjusted vehicle trip generation estimates for each use. The trip generation estimates for the proposed uses were projected using Land Use Code (LUC) 221 (Mid-Rise Residential), LUC 310 (Hotel), LUC 710 (General Office Building), and LUC 820 (Shopping Center).

The change in total site-generated vehicle trips with the building program is summarized below in Table 2 and a breakdown of the detailed trip generation analyses for the revised building program as requested by the City of Newton Planning Department is described in the following sections.

1 Trip Generation Manual, 10th Edition, Institute of Transportation Engineers, Washington, D.C., 2017.

Table 2 Total Site-Generated Vehicle Trip Generation Comparison

		Building Program in February 6, 2020 memo		Revised Building Program		
Time Period	Direction	Total Unadjusted Trips [a]	Total Net New Trips [b]	Total Unadjusted Trips [c]	Total Net New Trips [d]	Total Net New Trip Difference
Weekday Morning	Enter	421	**313**	419	**314**	+ 1
Peak Hour	Exit	281	**154**	272	**149**	- 5
	Total	702	**467**	691	**463**	- 4
Weekday Evening	Enter	382	**163**	364	**158**	- 5
Peak Hour	Exit	516	**327**	501	**324**	- 3
	Total	898	**490**	865	**482**	- 8
Saturday Midday	Enter	426	**240**	406	**230**	- 10
Peak Hour	Exit	396	**217**	376	**205**	- 12
	Total	822	**457**	782	**435**	- 22

a Unadjusted trip generation estimates based on ITE Trip Generation Manual; from Table 2 in the February 6, 2020 Program Modification Traffic Generation memorandum (does not included MBTA-generated or trips).

b Total Net New trip generation estimate including credits for mode share, internal capture, pass-by, and existing trips; from Table 2 in the February 6, 2020 Program Modification Traffic Generation memorandum.

c Unadjusted trip generation estimates based on ITE Trip Generation Manual; as described in Table 4 in this memorandum (does not include MBTA-generated trips but does include Hotel-generated trips).

d Total Net New trip generation estimate for entire building program and including credits for mode share, internal capture, pass-by, and existing trips; as described in Table 6 in this memorandum.

As shown in Table 2, the revised building program as compared to the previous building program will result in 4 fewer new vehicle trips (+1 entering / -5 exiting) during the weekday morning peak hour, 8 fewer new vehicle trips (-5 entering / -3 exiting) during the weekday evening peak hour, and 22 fewer new vehicle trips (-10 entering / -12 exiting) during the Saturday midday peak hour. The weekday morning peak hour will see one additional trip entering the Site due to the slight increase in office spare footage while the Saturday midday peak period will see the biggest reduction in Site-generated trips due to the slight decrease in retail square footage.

Project-Generated Trips

Estimating future conditions volumes for the Site involved a review of the existing development on those parcels, along with the additional trip generation expected from the Project development.

Existing Site-Generated Traffic

The planned development parcels currently are occupied by the Hotel Indigo, which features 194 hotel rooms and an on-site restaurant, and a commuter park and ride, kiss and ride, and pick-up / drop-off loop for the MBTA Riverside Station featuring approximately 960 parking spaces. The vehicular Site trip generation for the weekday morning and

weekday evening peak hours under existing conditions was estimated based on turning movement counts conducted at the two Site driveways. Table 3 summarizes the Project-related trips for the existing uses on Site.

Table 3 Existing Site Trip Generation

	Hotel	MBTA Station	Total Vehicle Trips
Weekday Morning Peak Hour			
Enter	45	250	**295**
Exit	45	125	**170**
Total	90	375	**465**
Weekday Evening Peak Hour			
Enter	50	150	**200**
Exit	35	235	**270**
Total	85	385	**470**
Saturday Midday Peak Hour [c]			
Enter	30	225	**255**
Exit	25	95	**120**
Total	55	320	**375**

Based on turning movement counts conducted by VHB in June 2018, October 2018, and September 2019.

As shown in Table 3, the Site under existing conditions currently generates approximately 465 vehicular trips (295 entering / 170 exiting) during the weekday morning peak hour, 470 vehicular trips (200 entering / 270 exiting) during the weekday evening peak hour, and 375 vehicular trips (255 entering / 120 exiting) during the Saturday midday peak hour. It should be noted that the existing Site also contains the Riverside MBTA maintenance yard and supporting facilities, but it was assumed that the maintenance yard generated negligible trips during the weekday morning, weekday evening, and Saturday midday peak hours.

It is expected that the existing MBTA Station-generated vehicular trips will continue to be generated by the Site under future conditions. A parking garage with approximately 960 parking spaces for commuters and designated pick-up and drop-off areas near the station entrance will be provided on Site to accommodate the commuters that use the Riverside MBTA Station today. Thus, the existing MBTA Station-generated vehicle trips presented in Table 3 have been included in all future total Project-generated vehicular trip calculations.

While the site under existing conditions contains a 194-room hotel, the proposed building program includes a 150-room hotel, which is 44-rooms fewer than the existing hotel. Therefore, it is expected that the proposed hotel will generate a different number of peak hour trips than the existing hotel. To be consistent with the analysis for the rest of the proposed building program, ITE data was used to project the future number of hotel trips as opposed to the existing driveway counts.

Unadjusted Project-Generated Traffic

The proposed development will consist of a mixture of residential, office, hotel, and supporting retail uses. Specifically, the Site is proposed to include approximately 582 residential units, 246,328 sf of new office space, a 150-room hotel, 38,895 sf of supporting restaurant/retail uses, and 2,030 parking spaces on-Site to accommodate the proposed development and the commuters using the Riverside MBTA Station. Traffic associated with the residential units was estimated using ITE LUC 221 (Mid-Rise Residential), traffic associated with the hotel was estimated using ITE LUC 310 (Hotel), traffic associated with the office space was estimated using ITE LUC 710 (General Office Building), and traffic

associated with the retail uses was estimated with ITE LUC 820 (Shopping Center). As noted previously, traffic associated with the MBTA station was estimated based on the observed existing Site-generated vehicular trips.

Approximately 7,500 sf of additional office space will also be built and be dedicated office space for the Riverside MBTA. This space will replace existing office space that is currently housed within the rail yard. Those buildings will be eliminated. As this small portion of office space will not be considered a new use and will replace existing office on-Site, it is not included in the 246,328 sf of office space and is not reflected in the proposed Site-generated volumes.

It should be noted that the retail uses are expected to be smaller, Main Street style businesses catering to the residential and office space on-Site and the adjacent neighborhoods as opposed to large big-box style retail stores. Potential uses will may include eating establishments, coffee shops, pharmacies, convenience stores, or gallery uses. The service style retail that would serve the uses on site are not expected to draw heavily from the community like a shopping center would. While these do not fit the exact description of a traditional ITE "Shopping Center", retail traffic was estimated using this land use code, which results in an overly conservative analysis.

The unadjusted new vehicle trip estimates are presented in Table 4 and trip generation worksheets are included in the Attachments.

Table 4 Project Trip Generation – New Unadjusted Vehicle Trips

	Hotel [a]	Residential [b]	Office [c]	Retail [d]	Total New Unadjusted Vehicle Trips [e]
Weekday Daily					
Enter	633	1,585	1,272	1,582	**5,072**
Exit	633	1,585	1,272	1,582	**5,072**
Total	1,266	3,170	2,544	3,164	**10,144**
Weekday Morning Peak Hour					
Enter	41	50	222	106	**419**
Exit	29	142	36	65	**272**
Total	70	192	258	171	**691**
Weekday Evening Peak Hour					
Enter	44	147	43	130	**364**
Exit	42	94	225	140	**501**
Total	86	241	268	270	**865**
Saturday Daily					
Enter	574	1,093	272	2,481	**4,420**
Exit	574	1,093	272	2,481	**4,420**
Total	1,148	2,186	544	4,962	**8,840**
Saturday Midday Peak Hour					
Enter	60	123	70	153	**406**
Exit	47	128	60	141	**376**
Total	107	251	130	294	**782**

a Based on ITE LUC 310 (Hotel) for 150 rooms.
b Based on ITE LUC 221 (Mid-Rise Residential) for 582 residential units.
c Based on ITE LUC 710 (General Office Building) for 246,328 sf.
d Based on ITE LUC 820 (Shopping Center) for 38,895 sf.
e Sum of unadjusted hotel, residential, office, and retail trips. While hotel-generated trips are already generated under existing conditions and therefore are not "new" trips to the Site, the hotel trips are included in the sum to be conservative.

Note: MBTA Station generated trips are already generated under existing conditions and therefore are not included as "new" trips to the Site.

Person Trips

The unadjusted vehicle trips are converted into person trips by applying the average vehicle occupancy (AVO) of 1.18 for residential and office trips and of 1.82 for retail and hotel trips, as outlined by the U.S. Department of Transportation[2]. The unadjusted vehicle trips were converted into person trips in order to apply internal capture credits and applicable mode share credits, as described below. Applying these credits to person trips allows for estimates to be made for the total number of Site-generated transit users, walkers, and bicyclists in addition to the total number of Site-generated vehicles.

2 Summary of Travel Trends: 2017 National Household Survey, US Department of Transportation, Federal Highway Administration, Washington D.C., 2017. The 2017 survey was used to be consistent with the trip generation volumes presented in the December 2019 TIAS and the February 6, 2020 memorandum.

Internal Capture Trips

Since the proposed development is a mixed-use project, the trip generation characteristics of the Site will be different from a single-use project. Some of the traffic to be generated by the proposed development will be contained on site as "internal" or "shared vehicle" trips. For example, workers at the office space on Site may patron the retail shops after work, or residents who live in the development may also work in the office on Site. While these shared trips represent new traffic to the individual uses, they would not show up as new vehicle trips on the surrounding roadway network.

As described in the ITE Trip Generation Handbook[3] "because of the complementary nature of these land uses, some trips are made among the on-site uses. This capture of trips internal to the site has the net effect of reducing vehicle trip generation between the overall development site and the external street system (compared to the total number of trips generated by comparable land uses developed individually on stand-alone sites) an internal capture rate can generally be defined as the percentage of total person trips generated by a site that are made entirely within the site. The trip origin, destination, and travel path are all within the site."

Based on the methodology outlined in the ITE Trip Generation Handbook, internal capture rates were applied to the gross person trips. Internal capture worksheets are included in the Attachments to this memorandum.

Mode Share

The Project is conveniently located at the Riverside MBTA Station, providing direct access to both the MBTA Green Line and several MBTA bus routes, local shuttles, etc. and making it a true Transit Oriented Development. Mode shares for the proposed development were assigned in the December 2019 TIAS based on research and previously submitted traffic studies. Table 5 provides a summary of the projected mode shares by land use.

Table 5 Project Mode Share

Use	Vehicle	Transit	Walk/Bike
Residential	75%	25%	0%
Office	95%	5%	0%
Retail	100%	0%	0%

The mode shares discussed above were applied to the net-new person trips to generate the adjusted Project trips by mode. The local average vehicle occupancy, based US Census data for each primary use, was then applied to the vehicle mode to reflect the number of vehicle trips generated by the Site. The trip generation calculations are included in the Attachments to this memorandum.

It should be noted again that the vehicle mode shares were applied in order to present a conservative assessment of future traffic impacts. The use of the high vehicle mode shares and low transit and walk/bike mode shares was a directive of MassDOT as part of the former approval process to be conservative in assessing project impacts and potential improvements.

Overall, the following conservative assumptions were made throughout the trip generation process to evaluate the traffic impacts on the regional roadway network:

- Use of LUC 820 (Shopping Center) for retail when service style is primarily what will be present.

3 Trip Generation Handbook, 3rd Edition, Institute of Transportation Engineers, Washington, D.C., 2017.

- High vehicle mode share assumptions for Office
- High vehicle mode share assumption for Residential
- No non-vehicular mode share application for Retail
- No mode share for bicycles and pedestrians

In the December 2019 TIAS, a transit analysis was introduced that discusses the impact the project will have on transit operations in the vicinity. The transit analysis has been conducted using both the mode shares shown above and a second set of mode shares (more realistic) that would be considered more conservative from a transit-analysis viewpoint. Application of a more realistic mode shares that are likely to be realized will better assess the potential impacts to the MBTA.

Pass-By Trips

While the ITE rates provide estimates for all the traffic associated with each land use, not all of the traffic generated by the Project will be new to the area roadways. A portion of the vehicle-trips generated by the retail land use will likely be drawn from the traffic volume roadways adjacent to the Project Site. For example, someone traveling on Grove Street may choose to deviate from their original travel path to visit the site retail, before heading back to continue to their final destination. For this evaluation, ITE pass-by rates for LUC 820 (Shopping Center) were utilized for the retail trip generation and applied to existing trips on Grove Street. Specifically, 34-percent and 26-percent of the retail trip generation was assumed to be drawn from the surrounding roadway network during the weekday evening and Saturday midday peak hours, respectively, as outlined in the ITE Trip Generation Handbook. For all other time periods studied, a 25-percent pass-by rate was assumed.

Project-Generated Trips

As described above, internal capture credit, mode share credit, and pass-by credit for the retail portion of the Project was applied to the unadjusted new vehicle trips presented in Table 4 to develop the net new trips expected to be generated by the Site. Table 6 presents the Project-generated net new vehicle peak hour trips by land use and Table 7 presents the Project-generated net new peak hour trips by mode.

Table 6 Project-Generated Peak-Hour Vehicle Trips by Use

	Hotel [b]	Residential [a]	Office [c]	Retail [d]	Total Net Vehicle Trips [e]	Existing Hotel Trips [f]	Total Net New Vehicle Trips [g]	Pass-By [h]	Existing MBTA Trips [i]	Total Site-Generated Vehicle Trips [j]
Weekday Morning										
Enter	41	38	204	76	**359**	-45	**314**	19	250	**628**
Exit	20	108	26	40	**194**	-45	**149**	19	125	**338**
Total	61	146	230	116	**553**	-90	**463**	38	375	**966**
Weekday Evening										
Enter	35	67	36	70	**208**	-50	**158**	33	150	**391**
Exit	40	53	205	61	**359**	-35	**324**	33	235	**627**
Total	75	120	241	131	**567**	-85	**482**	66	385	**1,018**
Saturday Midday										
Enter	51	51	61	97	**260**	-30	**230**	29	225	**514**
Exit	44	74	47	65	**230**	-25	**205**	29	95	**354**
Total	95	125	108	162	**490**	-55	**435**	58	320	**868**

a Hotel vehicle trips with internal capture and mode share credits applied (does not include removal of existing hotel trips).
b Residential vehicle trips with internal capture and mode share credits applied.
c Office vehicle trips with internal capture and more share credits applied.
d Retail vehicle trips with internal capture, mode share credits, and pass-by credits applied.
e Sum of columns a through d.
f Existing Hotel Indigo trips based on traffic counts conducted by VHB in October 2018 and September 2019.
g Sum of columns e and f.
h Pass-by Credits of 25%, 34%, and 26% applied to weekday morning, weekday evening, and Saturday midday peak hour retail trip generation, respectively.
i MBTA Station trips based on traffic counts conducted by VHB in June 2018 and September 2019.
j Sum of columns e, h, and i.

As shown in Table 6, the Site is expected to generate a total of 966 vehicle trips (628 entering / 338 exiting) during the weekday morning peak hour, 1,018 vehicle trips (391 entering / 627 exiting) during the weekday evening peak hour, and 868 vehicle trips (514 entering / 354 exiting) during the Saturday midday peak hour. However, these totals include traffic already generated on-Site by the hotel and the MBTA station and pass-by trips that will not be added as new trips to the roadway. After considering the existing traffic generation and the pass-by trips, the Project will result in an additional 463 vehicle trips (314 entering / 149 exiting) to the roadway network during the weekday morning peak hour, 482 vehicle trips (158 entering / 324 exiting) during the weekday evening peak hour, and 435 vehicle trips (230 entering / 205 exiting) during the Saturday midday peak hour.

As discussed previously, the Site currently contains a 194-room hotel and the proposed revised building program includes a 150-room hotel (which is a reduction of 44 rooms from existing). The trip generation analyses summarized above include this reduction of hotel rooms on-Site, as the proposed hotel is expected to generate trips at a different rate than the existing hotel. The proposed hotel trip generation is based on ITE data to be consistent with the rest of the development trip generation while the existing hotel trip generation is based on driveway counts conducted by VHB in October 2018 and September 2019.

Table 7 below summarizes the Project-generated net new peak hour trips by mode.

Table 7 Net New Project-Generated Peak-Hour Trips by Mode

	Net New Vehicle Trips [a]	Net New Transit Trips
Weekday Morning Peak Hour		
Enter	314	27
Exit	149	43
Total	463	70
Weekday Evening Peak Hour		
Enter	158	27
Exit	324	32
Total	482	59
Saturday Midday Peak Hour		
Enter	230	23
Exit	205	31
Total	435	54

a Net vehicle trips not including pass-by trips associated with the retail.
Note: Hotel and MBTA Station generated trips are already generated on-Site under existing conditions and therefore are not included as "new" trips to the Site.

As shown in Table 7, the Project is expected to generate between 54 and 70 new transit trips during the weekday morning, weekday evening, and Saturday midday peak hours and between 435 and 482 net new vehicular trips during the same peak hours. As stated in the TIAS, while the Project is likely to generate walk/bike trips in line with existing office and residential uses in the City of Newton, to provide a conservative analysis and to be consistent with the 2015 MEPA filing for the previous iteration of the Project, no credit was applied for walk/bike trips to and from the Site.

Conclusion

VHB has developed a memorandum to supplement the trip generation presented in the December 2019 TIAS and in the February 6, 2020 memorandum. As presented in this memorandum, the slight change in building program is expected to have a very minimal impact on the Project trip generation. As compared to the trip generation presented in February 2020, the new building program is expected to generate approximately 4 fewer trips during the weekday morning peak hour, 8 fewer trips during the weekday evening peak hour, and 22 fewer trips during the Saturday midday peak hour.

Memorandum

Attachments

- Trip Generation Worksheets
- Shared Trip Calculations
- Trip Generation Calculations

ITE TRIP GENERATION WORKSHEET

(10th Edition, Updated 2017)

PROPOSED REVISED BUILDING PROGRAM - APRIL 2020

LANDUSE: Hotel
LANDUSE CODE: 310
SETTING/LOCATION: General Urban/Suburban
JOB NAME: **Riverside Redevelopment**
JOB NUMBER: **10865.03**

Independent Variable --- Number of Rooms

150 rooms

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends			Independent Variable Range			Directional Distribution	
			Average	Low	High	Average	Low	High	Enter	Exit
DAILY	6	0.92	8.36	5.31	9.53	146	100	260	50%	50%
'EAK (ADJACENT ST)	25	0.85	0.47	0.20	0.84	178	74	426	59%	41%
'EAK (ADJACENT ST)	28	0.80	0.60	0.26	1.06	183	74	426	51%	49%

TRIPS:

	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	1,254	627	627	1,267	633	633
AM PEAK (ADJACENT ST)	71	42	29	70	41	29
PM PEAK (ADJACENT ST)	90	46	44	86	44	42

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends			Independent Variable Range			Directional Distribution	
			Average	Low	High	Average	Low	High	Enter	Exit
DAILY	8	0.93	8.19	6.35	9.79	206	100	355	50%	50%
:AK OF GENERATOR	9	0.80	0.72	0.49	1.23	194	100	355	56%	44%

TRIPS:

	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	1,229	614	614	1,148	574	574
PEAK OF GENERATOR	108	60	48	108	60	47

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends			Independent Variable Range			Directional Distribution	
			Average	Low	High	Average	Low	High	Enter	Exit
DAILY	8	0.90	5.95	4.01	8.48	206	100	355	50%	50%
:AK OF GENERATOR	8	0.87	0.56	0.39	0.72	206	100	355	46%	54%

TRIPS:

	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	893	446	446	746	373	373
PEAK OF GENERATOR	84	39	45	75	35	41

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

PROPOSED REVISED BUILDING PROGRAM - APRIL 2020

LANDUSE: Mid-Rise Residential
LANDUSE CODE: 221
SETTING/LOCATION: General Urban/Suburban
JOB NAME: **Riverside Redevelopment**
JOB NUMBER: **10865.03**

Independent Variable --- Number of Units

582 units

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends			Independent Variable Range			Directional Distribution	
			Average	Low	High	Average	Low	High	Enter	Exit
DAILY	27	0.77	5.44	1.27	12.50	205	21	494	50%	50%
AM PEAK (ADJACENT ST)	53	0.67	0.36	0.06	1.61	207	26	703	26%	74%
PM PEAK (ADJACENT ST)	60	0.72	0.44	0.15	1.11	208	26	703	61%	39%

TRIPS:

	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	3,166	1,583	1,583	3,170	1,585	1,585
AM PEAK (ADJACENT ST)	210	54	155	192	50	142
PM PEAK (ADJACENT ST)	256	156	100	240	147	94

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends			Independent Variable Range			Directional Distribution	
			Average	Low	High	Average	Low	High	Enter	Exit
DAILY	6	0.73	4.91	4.03	8.51	224	111	336	50%	50%
PEAK OF GENERATOR	8	0.89	0.44	0.34	0.73	264	111	462	49%	51%

TRIPS:

	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	2,858	1,429	1,429	2,186	1,093	1,093
PEAK OF GENERATOR	256	125	131	251	123	128

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends			Independent Variable Range			Directional Distribution	
			Average	Low	High	Average	Low	High	Enter	Exit
DAILY	6	--	4.09	3.06	8.41	224	111	336	50%	50%
PEAK OF GENERATOR	6	--	0.39	0.26	1.07	224	111	336	62%	38%

TRIPS:

	BY AVERAGE			BY REGRESSION		
	Total	Enter	Exit	Total	Enter	Exit
DAILY	2,380	1,190	1,190	N/A	N/A	N/A
PEAK OF GENERATOR	227	141	86	N/A	N/A	N/A

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

PROPOSED REVISED BUILDING PROGRAM - APRIL 2020

LANDUSE: General Office Building
LANDUSE CODE: 710
SETTING/LOCATION: General Urban/Suburban
JOB NAME: **Riverside Redevelopment**
JOB NUMBER: **10865.03**

Independent Variable --- Square Feet

FLOOR AREA (KSF): 246.33

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	66	0.83	9.74	2.71	27.56	171	6	1,300	50%	50%
AM PEAK (ADJACENT ST)	35	0.85	1.16	0.37	4.23	117	5	511	86%	14%
PM PEAK (ADJACENT ST)	32	0.88	1.15	0.47	3.23	114	6	511	16%	84%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	2,399	1,200	1,200	2,544	1,272	1,272
AM PEAK (ADJACENT ST)	286	246	40	258	222	36
PM PEAK (ADJACENT ST)	283	45	238	268	43	225

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	5	--	2.21	1.24	7.46	94	28	183	50%	50%
PEAK OF GENERATOR	3	--	0.53	0.30	1.57	82	28	183	54%	46%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	544	272	272	N/A	N/A	N/A
PEAK OF GENERATOR	131	70	60	N/A	N/A	N/A

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	5	--	0.70	0.19	3.05	94	28	183	50%	50%
PEAK OF GENERATOR	3	--	0.21	0.11	0.68	82	28	183	58%	42%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	172	86	86	N/A	N/A	N/A
PEAK OF GENERATOR	52	30	22	N/A	N/A	N/A

ITE TRIP GENERATION WORKSHEET
(10th Edition, Updated 2017)

PROPOSED REVISED BUILDING PROGRAM - APRIL 2020

LANDUSE: Shopping Center
LANDUSE CODE: 820
SETTING/LOCATION: General Urban/Suburban
JOB NAME: **Riverside Redevelopment**
JOB NUMBER: **10865.03**

Independent Variable --- Square Feet

FLOOR AREA (KSF): 38.895

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	147	0.76	37.75	7.42	207.98	453	9	1,510	50%	50%
AM PEAK (ADJACENT ST)	84	0.90	0.94	0.18	23.74	351	9	1,510	62%	38%
PM PEAK (ADJACENT ST)	261	0.82	3.81	0.74	18.69	327	2	2,200	48%	52%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	1,468	734	734	3,163	1,582	1,582
AM PEAK (ADJACENT ST)	37	23	14	171	106	65
PM PEAK (ADJACENT ST)	148	71	77	270	130	140

SATURDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	58	0.71	46.12	13.07	167.89	602	56	1,510	50%	50%
PEAK OF GENERATOR	119	0.87	4.50	1.42	15.10	416	4	1,510	52%	48%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	1,794	897	897	4,963	2,481	2,481
PEAK OF GENERATOR	175	91	84	294	153	141

SUNDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	30	–	21.10	4.15	148.15	509	47	1,510	50%	50%
PEAK OF GENERATOR	24	–	2.79	0.39	12.40	382	47	1,268	49%	51%

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	BY REGRESSION Total	BY REGRESSION Enter	BY REGRESSION Exit
DAILY	821	410	410	N/A	N/A	N/A
PEAK OF GENERATOR	109	53	55	N/A	N/A	N/A

SHARED TRIP CALCULATIONS [1]

APRIL 2020 UPDATE

RETAIL - OFFICE

WEEKDAY DAILY

RETAIL	%	#	BALANCED	#	%	OFFICE
EXIT ->	3%	2,879	**86**	1,501	15%	-> ENTER
ENTER <-	4%	2,879	**115**	1,501	22%	<- EXIT

WEEKDAY MORNING

RETAIL	%	#	BALANCED	#	%	OFFICE
EXIT ->	29%	118	**10**	262	4%	-> ENTER
ENTER <-	32%	193	**12**	43	28%	<- EXIT

WEEKDAY EVENING

RETAIL	%	#	BALANCED	#	%	OFFICE
EXIT ->	2%	256	**5**	51	31%	-> ENTER
ENTER <-	8%	236	**19**	266	20%	<- EXIT

RETAIL - HOTEL

WEEKDAY DAILY

RETAIL	%	#	BALANCED	#	%	HOTEL
EXIT ->	11%	2,879	**317**	1,153	33%	-> ENTER
ENTER <-	9%	2,879	**259**	1,153	38%	<- EXIT

WEEKDAY MORNING

RETAIL	%	#	BALANCED	#	%	HOTEL
EXIT ->	0%	118	**0**	75	0%	-> ENTER
ENTER <-	4%	193	**7**	52	14%	<- EXIT

WEEKDAY EVENING

RETAIL	%	#	BALANCED	#	%	HOTEL
EXIT ->	5%	256	**13**	80	17%	-> ENTER
ENTER <-	2%	236	**5**	77	16%	<- EXIT

RETAIL - RESIDENTIAL

WEEKDAY DAILY

RETAIL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	11%	2,879	**317**	1,870	33%	-> ENTER
ENTER <-	9%	2,879	**259**	1,870	38%	<- EXIT

WEEKDAY MORNING

RETAIL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	14%	118	**1**	59	2%	-> ENTER
ENTER <-	17%	193	**2**	168	1%	<- EXIT

WEEKDAY EVENING

RETAIL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	26%	256	**67**	173	46%	-> ENTER
ENTER <-	10%	236	**24**	111	42%	<- EXIT

OFFICE - HOTEL

WEEKDAY DAILY

OFFICE	%	#	BALANCED	#	%	HOTEL
EXIT ->	2%	1,501	**30**	1,153	3%	-> ENTER
ENTER <-	0%	1,501	**0**	1,153	0%	<- EXIT

WEEKDAY MORNING

OFFICE	%	#	BALANCED	#	%	HOTEL
EXIT ->	0%	43	**0**	75	0%	-> ENTER
ENTER <-	3%	262	**8**	52	75%	<- EXIT

WEEKDAY EVENING

OFFICE	%	#	BALANCED	#	%	HOTEL
EXIT ->	0%	266	**0**	80	0%	-> ENTER
ENTER <-	0%	51	**0**	77	0%	<- EXIT

OFFICE - RESIDENTIAL

WEEKDAY DAILY

OFFICE	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	2%	1,501	**30**	1,870	3%	-> ENTER
ENTER <-	0%	1,501	**0**	1,870	0%	<- EXIT

WEEKDAY MORNING

OFFICE	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	1%	43	**0**	59	0%	-> ENTER
ENTER <-	3%	262	**3**	168	2%	<- EXIT

WEEKDAY EVENING

OFFICE	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	2%	266	**5**	173	4%	-> ENTER
ENTER <-	57%	51	**4**	111	4%	<- EXIT

HOTEL - RESIDENTIAL

WEEKDAY DAILY

HOTEL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	0%	1,153	**0**	1,870	0%	-> ENTER
ENTER <-	0%	1,153	**0**	1,870	0%	<- EXIT

WEEKDAY MORNING

HOTEL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	0%	52	**0**	59	0%	-> ENTER
ENTER <-	0%	75	**0**	168	0%	<- EXIT

WEEKDAY EVENING

HOTEL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	2%	77	**0**	173	0%	-> ENTER
ENTER <-	12%	80	**3**	111	3%	<- EXIT

TOTAL SHARED TRIPS - WEEKDAY DAILY

	ENTER	EXIT	TOTAL
RETAIL	633	720	1353
OFFICE	86	175	261
HOTEL	347	259	606
RES	347	259	606
TOTAL	1,413	1,413	2826

TOTAL SHARED TRIPS - WEEKDAY MORNING

	ENTER	EXIT	TOTAL
RETAIL	21	11	32
OFFICE	21	12	33
HOTEL	0	15	15
RES	1	5	6
TOTAL	43	43	86

TOTAL SHARED TRIPS - WEEKDAY EVENING

	ENTER	EXIT	TOTAL
RETAIL	48	85	133
OFFICE	9	24	33
HOTEL	16	5	21
RES	72	31	103
TOTAL	145	145	290

Note: Shared trips based off of person-trips for each land use. Person trips were developed by multiplying the unadjusted vehicle trips for each ITE land use by an applicable VOR from the Summary of Travel Trends, 2017 National Household Travel Survey (Table 16), USDOT FHA

1 Weekday morning and evening internal capture rates based on NCHRP Report 684, Saturday midday rates assumed to be the same as weekday evening rates
Weekday daily internal capture rates based on ITE Trip Generation Handbook, 2nd Edition, Saturday daily rates assumed to be the same as weekday daily rates

SHARED TRIP CALCULATIONS [1]

APRIL 2020 UPDATE

RETAIL - OFFICE

SATURDAY DAILY

RETAIL	%	#	BALANCED	#	%	OFFICE
EXIT ->	3%	4,516	**48**	321	15%	-> ENTER
ENTER <-	4%	4,516	**71**	321	22%	<- EXIT

SATURDAY MIDDAY

RETAIL	%	#	BALANCED	#	%	OFFICE
EXIT ->	2%	256	**5**	83	31%	-> ENTER
ENTER <-	8%	278	**14**	71	20%	<- EXIT

RETAIL - HOTEL

SATURDAY DAILY

RETAIL	%	#	BALANCED	#	%	HOTEL
EXIT ->	11%	4,516	**345**	1,045	33%	-> ENTER
ENTER <-	9%	4,516	**397**	1,045	38%	<- EXIT

SATURDAY MIDDAY

RETAIL	%	#	BALANCED	#	%	HOTEL
EXIT ->	5%	256	**13**	110	17%	-> ENTER
ENTER <-	2%	278	**6**	86	16%	<- EXIT

RETAIL - RESIDENTIAL

SATURDAY DAILY

RETAIL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	11%	4,516	**426**	1,290	33%	-> ENTER
ENTER <-	9%	4,516	**406**	1,290	38%	<- EXIT

SATURDAY MIDDAY

RETAIL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	26%	256	**67**	145	46%	-> ENTER
ENTER <-	10%	278	**28**	151	42%	<- EXIT

OFFICE - HOTEL

SATURDAY DAILY

OFFICE	%	#	BALANCED	#	%	HOTEL
EXIT ->	2%	321	**6**	1,045	3%	-> ENTER
ENTER <-	0%	321	**0**	1,045	0%	<- EXIT

SATURDAY MIDDAY

OFFICE	%	#	BALANCED	#	%	HOTEL
EXIT ->	0%	71	**0**	110	0%	-> ENTER
ENTER <-	0%	83	**0**	86	0%	<- EXIT

OFFICE - RESIDENTIAL

SATURDAY DAILY

OFFICE	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	2%	321	**6**	1,290	3%	-> ENTER
ENTER <-	0%	321	**0**	1,290	0%	<- EXIT

SATURDAY MIDDAY

OFFICE	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	2%	71	**1**	145	4%	-> ENTER
ENTER <-	57%	83	**6**	151	4%	<- EXIT

HOTEL - RESIDENTIAL

SATURDAY DAILY

HOTEL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	0%	1,045	**0**	1,290	0%	-> ENTER
ENTER <-	0%	1,045	**0**	1,290	0%	<- EXIT

SATURDAY MIDDAY

HOTEL	%	#	BALANCED	#	%	RESIDENTIAL
EXIT ->	2%	86	**0**	145	0%	-> ENTER
ENTER <-	12%	110	**5**	151	3%	<- EXIT

TOTAL SHARED TRIPS - SATURDAY DAILY

	ENTER	EXIT	TOTAL
RETAIL	874	819	1693
OFFICE	48	83	131
HOTEL	351	397	748
RES	432	406	838
TOTAL	1,705	1,705	3410

TOTAL SHARED TRIPS - SATURDAY MIDDAY

	ENTER	EXIT	TOTAL
RETAIL	48	85	133
OFFICE	11	15	26
HOTEL	18	6	24
RES	68	39	107
TOTAL	145	145	290

Note: Shared trips based off of person-trips for each land use. Person trips were developed by multiplying the unadjusted vehicle trips for each ITE land use by an applicable VOR from the Summary of Travel Trends, 2017 National Household Travel Survey (Table 16), USDOT FHA

1 Weekday morning and evening internal capture rates based on NCHRP Report 684, Saturday midday rates assumed to be the same as weekday evening rates
Weekday daily internal capture rates based on ITE Trip Generation Handbook, 2nd Edition, Saturday daily rates assumed to be the same as weekday daily rates

TRIP GENERATION SUMMARY

	Residential [1]						Office [2]						Hotel [3]					Retail [4]							TOTAL				
		Gross		Net				Gross		Net				Gross		Net			Gross		Net								
LUC SIZE	Gross Trips	Person Trips [5]	Internal Capture [6]	Person Trips	Vehicle [7] Trips	Transit [8] Trips	Gross Trips	Person Trips [5]	Internal Capture [6]	Person Trips	Vehicle [7] Trips	Transit [8] Trips	Gross Trips	Person Trips [5]	Internal Capture [6]	Person Trips	Vehicle [7] Trips	Gross Trips	Person Trips [5]	Internal Capture [6]	Person Trips	Vehicle [7] Trips	Pass-By Trips [9]	Net Vehicle Trips	Total Vehicle Trips	EX Hotel Vehicle Trips [10]	New Vehicle Trips	Pass-By	Transit Trips
Weekday Daily																												
Enter	1,585	1,870	347	1,523	1,011	381	1,272	1,501	86	1,415	1,200	71	633	1,153	347	806	443	1,582	2,879	633	2,246	1,234	303	931	3,585	443	**3,142**	303	452
Exit	1,585	1,870	259	1,611	1,069	403	1,272	1,501	175	1,326	1,125	66	633	1,153	259	894	491	1,582	2,879	720	2,159	1,186	303	883	3,568	491	**3,077**	303	469
Total	3,170	3,740	606	3,134	2,080	784	2,544	3,002	261	2,741	2,325	137	1,267	2,306	606	1,700	934	3,163	5,758	1,353	4,405	2,420	606	1,814	7,153	934	**6,219**	606	921
Weekday Morning Peak Hour																												
Enter	50	59	1	58	38	15	222	262	21	241	204	12	41	75	-	75	41	106	193	21	172	95	19	76	359	45	**314**	19	27
Exit	142	168	5	163	108	41	36	43	12	31	26	2	29	52	15	37	20	65	118	11	107	59	19	40	194	45	**149**	19	43
Total	192	227	6	221	146	56	258	305	33	272	230	14	70	127	15	112	61	171	311	32	279	154	38	116	553	90	**463**	38	70
Weekday Evening Peak Hour																												
Enter	147	173	72	101	67	25	43	51	9	42	36	2	44	80	16	64	35	130	236	48	188	103	33	70	208	50	**158**	33	27
Exit	94	111	31	80	53	20	225	266	24	242	205	12	42	77	5	72	40	140	256	85	171	94	33	61	359	35	**324**	33	32
Total	240	284	103	181	120	45	268	317	33	284	241	14	86	157	21	136	75	270	492	133	359	197	66	131	567	85	**482**	66	59
Saturday Daily																												
Enter	1,093	1,290	432	858	569	215	272	321	48	273	232	14	574	1,045	351	694	381	2,481	4,516	874	3,642	2,001	504	1,497	2,679	381	**2,298**	504	229
Exit	1,093	1,290	406	884	587	221	272	321	83	238	202	12	574	1,045	397	648	356	2,481	4,516	819	3,697	2,031	504	1,527	2,672	356	**2,316**	504	233
Total	2,186	2,580	838	1,742	1,156	436	544	642	131	511	434	26	1,148	2,090	748	1,342	737	4,963	9,032	1,693	7,339	4,032	1,008	3,024	5,351	737	**4,614**	1,008	462
Saturday Midday Peak Hour																												
Enter	123	145	68	77	51	19	70	83	11	72	61	4	60	110	18	92	51	153	278	48	230	126	29	97	260	30	**230**	29	23
Exit	128	151	39	112	74	28	60	71	15	56	47	3	47	86	6	80	44	141	256	85	171	94	29	65	230	25	**205**	29	31
Total	251	296	107	189	125	47	131	154	26	128	108	7	108	196	24	172	95	294	534	133	401	220	58	162	490	55	**435**	58	54

1 Trip generation estimate based on ITE LUC 221 (Mid-Rise Residential), using regression equations for 582 residential units.
2 Trip generation estimate based on ITE LUC 710 (Office), using regression equations for weekday and average rates for Saturday for 246,328 sf.
3 Trip generation estimate based on ITE LUC 310 (Hotel), using regression equations for 150 rooms.
4 Trip generation estimate based on ITE LUC 820 (Shopping Center), using regression equations for 38,895 sf.
5 Gross Person Trips developed based on national VOR data from the 2017 National Household Travel Survey (USDOT FHWA).
6 Internal capture rates based on NCHRP Report 684, Saturday midday rates assumed to be the same was weekday evening rates.
7 Converted back into vehicle trips based on local VOR data from the City of Newton Census data and the mode shares used in the 2015 FEIR for The Station at Riverside.
8 Transit credits applied based on FEIR for The Station at Riverside, June 2015. (5% transit credit for office and 25% transit credit for residential).
9 Pass-by credit applied based on ITE Trip Generation Handbook data for LUC 820 (34% for weekday evening peak hour, 26% for Saturday midday peak hour, and 25% for all other time periods).
10 Existing hotel trips subtracted out based on peak hour data from Empirical counts. Daily projected data used to subtracted out existing hotel trips to provide a conservative analysis.