

Design Consultants, Inc.

120 Middlesex Avenue
Somerville, MA 02145
(617) 776-3350

MEMORANDUM

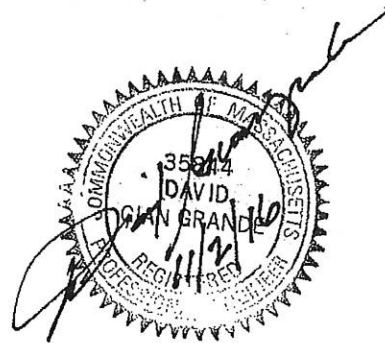
DCI JOB NO. 2016-127

TO: Michael Frawley, Cedar Murdock Partners LLC
6 Spice Street Suite 10
Charlestown, MA 02129

FROM: Tom Bertulis, P.E., PTOE
Design Consultants, Inc.

SUBJECT: Trip Generation Memorandum
21 Murdock Street
Somerville, MA

DATE: November 2, 2016



Design Consultants, Inc. (DCI) has been retained by the client to evaluate the transportation impacts of proposed residential units ("Project") located at 21 Murdock Street in Somerville, Massachusetts. It is our understanding that the client is proposing to construct three 6-unit buildings, one 3-unit buildings, and two 2-unit buildings, for a total number of 25 dwelling units. Five (5) of the 25 units will be inclusionary units. Moreover, 25 total parking spaces will be constructed for those units. These residential units will replace 23,151 square feet of commercial space. Figure 1 shows the proposed site layout for the Project.

This memorandum serves to demonstrate that there will be minimal traffic impact expected from the proposed development on the surrounding roadway networks.

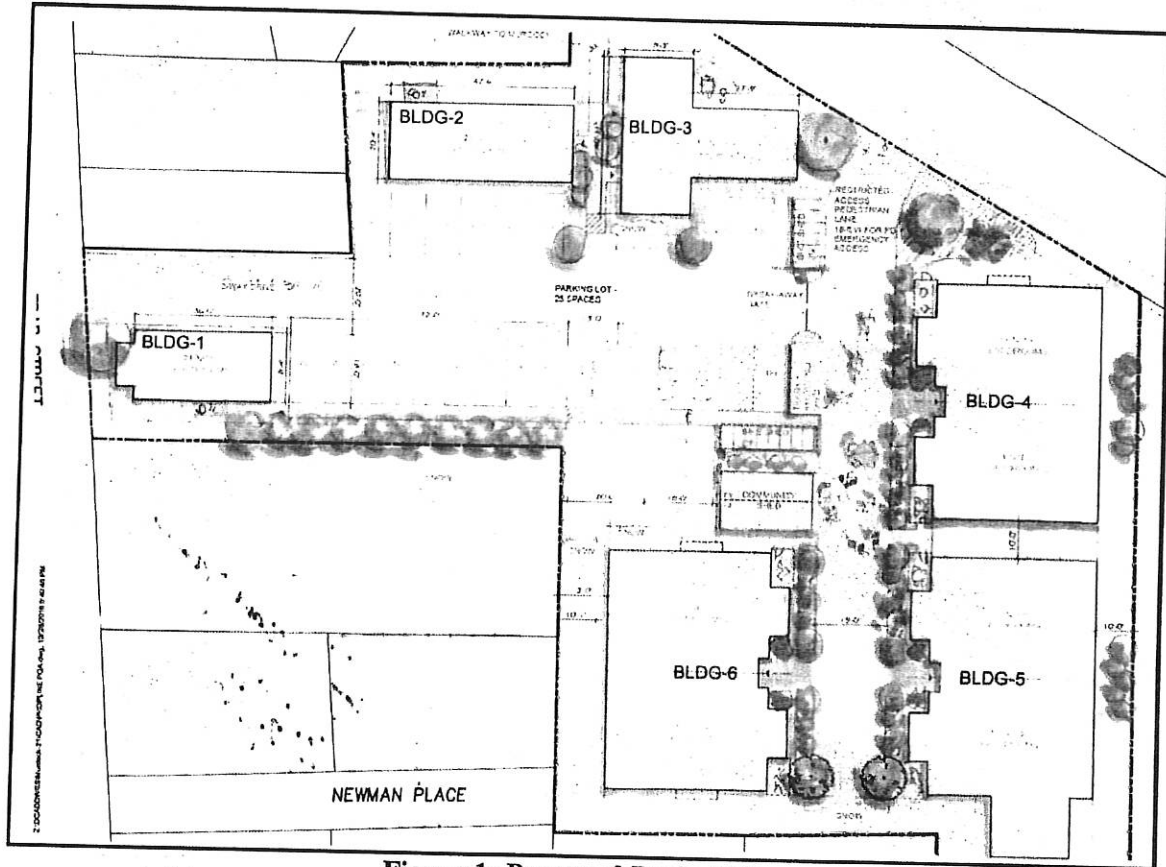


Figure 1: Proposed Project Site

Trip Generation

The base trip generation rates used were taken from the *Trip Generation Manual, 9th Edition* published by ITE in 2012. Land Use Code (LUC) 220 was used for this Project, for twenty-five (25) dwelling units. Table 1 shows the proposed site-generated trips estimate for the Project site. Additionally, there are existing buildings on site that will be demolished for the proposed Project. The trips generated by the existing uses were deducted from the proposed Project-generated trips, thus providing a net new number of trips during the morning and evening peak hours, and during a typical weekday. Land Use Code 890 was used for the existing land use to provide a conservative estimate. Preliminary trip generations calculations for the existing land uses can be found in Table 2, and the net new number of trips can be seen in Table 3. Detailed trip-generation calculations are in the Appendix attached to this memorandum.

Table 1: Proposed Project Trip Generation Calculations

| Land Use Code: 220 | | | |
|-----------------------|----------------------|-----------------------|------------------------|
| | AM | PM | Daily |
| Dwelling Units (X) | 25 | 25 | 25 |
| Fitted Curve Equation | $T = 0.49(X) + 3.73$ | $T = 0.55(X) + 17.65$ | $T = 6.06(X) + 123.56$ |
| Total Trips (T) | 16 | 31 | 276 |
| Entering% | 20% | 65% | 50% |
| Exiting% | 80% | 35% | 50% |
| Entering Trips | 3 | 20 | 138 |
| Exiting Trips | 13 | 11 | 138 |

Table 2: Existing Land Use Trip Generation Calculations

| Land Use Code: 890 | | | |
|-----------------------------|--------|--------|--------|
| | AM | PM | Daily |
| Size (per 1000 square feet) | 23.151 | 23.151 | 23.151 |
| Average Rate | 0.17 | 0.45 | 5.06 |
| Total Trips | 4 | 10 | 118 |
| Entering% | 69% | 48% | 50% |
| Exiting% | 31% | 52% | 50% |
| Entering Trips | 3 | 5 | 59 |
| Exiting Trips | 1 | 5 | 59 |

Table 3: Net New Trips for the Proposed Project

| | AM | PM | Daily |
|--------------------|----|----|-------|
| Total Net Trips | 12 | 21 | 158 |
| Entering Net Trips | 2 | 14 | 79 |
| Existing Net Trips | 10 | 7 | 79 |

As shown in Table 3, the proposed Project is expected to generate 12 net new trips during the morning peak hour, 21 net new trips during the evening peak hour, and 158 net new trips during a typical weekday. These trip rates are unadjusted as they only account for motorized traffic trips. Non-vehicle trips were deducted from the base trips in the following steps.

Mode Share and Average Vehicle Occupancy

ITE's Trip Generation methods are typically based on data from suburban developments with no nearby transit service and no appreciable share of people walking or bicycling to or from the site. Commuting characteristics were analyzed from the 2010-2014 American Community Survey 5-Year Estimates. Census Tract 3503.00 in Somerville, which covers the Project site, was analyzed and used to estimate mode splits for journeys to work in the Project area. Table 4 displays estimated mode splits.

Table 4: Mode Split Data for Residents of Census Tract 3503.00

| MEANS OF TRANSPORTATION TO WORK | |
|---|-------|
| Car, truck, or van | 59.1% |
| Drove alone | 49.5% |
| Carpooled: | 9.6% |
| In 2-person carpool | 7.3% |
| In 3-person carpool | 0.0% |
| In 4 person carpool | 2.3% |
| Public transportation (excluding taxicab) | 24.9% |
| Walked | 7.0% |
| Bicycle | 4.5% |
| Other means | 1.0% |
| Worked at home | 3.5% |

Based on the modal split data above, an Average Vehicle Occupancy (AVO) rate of 1.2 persons per vehicle was calculated. According to the *Trip Generation Handbook*, Land Use Code (LUC) 220 already accounts for an AVO of 1.1 for all trips. Consequently, the base trips for this Project had to be adjusted to account for this. The base trips were adjusted for the AVO of 1.1, and then the AVO of 1.2 was applied, thus giving the number of person-trips during the morning and evening peak hours, and during a typical weekday. Then the number of non-vehicle trips was determined by multiplying the person-trips by the percentage expected to utilize transit, bicycling and walking to access the Project site. The US Census Tract 3503.00 Journey to Work data is attached in the Appendix.

Trip Generation Summary

The public transit, walking, and biking mode share from US Census Tract 3503.00 was taken and applied to the total person-trips. By applying this non-vehicular mode split to the Trip Generation calculations, the amount of expected vehicle traffic associated with the Project is reduced. The resulting adjusted vehicular traffic on the surrounding roadways were estimated and are summarized in Table 5.

Table 5: Adjusted Trip Generation

| | AM | PM | Daily |
|--|-----------|-----------|--------------|
| Base Trips | 12 | 21 | 158 |
| Total Person-Trips | 13 | 23 | 172 |
| Total Vehicle Trips | 6 | 11 | 84 |
| Entering Vehicle-Trips | 1 | 7 | 42 |
| Exiting Vehicle-Trips | 5 | 4 | 42 |
| | | | |
| Total Public Transportation Trips | 3 | 6 | 43 |
| Total Bicycle Trips | 1 | 1 | 8 |
| Total Walking Trips | 1 | 2 | 12 |
| Other Trips | 1 | 1 | 11 |

As indicated in Table 5, the Project is expected to generate **six (6) net new vehicle-trips** during the weekday morning peak hour, **eleven (11) net new vehicle-trips** during the weekday evening peak hour and, **84 net new vehicle-trips** during a typical weekday. Generated transit trips are expected to be three (3) net new trips during the weekday morning peak hour and six (6) net new trips during the weekday evening peak hour. The Project is expected to generate 43 net new transit trips on a daily weekday basis. Pedestrian trips are expected to be one (1) net new person-trip during the weekday morning peak hour, two (2) net new person-trips during the weekday evening peak hour, and 12 net new person-trips during a typical weekday. Bicycle trips are expected to be one (1) net new person-trip during the morning peak hour, one (1) net new person-trip during the evening peak hour, and 8 net new person-trips during a typical weekday. These trips are based on the mode split from the Census Data.

Conclusion

The proposed Project will demolish 23,151 square feet of commercial space and there will be construction three 6-unit buildings, one 3-unit buildings, and two 2-unit buildings, as well as 25 total parking spaces for those units. The total number of dwelling units will be 25. The proposed site-generated trips are estimated to be six (6) net new vehicle-trips during the morning peak hour, eleven (11) net new vehicle-trips during the afternoon peak hour, and 84 net new vehicle-trips on typical weekday daily basis.

Considering the results of the trip generation calculations, DCI concludes that the proposed redevelopment at 21 Murdock Street will not have an adverse impact on the traffic network in Somerville, Massachusetts.

APPENDIX



S0801

COMMUTING CHARACTERISTICS BY SEX

2010-2014 American Community Survey 5-Year Estimates

Supporting documentation on code lists, subject definitions, data accuracy, and statistical testing can be found on the American Community Survey website in the Data and Documentation section.

Sample size and data quality measures (including coverage rates, allocation rates, and response rates) can be found on the American Community Survey website in the Methodology section.

Although the American Community Survey (ACS) produces population, demographic and housing unit estimates, it is the Census Bureau's Population Estimates Program that produces and disseminates the official estimates of the population for the nation, states, counties, cities and towns and estimates of housing units for states and counties.

| Subject | Census Tract 3503, Middlesex County, Massachusetts | | | | |
|--|--|-----------------|----------|-----------------|----------|
| | Total | | Male | | Female |
| | Estimate | Margin of Error | Estimate | Margin of Error | Estimate |
| Workers 16 years and over | 1,613 | +/-189 | 857 | +/-173 | 756 |
| MEANS OF TRANSPORTATION TO WORK | | | | | |
| Car, truck, or van | 59.1% | +/-9.2 | 56.6% | +/-10.8 | 62.0% |
| Drove alone | 49.5% | +/-7.8 | 46.0% | +/-9.3 | 53.6% |
| Carpooled | 9.6% | +/-5.5 | 10.6% | +/-9.1 | 8.5% |
| In 2-person carpool | 7.3% | +/-5.4 | 6.3% | +/-7.9 | 8.5% |
| In 3-person carpool | 0.0% | +/-2.1 | 0.0% | +/-4.0 | 0.0% |
| In 4-or-more person carpool | 2.3% | +/-2.5 | 4.3% | +/-4.7 | 0.0% |
| Workers per car, truck, or van | 1.10 | +/-0.06 | 1.13 | +/-0.12 | 1.08 |
| Public transportation (excluding taxicab) | 24.9% | +/-6.6 | 22.9% | +/-9.3 | 27.2% |
| Walked | 7.0% | +/-3.9 | 8.3% | +/-6.3 | 5.6% |
| Bicycle | 4.5% | +/-3.5 | 8.4% | +/-6.5 | 0.0% |
| Taxicab, motorcycle, or other means | 1.0% | +/-1.4 | 1.8% | +/-2.5 | 0.1% |
| Worked at home | 3.5% | +/-2.9 | 2.1% | +/-2.5 | 5.0% |
| PLACE OF WORK | | | | | |
| Worked in state of residence | 100.0% | +/-2.1 | 100.0% | +/-4.0 | 100.0% |
| Worked in county of residence | 63.8% | +/-6.9 | 69.0% | +/-10.0 | 57.9% |
| Worked outside county of residence | 36.2% | +/-6.9 | 31.0% | +/-10.0 | 42.1% |
| Worked outside state of residence | 0.0% | +/-2.1 | 0.0% | +/-4.0 | 0.0% |
| Living in a place | 100.0% | +/-2.1 | 100.0% | +/-4.0 | 100.0% |
| Worked in place of residence | 23.7% | +/-6.5 | 20.0% | +/-8.3 | 27.9% |
| Worked outside place of residence | 76.3% | +/-6.5 | 80.0% | +/-8.3 | 72.1% |
| Not living in a place | 0.0% | +/-2.1 | 0.0% | +/-4.0 | 0.0% |
| Living in 12 selected states | 100.0% | +/-2.1 | 100.0% | +/-4.0 | 100.0% |
| Worked in minor civil division of residence | 23.7% | +/-6.5 | 20.0% | +/-8.3 | 27.9% |
| Worked outside minor civil division of residence | 76.3% | +/-6.5 | 80.0% | +/-8.3 | 72.1% |
| Not living in 12 selected states | 0.0% | +/-2.1 | 0.0% | +/-4.0 | 0.0% |
| Workers 16 years and over who did not work at home | 1,557 | +/-195 | 839 | +/-177 | 718 |
| TIME LEAVING HOME TO GO TO WORK | | | | | |

| Subject | Census Tract 3503, Middlesex County, Massachusetts | | | | |
|---|--|-----------------|----------|-----------------|----------|
| | Total | | Male | | Female |
| | Estimate | Margin of Error | Estimate | Margin of Error | Estimate |
| 12:00 a.m. to 4:59 a.m. | 4.9% | +/-3.2 | 5.7% | +/-4.8 | 4.0% |
| 5:00 a.m. to 5:29 a.m. | 0.3% | +/-0.6 | 0.6% | +/-1.1 | 0.0% |
| 5:30 a.m. to 5:59 a.m. | 1.2% | +/-1.3 | 0.0% | +/-4.1 | 2.5% |
| 6:00 a.m. to 6:29 a.m. | 8.1% | +/-4.1 | 9.1% | +/-7.7 | 7.0% |
| 6:30 a.m. to 6:59 a.m. | 5.8% | +/-3.1 | 5.2% | +/-4.3 | 6.5% |
| 7:00 a.m. to 7:29 a.m. | 11.2% | +/-4.3 | 10.7% | +/-6.2 | 11.7% |
| 7:30 a.m. to 7:59 a.m. | 20.6% | +/-6.2 | 8.3% | +/-5.3 | 34.8% |
| 8:00 a.m. to 8:29 a.m. | 27.3% | +/-7.6 | 33.0% | +/-11.3 | 20.6% |
| 8:30 a.m. to 8:59 a.m. | 6.2% | +/-2.9 | 5.5% | +/-3.3 | 7.1% |
| 9:00 a.m. to 11:59 p.m. | 14.4% | +/-6.2 | 21.8% | +/-10.0 | 5.7% |
| TRAVEL TIME TO WORK | | | | | |
| Less than 10 minutes | | | | | |
| 10 to 14 minutes | 10.1% | +/-5.0 | 12.8% | +/-6.6 | 7.1% |
| 15 to 19 minutes | 6.7% | +/-4.2 | 5.8% | +/-4.5 | 7.7% |
| 20 to 24 minutes | 15.0% | +/-5.1 | 13.3% | +/-9.2 | 17.0% |
| 25 to 29 minutes | 9.0% | +/-4.1 | 9.2% | +/-5.7 | 8.8% |
| 30 to 34 minutes | 3.6% | +/-2.3 | 3.0% | +/-3.1 | 4.3% |
| 35 to 44 minutes | 15.7% | +/-6.2 | 18.0% | +/-8.5 | 13.1% |
| 45 to 59 minutes | 8.7% | +/-4.5 | 13.0% | +/-7.3 | 3.8% |
| 60 or more minutes | 18.0% | +/-5.9 | 13.7% | +/-9.8 | 23.1% |
| Mean travel time to work (minutes) | 13.0% | +/-4.6 | 11.2% | +/-6.1 | 15.2% |
| | 31.8 | +/-2.8 | 31.5 | +/-4.7 | 32.2 |
| VEHICLES AVAILABLE | | | | | |
| Workers 16 years and over in households | 1,612 | +/-189 | 857 | +/-173 | 755 |
| No vehicle available | 11.6% | +/-6.7 | 12.7% | +/-8.0 | 10.3% |
| 1 vehicle available | 47.6% | +/-9.0 | 47.0% | +/-12.1 | 48.2% |
| 2 vehicles available | 28.5% | +/-9.6 | 27.8% | +/-12.3 | 29.4% |
| 3 or more vehicles available | 12.3% | +/-7.7 | 12.5% | +/-9.3 | 12.1% |
| PERCENT IMPUTED | | | | | |
| Means of transportation to work | 3.1% | (X) | (X) | (X) | (X) |
| Private vehicle occupancy | 2.7% | (X) | (X) | (X) | (X) |
| Place of work | 12.5% | (X) | (X) | (X) | (X) |
| Time leaving home to go to work | 5.5% | (X) | (X) | (X) | (X) |
| Travel time to work | 6.6% | (X) | (X) | (X) | (X) |
| Vehicles available | 0.0% | (X) | (X) | (X) | (X) |

| Subject | Census Tract 3503, Middlesex County, Massachusetts Female Margin of Error |
|--|--|
| Workers 16 years and over | +/-138 |
| MEANS OF TRANSPORTATION TO WORK | |
| Car, truck, or van | +/-13.0 |
| Drove alone | +/-10.2 |
| Carpooled | +/-6.2 |
| In 2-person carpool | +/-6.2 |
| In 3-person carpool | +/-4.5 |
| In 4-or-more person carpool | +/-4.5 |
| Workers per car, truck, or van | +/-0.05 |
| Public transportation (excluding taxicab) | +/-9.1 |
| Walked | +/-5.5 |
| Bicycle | +/-4.5 |
| Taxicab, motorcycle, or other means | +/-0.6 |
| Worked at home | +/-4.3 |
| PLACE OF WORK | |
| Worked in state of residence | +/-4.5 |
| Worked in county of residence | +/-9.8 |
| Worked outside county of residence | +/-9.8 |
| Worked outside state of residence | +/-4.5 |
| Living in a place | +/-4.5 |
| Worked in place of residence | +/-9.0 |
| Worked outside place of residence | +/-9.0 |
| Not living in a place | +/-4.5 |
| Living in 12 selected states | +/-4.5 |
| Worked in minor civil division of residence | +/-9.0 |
| Worked outside minor civil division of residence | +/-9.0 |
| Not living in 12 selected states | +/-4.5 |
| Workers 16 years and over who did not work at home | +/-140 |
| TIME LEAVING HOME TO GO TO WORK | |
| 12:00 a.m. to 4:59 a.m. | +/-5.1 |
| 5:00 a.m. to 5:29 a.m. | +/-4.8 |
| 5:30 a.m. to 5:59 a.m. | +/-2.8 |
| 6:00 a.m. to 6:29 a.m. | +/-4.2 |
| 6:30 a.m. to 6:59 a.m. | +/-4.4 |
| 7:00 a.m. to 7:29 a.m. | +/-5.2 |
| 7:30 a.m. to 7:59 a.m. | +/-10.0 |
| 8:00 a.m. to 8:29 a.m. | +/-9.2 |
| 8:30 a.m. to 8:59 a.m. | +/-4.5 |
| 9:00 a.m. to 11:59 p.m. | +/-4.2 |
| TRAVEL TIME TO WORK | |
| Less than 10 minutes | +/-6.3 |
| 10 to 14 minutes | +/-6.1 |
| 15 to 19 minutes | +/-8.2 |
| 20 to 24 minutes | +/-4.8 |
| 25 to 29 minutes | +/-3.4 |
| 30 to 34 minutes | +/-8.4 |
| 35 to 44 minutes | +/-2.8 |
| 45 to 59 minutes | +/-7.5 |
| 60 or more minutes | +/-7.2 |
| Mean travel time to work (minutes) | +/-3.4 |

| Subject | Census Tract 3503, Middlesex County, Massachusetts Female Margin of Error |
|---|--|
| VEHICLES AVAILABLE | |
| Workers 16 years and over in households | +/-137 |
| No vehicle available | +/-7.4 |
| 1 vehicle available | +/-13.4 |
| 2 vehicles available | +/-11.1 |
| 3 or more vehicles available | +/-8.7 |
| PERCENT IMPUTED | |
| Means of transportation to work | (X) |
| Private vehicle occupancy | (X) |
| Place of work | (X) |
| Time leaving home to go to work | (X) |
| Travel time to work | (X) |
| Vehicles available | (X) |

Data are based on a sample and are subject to sampling variability. The degree of uncertainty for an estimate arising from sampling variability is represented through the use of a margin of error. The value shown here is the 90 percent margin of error. The margin of error can be interpreted roughly as providing a 90 percent probability that the interval defined by the estimate minus the margin of error and the estimate plus the margin of error (the lower and upper confidence bounds) contains the true value. In addition to sampling variability, the ACS estimates are subject to nonsampling error (for a discussion of nonsampling variability, see Accuracy of the Data). The effect of nonsampling error is not represented in these tables.

The 12 selected states are Connecticut, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Wisconsin.

Workers include members of the Armed Forces and civilians who were at work last week.

While the 2010-2014 American Community Survey (ACS) data generally reflect the February 2013 Office of Management and Budget (OMB) definitions of metropolitan and micropolitan statistical areas; in certain instances the names, codes, and boundaries of the principal cities shown in ACS tables may differ from the OMB definitions due to differences in the effective dates of the geographic entities.

Estimates of urban and rural population, housing units, and characteristics reflect boundaries of urban areas defined based on Census 2010 data. As a result, data for urban and rural areas from the ACS do not necessarily reflect the results of ongoing urbanization.

Source: U.S. Census Bureau, 2010-2014 American Community Survey 5-Year Estimates

Explanation of Symbols:

1. An '***' entry in the margin of error column indicates that either no sample observations or too few sample observations were available to compute a standard error and thus the margin of error. A statistical test is not appropriate.
2. An '-' entry in the estimate column indicates that either no sample observations or too few sample observations were available to compute an estimate, or a ratio of medians cannot be calculated because one or both of the median estimates falls in the lowest interval or upper interval of an open-ended distribution.
3. An '-' following a median estimate means the median falls in the lowest interval of an open-ended distribution.
4. An '+' following a median estimate means the median falls in the upper interval of an open-ended distribution.
5. An '****' entry in the margin of error column indicates that the median falls in the lowest interval or upper interval of an open-ended distribution. A statistical test is not appropriate.
6. An '*****' entry in the margin of error column indicates that the estimate is controlled. A statistical test for sampling variability is not appropriate.
7. An 'N' entry in the estimate and margin of error columns indicates that data for this geographic area cannot be displayed because the number of sample cases is too small.
8. An '(X)' means that the estimate is not applicable or not available.

Design Consultants, Inc.
 October 2016
 21 Murdock Street Somerville, MA
 Preliminary Trip Generation Calculations
 Based on ITE's Trip Generation Manual, 9th Edition (2012)

Proposed Land Use - by # of dwelling units

| Land Use Code: 220 | | Apartment | |
|-----------------------|----------------------|-----------------------|------------------------|
| | AM | PM | Daily |
| Dwelling Units (X) | 25 | 25 | 25 |
| Fitted Curve Equation | $T = 0.49(X) + 3.73$ | $T = 0.55(X) + 17.65$ | $T = 6.06(X) + 123.56$ |
| Total Trips (T) | 16 | 31 | 276 |
| Entering% | 20% | 65% | 50% |
| Exiting% | 80% | 35% | 50% |
| Entering Trips | 3 | 20 | 138 |
| Exiting Trips | 13 | 11 | 138 |

Existing Land Use

| Land Use Code: 890 | | | |
|-----------------------------|--------|--------|--------|
| | AM | PM | Daily |
| Size (per 1000 square feet) | 23.151 | 23.151 | 23.151 |
| Average Rate | 0.17 | 0.45 | 5.06 |
| Total Trips | 4 | 10 | 118 |
| Entering% | 69% | 48% | 50% |
| Exiting% | 31% | 52% | 50% |
| Entering Trips | 3 | 5 | 59 |
| Exiting Trips | 1 | 5 | 59 |

| MEANS OF TRANSPORTATION TO WORK | |
|---|-------|
| Car, truck, or van | 59.1% |
| Drove alone | 49.5% |
| Carpooled: | 9.6% |
| In 2-person carpool | 7.3% |
| In 3-person carpool | 0.0% |
| In 4 person carpool | 2.3% |
| Public transportation (excluding taxicab) | 24.9% |
| Bicycle | 7.0% |
| Walked | 4.5% |
| Other means | 1.0% |
| Worked at home | 3.5% |

| AVO | | | |
|-------------|--------|---|-------|
| # Occupants | Weight | | |
| Drove Alone | 0.495 | 1 | 0.495 |
| Carpool (2) | 0.073 | 2 | 0.146 |
| Carpool (3) | 0 | 3 | 0 |
| Carpool (4) | 0.023 | 4 | 0.092 |
| AVO | 1.2 | | 0.733 |