

TRAVEL BETWEEN CLASSES AT THE UNIVERSITY OF BRITISH COLUMBIA, VANCOUVER: A STUDY OF WALKING DISTANCES ON A LARGE CAMPUS

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INTRODUCTION

On a large campus such as the University of British Columbia – Vancouver (Point Grey Campus), distances between buildings can be substantial, creating challenges for students with consecutive classes in different parts of campus. This study used student registration data to evaluate travel distances between consecutive classes on campus to answer the question of whether there is adequate time to travel between classes for people with and without limited mobility.

METHODOLOGY

Anonymized student registration data (48,836 students), classroom and building data, and transport network data for 2016 Winter Term 1 at UBC-Vancouver were obtained from UBC Enrollment Services and Campus Planning. At the student level, inter-class trips were identified by class start and end dates and times. Consecutive classes were defined as those with the start time of one equal to the end time of another. Travel distances for consecutive classes were calculated as the shortest-path network distance between the main entrances of each class's building.

Required walking speeds were calculated from travel distances by assuming 10 minutes of travel time allowed between classes. Literature suggests a preferred walking speed of 1.4 m/s (Browning, 2006; Levine and Norenzayan, 1999; Mohler et al., 2007), which corresponds to a maximum comfortable walking distance of 840 m for a 10-minute trip. Thus, 840 m is selected as the threshold to identify “long” walking trips.

Accessibility issues were examined by restricting the transport network to wheelchair-accessible links (i.e. removing links with stairs) and applying an alternative preferred travel speed. Literature suggests a manual wheelchair speed range of 0.6 to 1 m/s (Oyster et al., 2011; Tolerico et al., 2007), which corresponds to a threshold comfortable travel distance of 360 to 600 m for a 10-minute trip.

RESULTS

Figure 1 shows the trip length distribution for all inter-class trips between consecutive classes in 2016 Winter Term 1 at UBC-Vancouver. The average trip length between consecutive classes was 374 m, including many intra-building trips of zero length for which students did not change buildings (28% of trips). Eliminating intra-building trips, the average trip length rises to 516 m.

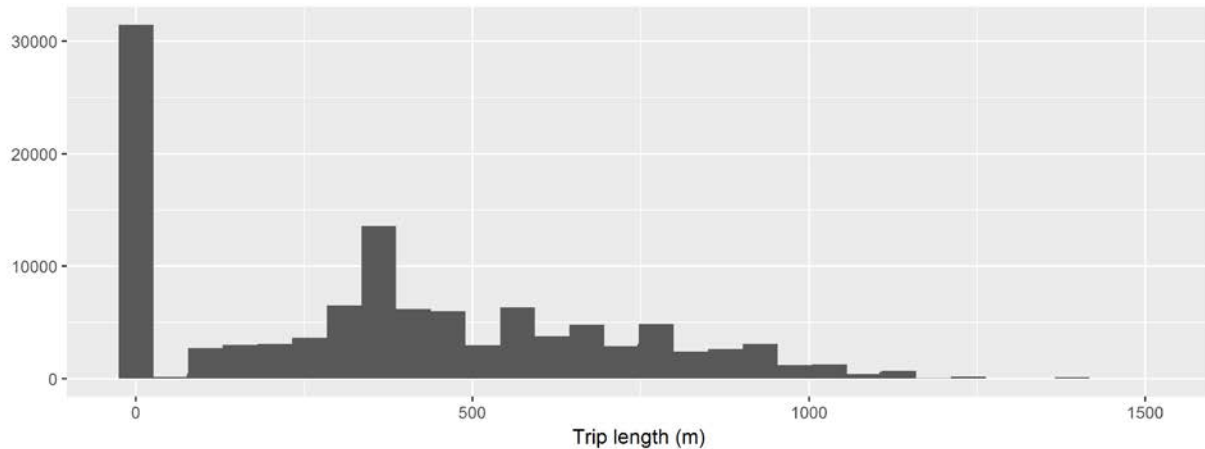


Figure 1 Trip length distribution for inter-class trips between consecutive classes

Table 1 gives trip length statistics for all inter-class trips between consecutive classes by day of the week. The results are roughly consistent across days of the week. Around 2,000 inter-class trips per day (9%) exceeded the 840 m threshold for a comfortable walking speed, which rises to 12% of inter-building trips (i.e. excluding the 28% zero-length trips). Around 200 trips per day (1%) exceeded 2 m/s, which nears the fastest walking speeds (Bohannon, 1997). Thus, given a 10-minute travel window, many inter-class trips require uncomfortably fast walking speeds, and some are nearly impossible to complete in 10 minutes by walking.

Table 1 Trip Length Statistics for Inter-Class Trips between Consecutive classes

Day	# trips	# (%) trips over 840 m	1 st quartile	Median	Mean	3 rd quartile	Range
Monday	26,692	2,356 (8.8)	0	357	374	597	0-1,484
Tuesday	17,895	1,686 (9.4)	0	371	374	604	0-1,495
Wednesday	27,908	2,432 (8.7)	0	363	370	586	0-1,494
Thursday	18,175	1,537 (8.5)	0	361	361	574	0-1,495
Friday	23,739	2,254 (9.5)	86	371	390	603	0-1,484
Total	114,409	10,265 (9.0)	0	368	374	596	0-1,495

The distribution of inter-class trips and trip lengths was fairly consistent over the course of the semester. Inter-class trips during the peak travel period of the term (Tuesday, September 27th at 11 AM) are shown on the map in Figure 5 as cumulative travel volumes on each link of the

network. Main Mall had the highest volume along with links near certain high-volume building entrances such as the Buchanan Building (BUCH). Note that this map assumes shortest-path routing and only includes student travel between consecutive classes. There is expected to be much additional travel on campus by other persons, and likely a more disperse set of routes chosen by students for reasons other than distance (pass-by trips, facility type, etc.).

Long Trips by Building and Class Subject

Figure 2 gives the percent of “long” inter-class trips (≥ 840 m) by building of origin and destination for the 12 buildings with the highest shares of long trips. Buchanan Building and Woodward Instructional Resources Centre generate by far the largest shares of long trips. The maps in Figure 6 and Figure 7 show, alternatively, the percent of trips originating and terminating at each building that are long (≥ 840 m). Classes in Buchanan and Woodward generate over 35% of the long trips, yet only around 30% of inter-class trips to or from Woodward are long and only around 10% of inter-class trips to or from Buchanan are long. For Buchanan, in particular, the large portion of long trips generated by classes there is largely due to the high total number of students.

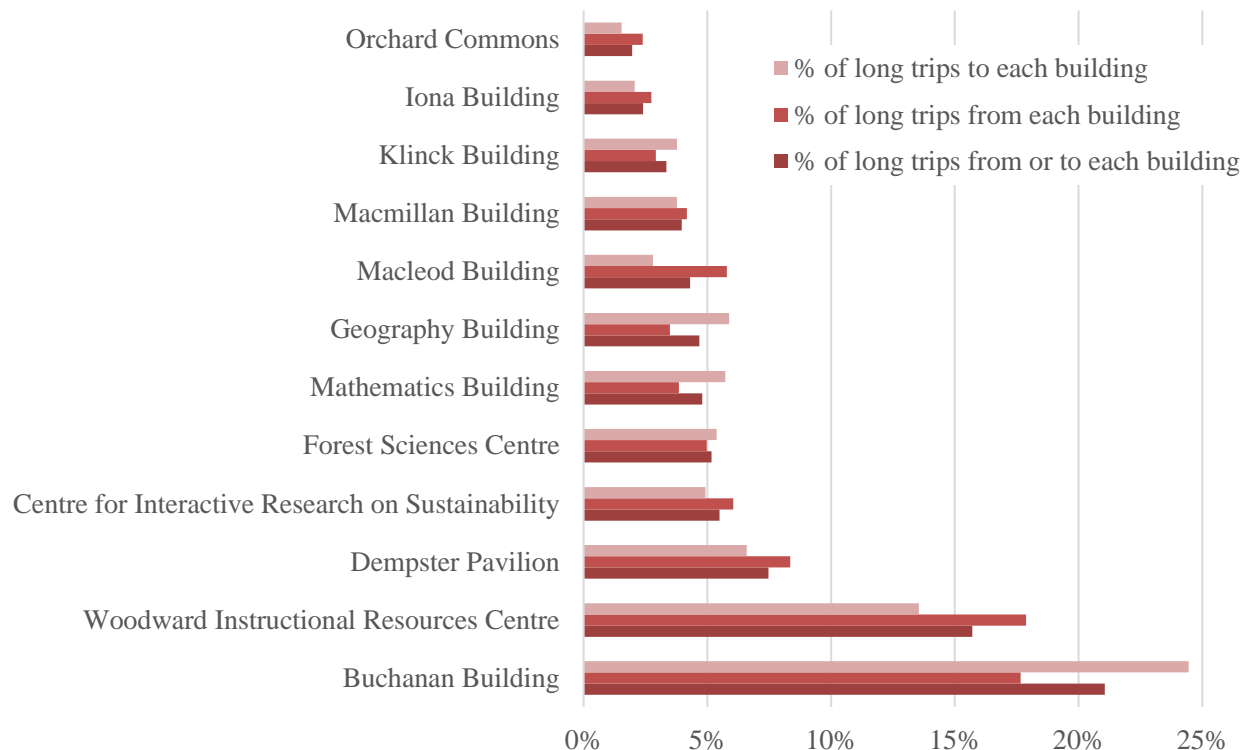


Figure 2 Percent of long trips (≥ 840 m) that are from and to each building

The buildings with the highest percentage of trips that are long are Life Sciences Centre (LSC), Friedman Building (FRDM) and West Mall Annex (WMAX) – see Figure 6 and Figure 7. These buildings generated relatively few inter-class trips, and so are not represented in Figure 2, but most inter-class trips there are long. This result could be due to the locations of the buildings on campus and/or the types of classes schedule there (perhaps with student enrollment from more diverse programs).

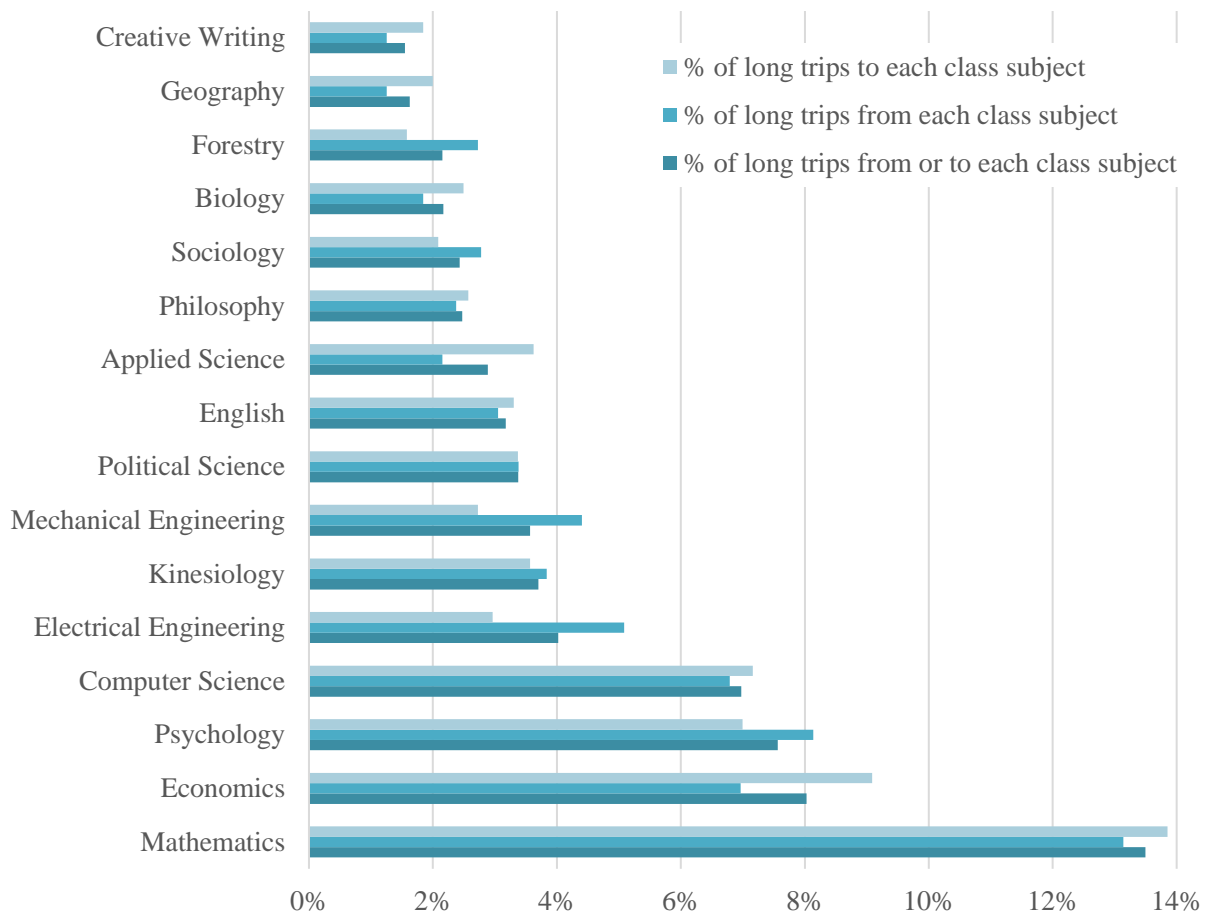


Figure 3 Percent of long trips (≥ 840 m) that are from and to each class subject

Figure 3 gives the percent of “long” inter-class trips (≥ 840 m) by class subject for the 16 subjects with the highest shares of long trips. Mathematics classes generated the highest share of long trips, followed by Economics, Psychology, and Computer Science. Around 15% of the inter-class trips generated by classes in these subject were long (≥ 840 m). As with the results by building, the high shares of long trips for these subjects is at least partially due to the large number of consecutive classes experienced by students enrolled in these courses.

Table 2 lists the class subjects with the largest percentage of their inter-class trips that were long (≥ 840 m). The 11 subjects with the highest percentage of long trips span 6 different faculties/schools. These subjects’ courses likely are taught in varying buildings, or are enrolled in by students in varying programs. Kinesiology and Electrical Engineering stand out as subjects with both a large number and high percentage of long inter-class trips.

Table 2. Inter-class trips by class subject*

Class subject	Faculty/School	Total inter-class trips (from or to)	Total long (≥ 840 m) trips (from or to)	Percent of trips (from or to) that were long
Naval Architecture and Marine Engineering	Faculty of Applied Science	60	24	40%
Arabic Studies	Faculty of Arts	99	39	39%
Family Studies	Faculty of Arts	545	197	36%
Natural Resources Conservation	Faculty of Forestry	912	293	32%
Pharmacology and Therapeutics	Faculty of Medicine	495	153	31%
Biochemistry	Faculty of Medicine	720	205	28%
Scandinavian	Faculty of Arts	65	18	28%
Food and Resource Economics	Faculty of Land and Food Systems	226	61	27%
Kinesiology	School of Kinesiology	3,247	760	23%
Electrical Engineering	Faculty of Applied Science	3,888	826	21%
Film Studies	Faculty of Arts	229	45	20%

* Subjects with at least 10 inter-class trips and at least 20% of those over 840 m

Accessibility

Figure 4 shows the different distributions of inter-class trip lengths with and without stairs in the network. The accessible network without stairs has a trip length distribution shifted to the right, with an increase in mean trip length from 374 m to 407 m. The difference in trip lengths between the networks is predominantly for the longest 40% of trips. Using a threshold of 360-600 m (0.6-1.0 m/s) to identify long trips by manual wheelchair on the accessible network, 30-51% of inter-class trips would be uncomfortably long by wheelchair. This much higher rate of problematic trips by wheelchair highlights the potential for significant on-campus mobility issues for some students.

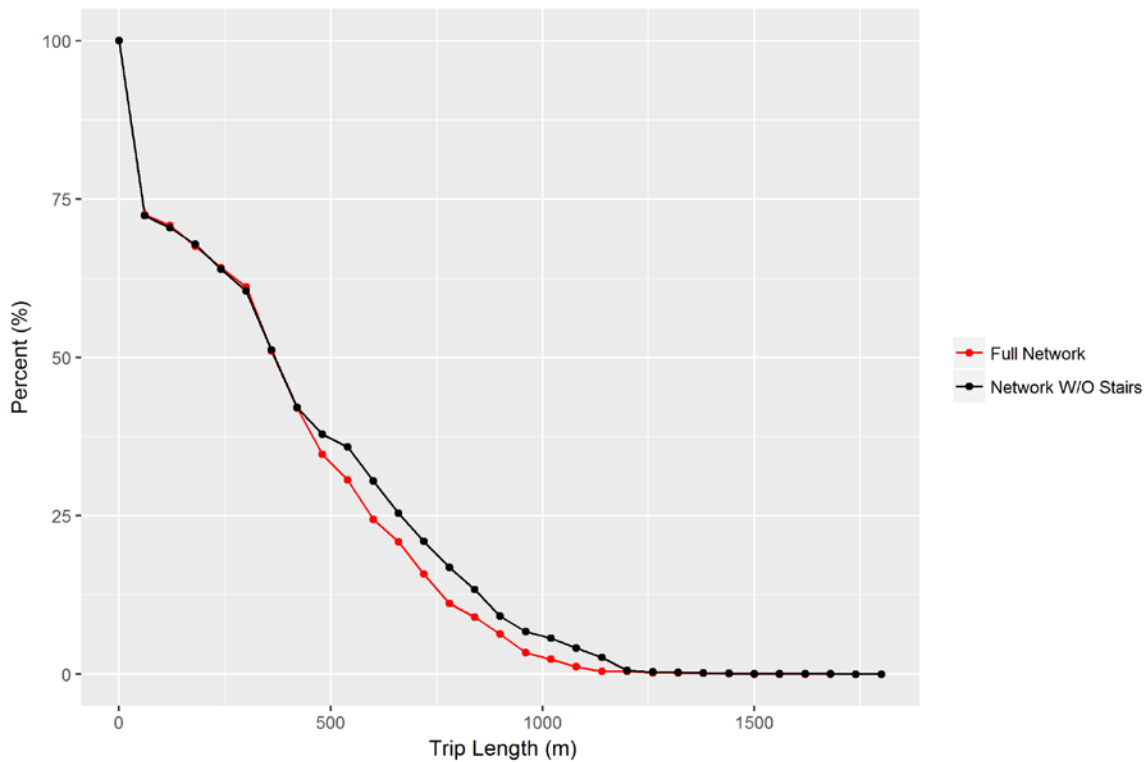


Figure 4 Reverse cumulative distribution of inter-class trip length

CONCLUSIONS

Most trips between consecutive classes (~90%) at UBC-Vancouver can be made at a comfortable walking pace in 10 minutes. There are many students, however, for which walking distances between classrooms is likely a challenge (about 2,000 trips per day). In certain subjects, up to 40% of inter-class trips are uncomfortably long to walk. For students with limited mobility, 30-50% of all inter-class trips would be challenging to complete in 10 minutes.

These issues could potentially be addressed with revised scheduling strategies, for example better coordinating class locations and times for courses with overlapping enrollment. Improved wheeled travel options on campus could also mitigate travel issues for large inter-class distances, such as expanded on-campus bike-share, a scooter-share program, and/or improved non-motorized vehicle parking and travel facilities. Extending time between classes is another possible approach: increasing travel time to 15 minutes reduces the number of “long” trips by 37%.

This study is an initial examination of the data and could be improved and expanded by consideration of absenteeism, student travel modes, on-campus routing decisions, multiple building entrances for access/egress, student travel for non-consecutive classes, non-student travel, and topography.

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APPENDIX

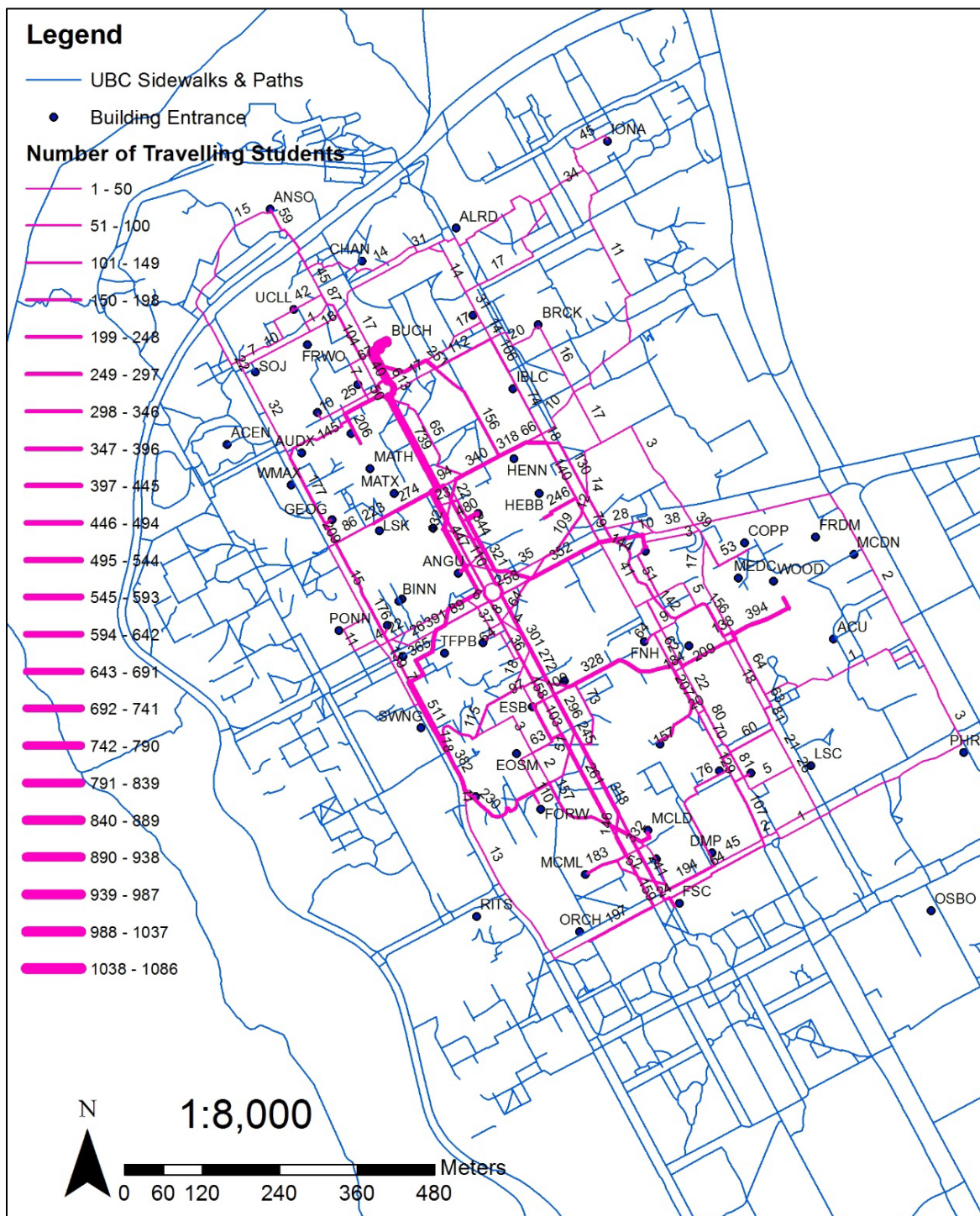


Figure 5 Inter-class student travel volumes on September 27, 2016 at 11 am

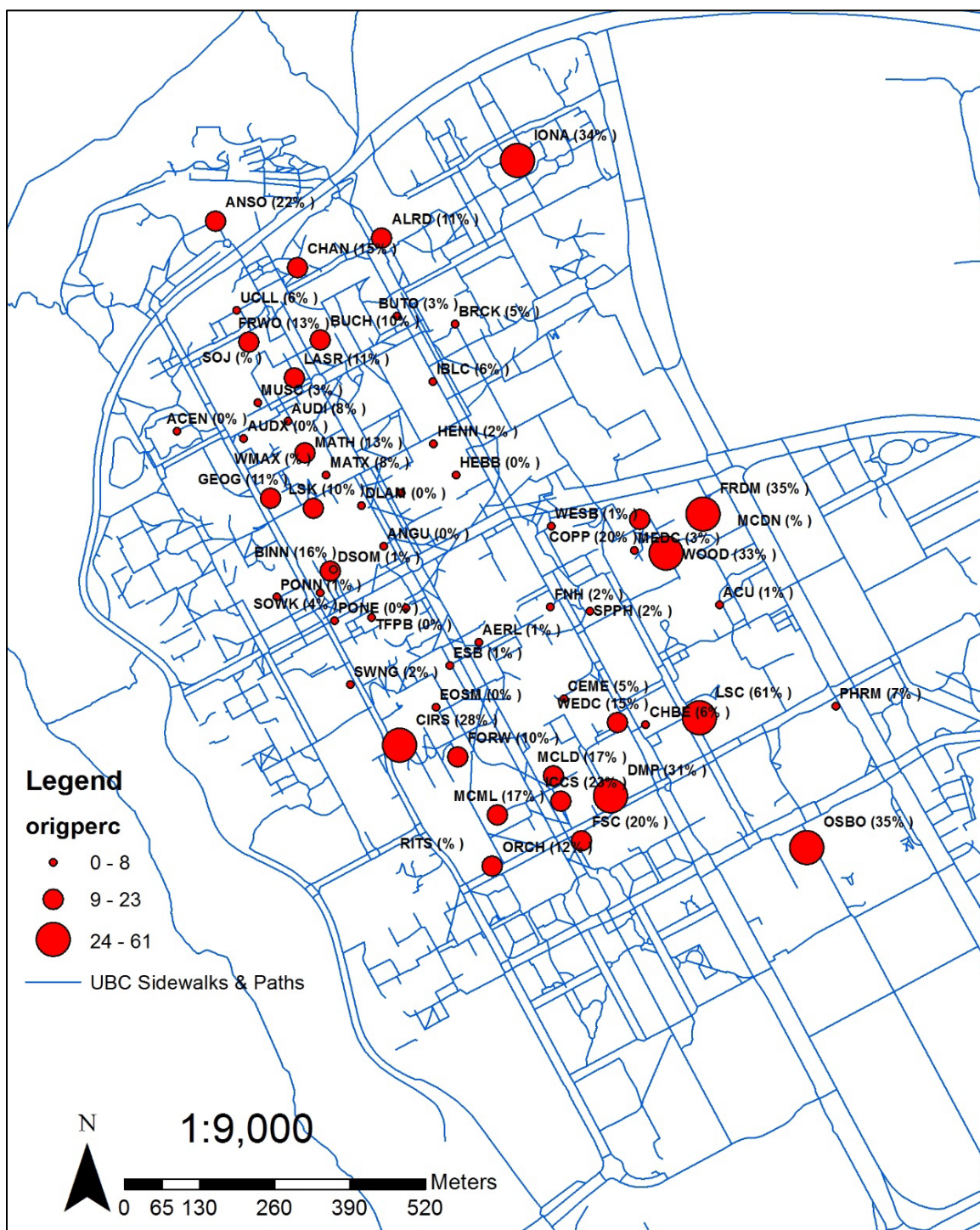


Figure 6 Percent of trips originating at each building that are long (≥ 840 m)

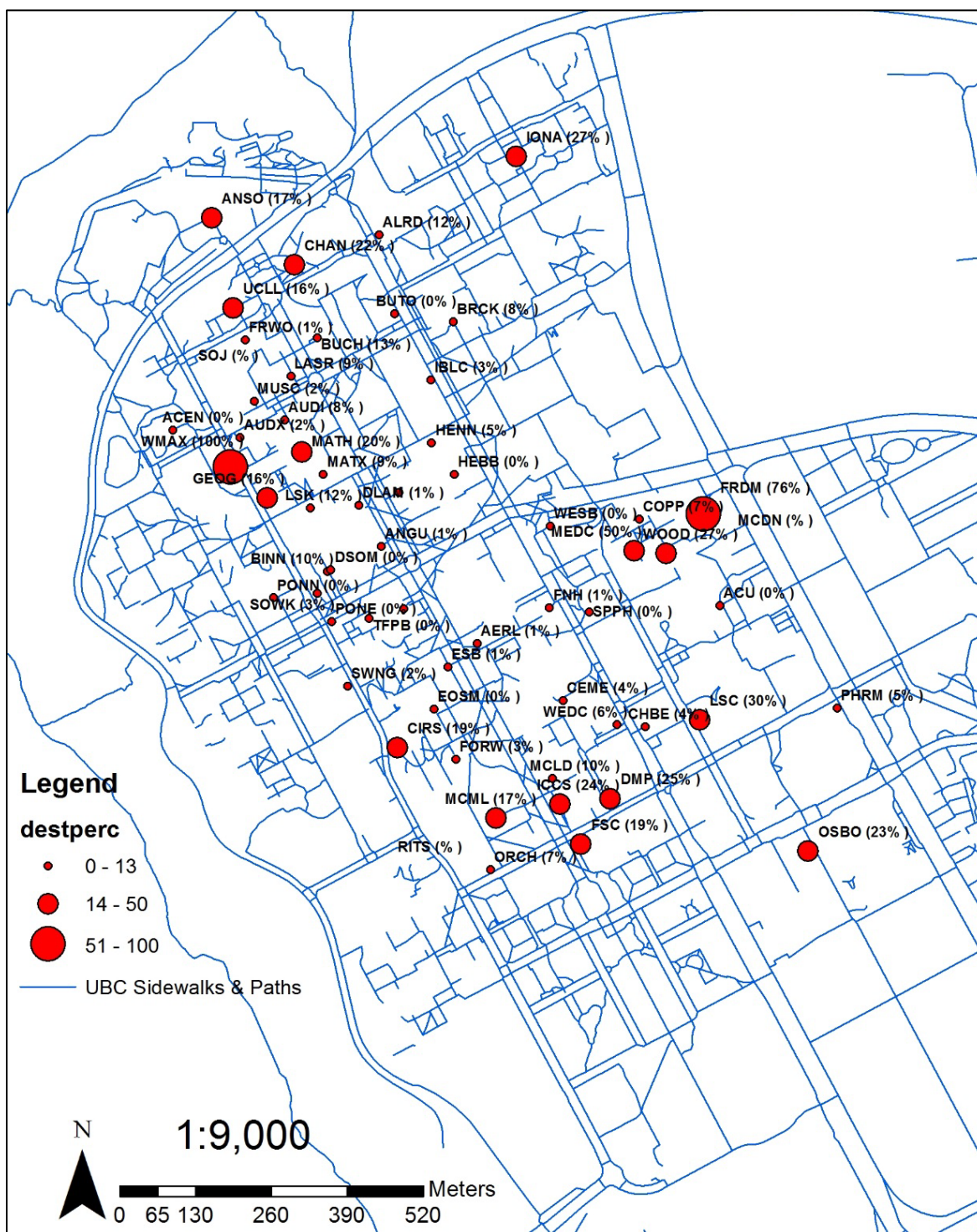


Figure 7 Percent of trips terminating at each building that are long (≥ 840 m)