BYU TRAFFIC BASELINE STUDY
PROJECT ID: CEEN_CPST_0 07

by

Y-Travel
Nicole Adams
Hayden Atchley
Daniel Jarvis
Kyle Leatham

A Capstone Project Final Report

Submitted to

Bremen Leak
BYU Sustainability & Continuity

Department of Civil and Construction Engineering
Ira A. Fulton College of Engineering
Brigham Young University

April 11, 2022

Executive Summary

PROJECT TITLE: **BYU TRAFFIC BASELINE STUDY**
PROJECT ID: CEEn_CPST_0 07
PROJECT SPONSOR: Bremen Leak
TEAM NAME: Y-Travel

The sustainability office on campus is researching BYU's campus' energy expenditure on an average school day. Their office asked our team to conduct a transportation survey that they will include in their research. This project's ultimate purpose is to determine the commuting patterns of campus students, faculty, and staff. We created and distributed a survey that gathers socioeconomic information, mode choice, and previous travel history. This survey will serve as a baseline for further investigation. The sustainability office intends to compare this baseline with the same survey performed after potential policy changes BYU may make to measure their respected impact.

Table of Contents

List of Figures

List of Tables

Introduction

This project's ultimate purpose was to determine BYU's campus' community energy expenditure on an average school day. This project involved creating a survey that gathers socioeconomic information, mode choice, and previous travel history of individuals throughout our community. The survey we created and distributed will be a baseline intended to be compared to the same survey performed after BYU implements its new housing policy.

Our team was assigned to work with Bremen Leak of the Sustainability Department and Dr. Macfarlane of the Transportation Department. Per the requests of our sponsor and our advisor, our project serves as a vital tool in two separate but similar projects. First, the sustainability department aims to better understand BYU's average energy expenditures. As part of their research, it is essential to have accurate data on the transport patterns of students and faculty in our community. Second, Dr. Macfarlane is interested in publishing research about BYU's transportation patterns, the accuracy of our survey methodology, and the effect of university policy on commuting habits. The changes in transportation mode choice and travel distance due to the BYU housing policy are of particular interest to the sustainability office and the transportation department.

Much of our Fall semester agenda consisted of researching and designing our survey. We built upon prior research conducted at the University of Utah and the University of Washington. Based upon their research and the requests of our sponsor, we created a Traffic Baseline Survey that gathers socioeconomic information, mode choice, and previous travel history. The survey creation involved extensive editing and revising to ensure that it was meaningful and straightforward enough to be completed in about five minutes. Dr. Macfarlane helped advise our team on what type of questions would be most beneficial to include in our survey. At the beginning of the Winter semester, our team's focus shifted to obtaining BYU approval for the distribution of our survey.

Our team developed sampling plans during the winter semester and sought APAP approval to distribute our transportation survey via a campus wide email. We also worked to receive BYU IRB approval so that Bremen Leak or Dr. Macfarlane could publish the data we collected. Unfortunately, we did not receive APAP approval and had to alter our survey distribution plans; however, we did receive IRB survey approval and began sharing the survey accordingly. We distributed our survey through the following email lists: civil engineering department newsletters, sustainability newsletter, ASCE Club, and the first-generation student organization. Aside from emails, we also conducted in-person polling in the Wilkinson Center. We received 945 survey responses which we organized, cleaned, and used to conduct preliminary analysis. As will be seen throughout this report, we have categorized the survey results by mode choice, mode by weather, the distance by mode,

departure and arrival times, gender distribution, school year distribution, and college distribution. The survey will serve as a baseline for future studies.

Schedule

As shown in Figure 1, a majority of our time was spent in creating the survey and navigating the approval process. Our main challenges that we faced was being denied for APAP and IRB approval. After being denied the first time for IRB, we were able to create an IRB reacquisition that met all the requirements which granted us IRB approval. For context, quarter 1 is August 30, 2021- October 19, 2021, quarter 2 is October 20, 2021 – December 9, quarter 3 is January 3, 2022- February 23, 2022, and quarter 4 is February 24, 2022- April 13, 2022.

Figure 2 details of time spent in meetings. These meetings were typically used as strategy councils for when the project was not able to move forward due to various issues.

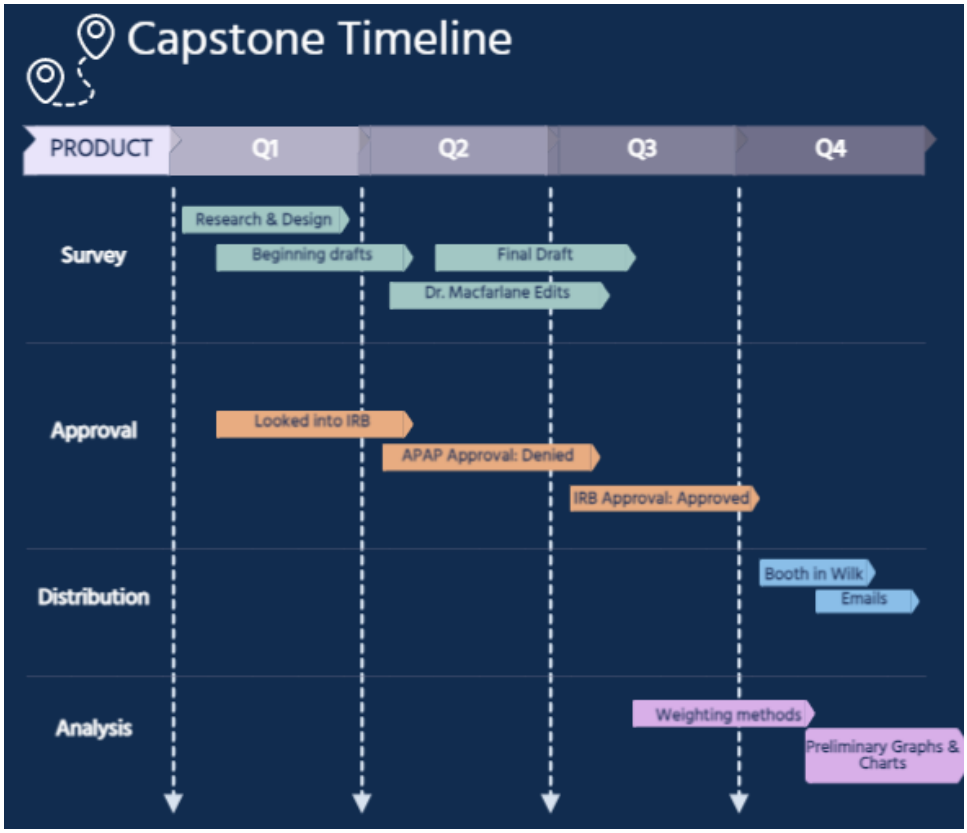


Figure 1: Timeline

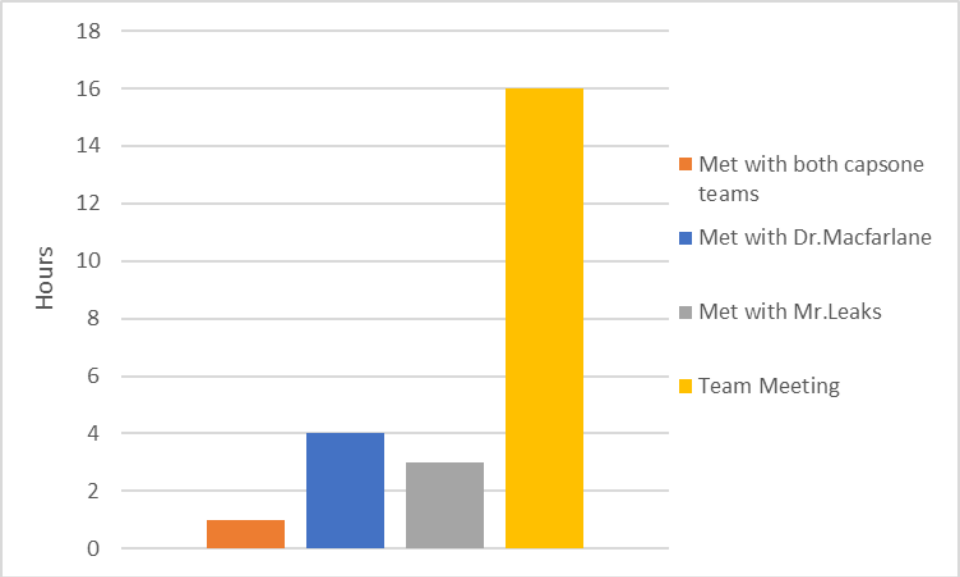


Figure 2: Meeting Hours

Assumptions & Limitations

This project had several limitations during collecting data that could have influenced results. The first limitation was the location of survey distribution. A large majority of survey results were gathered from in-person contacting in a booth in the Wilkinson Center. Since this was the singular location of in-person contacting it limits the survey results to people who were on that part of campus. The second limitation was the weather. Since the survey asked people how they travelled to campus that particular day, the responses may have been influenced by what the weather was like on said day. For instance, Friday April 1st had overcast weather with rain, which may have caused students to alter their transportation mode to accommodate the weather.

Assumptions were made by designing and distributing this survey. It is necessary to assume that all survey participants answered honestly to the survey questions. It is also necessary to assume that the survey is reliable, meaning that it would give the same responses in repetitive testing.

Design, Analysis & Results

The survey design and layout were completed per the recommendations of Dr. Macfarlane and Bremen Leak. Upon meeting with our faculty advisor and sponsor, we determined which questions would be best to analyze BYU's energy expenditures and the impact of university policy on the transportation patterns of this campus community.

Initially, we had hoped to receive responses from 2000 students and 500 faculty and staff, primarily through a campus wide email. Upon being denied APAP approval, we followed our secondary plan and distributed the survey through the following email lists: civil engineering department newsletters, sustainability newsletter, ASCE Club, and the first-generation student organization. Aside from emails, we also conducted in-person polling in the Wilkinson Center.

Needing 400 survey responses, we were pleased to receive over 930 responses by April 8th, 2022. The primary motivating factor for our survey respondents seemed to be the free cookies that we offered at the booth we had set up in the Wilkinson Center.

Preliminary analysis has been conducted based on the responses categorized by mode choice, mode by weather, the distance by mode, departure and arrival times, gender distribution, school year distribution, and college distribution. The graphs for mode choice and departure and arrival times are found below. Found below is also a table that shows the factors associated with why students and faculty chose their specific mode.

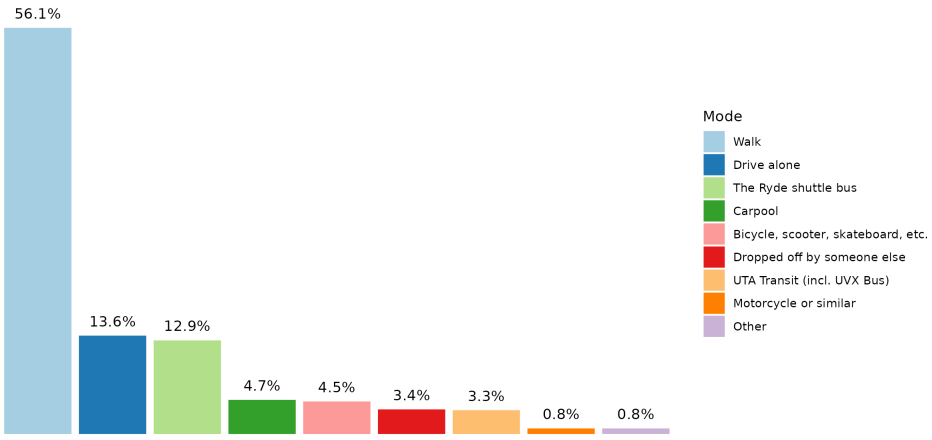


Figure 3: Mode Choice Graph

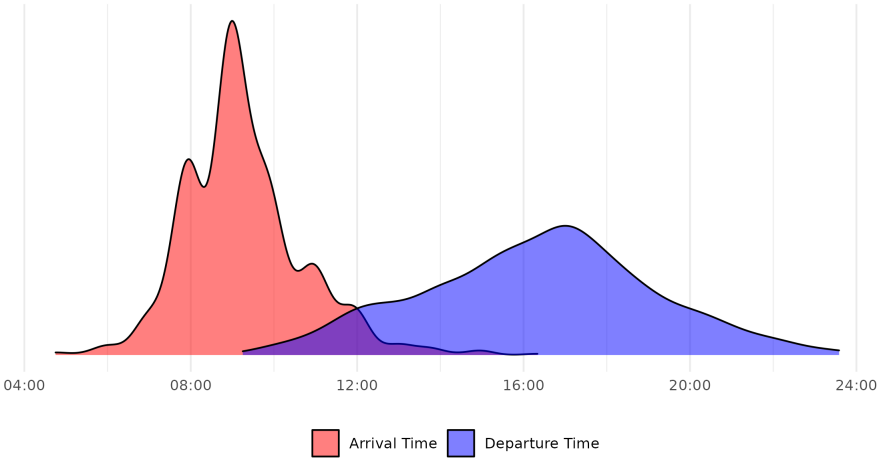


Figure 4: Departure and Arrival Time Graph

Top Five Mode Choice Factors	
Convenience	19.2%
Distance	14.3%
Parking	11.7%
Cost	11.5%
Travel Time	7.6%

Percentage values indicate the number of respondents who chose the given factor as a leading contributor to their mode choice decision.

Table 1: Mode Choice Factors

Because of the lengthy approval processes, we could not compute the average daily campus energy expenditure. Still, this analysis is likely to complete by team members staying in Provo over the spring and summer.

Related Issues

The execution of this project has multiple impacts that will be discussed. The most notable impacts of this project relate to safety, environmental factors, and economic factors. With the data collected through this project, the BYU office of sustainability will better understand how students and faculty travel to and from campus and may use this information to effect change. One example of this would be that upon seeing that a large group of people use bicycle to commute, BYU may implement safer routes around campus in order to accommodate them. This example would have a positive effect on the safety around this area.

An analysis of the impacts on environmental factors shows that there may be some effects from this project. With this information, BYU may decide that more parking is necessary for student and will then create more parking lots in the surrounding area. Doing this, however, will have a negative impact on the local environment since more students will then drive their cars due to the surplus of parking. With the increased use of cars, local pollution will see an increase as well as consumptive energy use. On the flip sound, however, if BYU sees a trend of students and faculty ditching their cars and opting for public or self-sustaining transportation then they may decide to decrease car parking surrounding campus. This action would have a positive effect on the environment and further discourage students and faculty from driving to campus.

Looking at economic impacts of this project it is clear to see that there may be some effects. In a very general sense, if BYU were to change anything about the transportation infrastructure around campus, then it would have an economic impact on the school. For a more precise example, if BYU were to look at these base survey results and notice a larger need for public transit for students, then they could possibly increase their shuttle inventory and open new routes. This action by BYU would have an initially heavy economic impact as they would have to purchase a new shuttle, analyze where the greatest need would be, and train new drivers to cover these routes. In this example, BYU could offset these economic factors and charge for this shuttle service, however this would only pass along the economic impact to the students and faculty using the service. Any major changes sought out by BYU will also have a positive impact on the local economy since they will be creating local work and purchasing necessary items and materials in the area.

The final potential impact from this project would be the effect on public health. There are many potential effects on public health depending on how BYU decides to proceed with these base survey results and their future testing counterparts. Should

BYU decide to further promotes self-sustaining transportation methods such as walking and biking while disincentivizing driving, there will be a positive effect on public health since student and faculty will be more active and there will be less pollution from vehicles in the air.

Lessons Learned

The largest problem that was encountered during this project was getting approval from BYU to conduct the survey. The original plan for this project was to distribute the survey in a campus-wide email in order to reach as many students and faculty as possible. In order to apply for approval, we first had to compile a large list of items as well as complete our survey. Completing all the mentioned prerequisites took quite a while and so we ended up applying for approval a few months into the class. Unfortunately, BYU rejected our proposal. We were then tasked with altering our application in order to fix any issues BYU had with it. After a second attempt, we were once again denied approval from BYU.

Due to these rejections from BYU to advertise our survey, we found ourselves behind our projected schedule. We decided at this point that we would give up on trying to get a university wide email sent and would instead focus our efforts on multiple, small methods of distribution. After once again applying for approval from BYU, we were granted permission to distribute our survey through in-person contacting as well as smaller emails through clubs and colleges. With these smaller methods, we were able to exceed the required amount of survey responses that we needed. From this experience we learned to expect delays in schedules and do our best to account for them when planning items out.

A large amount of time on this project was spent perfecting our survey. To do this, we had to spend quite a while deciding what information we wanted to receive from the responses. After many meetings with our faculty mentor and sponsor we finally decided what we wanted to know. The next task was to then formulate how to ask survey questions in order to get the information we desired. This task was very time consuming and exhaustive; it was incredibly important that our questions were formatted in such a way that there would be clear and concise responses without confusion. From this experience, we had to learn a lot about statistics and survey theory. We gained valuable knowledge on how to create and conduct this survey.

Conclusions

The goals of this capstone project included creating and distributing a transportation survey to the students and faculty of BYU and performing some preliminary analysis of their responses, including determining the overall average energy expenditure in commuting to and from campus. We also planned to prepare a report and presentation to present to the BYU Office of Sustainability.

As our statement of work last semester explained, "If we can widely distribute the survey (such as through BYU's email system), we will be able to perform more analysis and discuss the implications of the survey's findings. However, if distribution proves to be a more difficult task, we will not be able to do much analysis beyond cleaning and summarizing the data." Unfortunately, BYU's denial of our APAP request made distribution more challenging, and we could not perform an extensive analysis of campus wide energy expenditures.

The survey approval process through the Institutional Review Board (IRB) and the Assistant to the President for Assessment and Planning (APAP) was more cumbersome than we had initially anticipated. Preparing the necessary documentation for both approval processes was a time-consuming obstacle we did not foresee. Although, as mentioned, the APAP request was denied, the approval from IRB ensures that Bremen Leak and Greg Macfarlane can use the data that we collected in their respected research. Our sponsor and advisor have expressed their approval of the survey itself and the hard work we put into distributing it across this campus community.

We have designed our survey, distributed it broadly, and organized the results. We collected data from over 940 respondents that we have cleaned, categorized, and prepared for further analysis. We are ready to submit our initial findings to the sustainability office; they will use our data to further their research on average daily energy expenditures. We anticipate that their office will re-distribute our survey in the future to evaluate the respected impact of BYU policy changes. Additionally, researchers in the BYU transportation department will compare our data to similar studies to determine the survey's level of accuracy.

Our survey reached hundreds of individuals throughout the BYU community despite the obstacles we faced. It will serve as a solid foundation for the continuing research of the Sustainability Office and the Transportation Department. We are pleased with our work. Although we could not resolve Mr. Leak's design question as initially planned, we feel that our work will greatly benefit him and the Sustainability Office in their ongoing research.

Recommendations

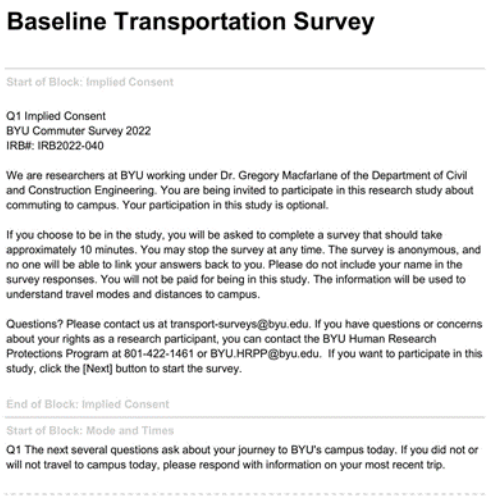
We recommend that researchers in the BYU transportation department work with Dr. Macfarlane to conduct survey weighting and calculate campus energy expenditure based on the respondent's mode choice and distance traveled. Additionally, we recommend that they compare our data to similar studies to determine the survey's level of accuracy. Due to their familiarity with the project, we recommend that Hayden Atchley and Daniel Jarvis complete this additional analysis over the spring and summer.

We anticipate that the Sustainable Office will redistribute our survey in the future to evaluate the respected impact of BYU policy changes. We recommend that they limit the survey alterations when it is redistributed. The survey setup and distribution shouldn't change too much from year to year to ensure a reliable comparison.

However, we feel the survey would better serve the campus community if its reach was expanded. Reapplying for APAP approval could be beneficial. If possible, the sustainability office could show how the survey aligns with the BYU aims when seeking future APAP approval, seeing that their denial this year hinged on the premise that our survey didn't clearly align with the University's stated objectives. If BYU could send out a mass email containing the transportation survey, future studies could have improved accuracy and reach.

Appendix A

Below is a printed-out version of the online transportation survey including the preface and maps used in the survey itself.



Baseline Transportation Survey

Start of Block: Implied Consent

Q1 Implied Consent
BYU Commuter Survey 2022
IRB#: IRB2022-040

We are researchers at BYU working under Dr. Gregory Macfarlane of the Department of Civil and Construction Engineering. You are being invited to participate in this research study about commuting to campus. Your participation in this study is optional.

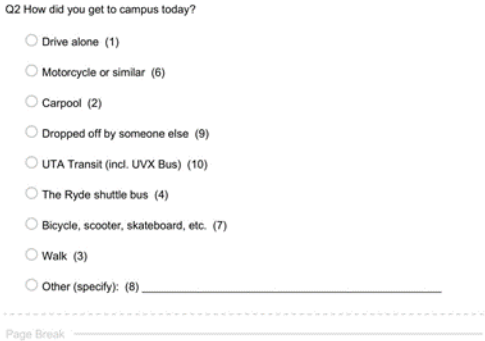
If you choose to be in the study, you will be asked to complete a survey that should take approximately 10 minutes. You may stop the survey at any time. The survey is anonymous, and no one will be able to link your answers back to you. Please do not include your name in the survey responses. You will not be paid for being in this study. The information will be used to understand travel modes and distances to campus.

Questions? Please contact us at transport-surveys@byu.edu. If you have questions or concerns about your rights as a research participant, you can contact the BYU Human Research Protections Program at 801-422-1461 or BYU.HRPP@byu.edu. If you want to participate in this study, click the [Next] button to start the survey.

End of Block: Implied Consent

Start of Block: Mode and Times

Q1 The next several questions ask about your journey to BYU's campus today. If you did not or will not travel to campus today, please respond with information on your most recent trip.



Q2 How did you get to campus today?

- ○ Drive alone (1)
- ○ Motorcycle or similar (6)
- ○ Carpool (2)
- ○ Dropped off by someone else (9)
- ○ UTA Transit (incl. UVX Bus) (10)
- ○ The Ryde shuttle bus (4)
- ○ Bicycle, scooter, skateboard, etc. (7)
- ○ Walk (3)
- ○ Other (specify): (8) _____

Page Break

JS

Q3 What time did you arrive on campus today? Include AM/PM

_____

JS

Q4 What time will you leave campus today? Include AM/PM

_____

Q5 Do you own a car?

- Yes (1)
- No (2)

End of Block: Mode and Times

Start of Block: Reasons

Q6 What influenced your decision to use the transportation mode you chose (${Q2/ChoiceGroup/SelectedChoices})? Select up to 5 that apply:

- Parking availability (1)
- Cost (2)
- Convenience (27)
- Safety (14)
- Privacy (15)
- Weather (16)
- Flexibility (18)
- Distance (26)
- Health (19)
- Exercise (29)
- Personal preference (20)
- Mode availability (21)
- Travel Time (22)
- Environmental concerns (23)
- None of the above (24)

Page Break

Display This Question:

If What influenced your decision to use the transportation mode you chose (... != None of the above

And And What influenced your decision to use the transportation mode you chose (... q://QID48/SelectedChoicesCount Is Not Equal to 1

Carry Forward Selected Choices from "What influenced your decision to use the transportation mode you chose (${q://QID33/ChoiceGroup/SelectedChoices})? Select up to 5 that apply."

Q7 Rank the reasons you chose from most influential to least influential (drag and drop):

_____ Parking availabliity (1)
_____ Cost (2)
_____ Convenience (3)
_____ Safety (4)
_____ Privacy (5)
_____ Weather (6)
_____ Flexibility (7)
_____ Distance (8)
_____ Health (9)
_____ Exercise (10)
_____ Personal preference (11)
_____ Mode availability (12)
_____ Travel Time (13)
_____ Environmental concerns (14)
_____ None of the above (15)

End of Block: Reasons

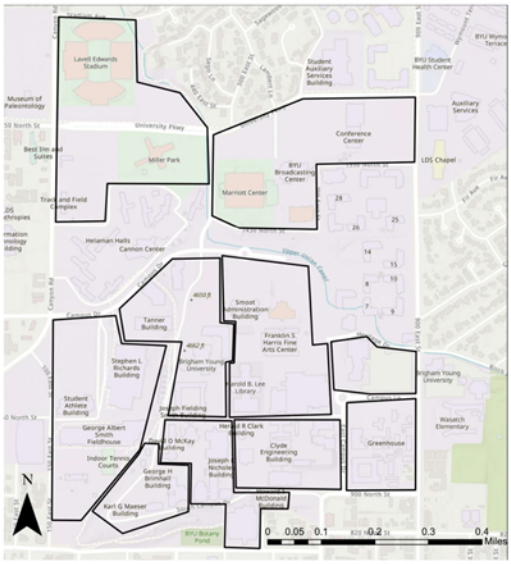
Start of Block: Locations

Q8 What year are you in school?

- Freshman (1)
- Sophomore (2)
- Junior (3)
- Senior (4)
- Graduate student (5)
- Faculty/Staff (6)

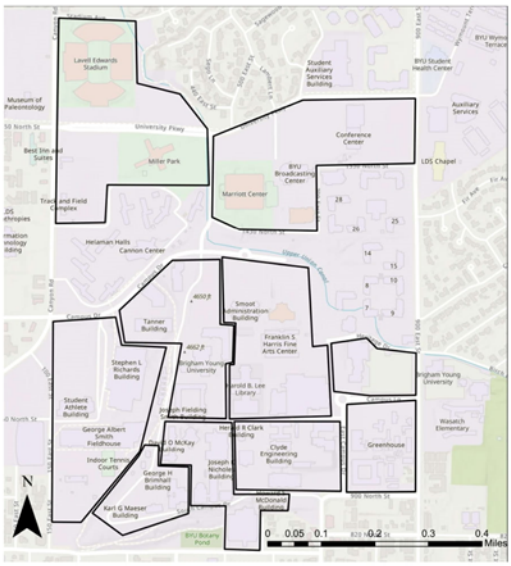
Q9 Select where your first on-campus activity was located today:

	Off (1)	On (2)
Group # 5 (Law) (7)		
Group #12 (Greenhouse) (9)		
Group #6 (Wilk) (10)		
Group #7 (Clyde) (11)		
Group #9 (Tanner) (12)		
Group #8 (McKay) (13)		
Group #10 (Fieldhouse) (14)		
Group #11 (Maeser) (15)		
Group #4 (Lavell) (16)		
Group #2 (Marriott) (17)		



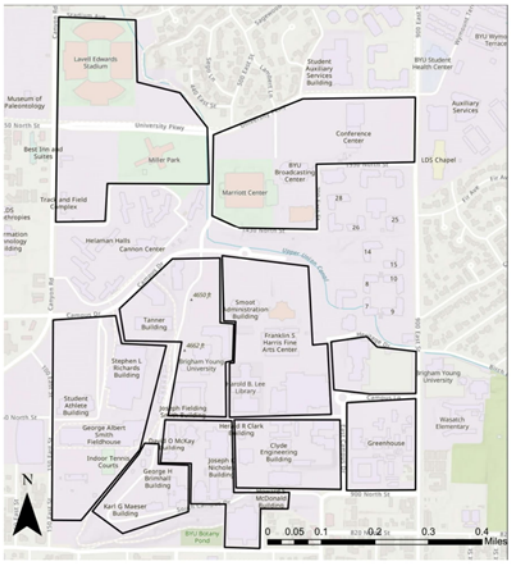
Q10 Select where your last on-campus activity is located today:

	Off (1)	On (2)
Group # 5 (Law) (7)		
Group #12 (Greenhouse) (9)		
Group #6 (Wilk) (10)		
Group #7 (Clyde) (11)		
Group #9 (Tanner) (12)		
Group #8 (McKay) (13)		
Group #10 (Fieldhouse) (14)		
Group #11 (Maeser) (15)		
Group #4 (Lavell) (16)		
Group #2 (Marriott) (17)		



Q10 Select where your last on-campus activity is located today:

	Off (1)	On (2)
Group # 5 (Law) (7)		
Group #12 (Greenhouse) (9)		
Group #6 (Wilk) (10)		
Group #7 (Clyde) (11)		
Group #9 (Tanner) (12)		
Group #8 (McKay) (13)		
Group #10 (Fieldhouse) (14)		
Group #11 (Maeser) (15)		
Group #4 (Lavell) (16)		
Group #2 (Marriott) (17)		



Q10 Select where your last on-campus activity is located today:

	Off (1)	On (2)
Group # 5 (Law) (7)		
Group #12 (Greenhouse) (9)		
Group #6 (Wilk) (10)		
Group #7 (Clyde) (11)		
Group #9 (Tanner) (12)		
Group #8 (McKay) (13)		
Group #10 (Fieldhouse) (14)		
Group #11 (Maeser) (15)		
Group #4 (Lavell) (16)		
Group #2 (Marriott) (17)		

Q16 Thank you! Please answer a few additional questions about your background:

Q17 Where did you grow up? (City, State, Country)

_____

Q18 What mode(s) of transportation did you primarily use to get to high school? (select all that apply)

- ☐ Drive alone or with siblings (1)
- ☐ Motorcycle or similar (6)
- ☐ Carpool with peers (2)
- ☐ Dropped off by parent or guardian (9)
- ☐ School bus (4)
- ☐ Public transportation (10)
- ☐ Bicycle, scooter, skateboard, etc. (7)
- ☐ Walk (3)
- ☐ Other (specify): (8) _____

Q19 How do you describe yourself?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer to self-describe (4) _____
- ○ Prefer not to say (5)

Q20 Are you married?

- ○ Yes (1)
- ○ No (2)

Q21 Do you have children?

- ○ Yes, 1 (2)
- ○ Yes, more than 1 (3)
- ○ No (1)

Page Break

Display This Question:
If What year are you in school? = Freshman
Or What year are you in school? = Sophomore
Or What year are you in school? = Junior
Or What year are you in school? = Senior
Or What year are you in school? = Graduate student

Q22 What is your area of study?

- Business (4)
- Education (7)
- Engineering (8)
- Family, Home, and Social Sciences (9)
- Fine Arts and Communications (10)
- Humanities (11)
- International and Area Studies (17)
- Law (12)
- Life Sciences (13)
- Nursing (14)
- Physical and Mathematical Sciences (15)
- Religious Studies (16)
- Other/Undeclared (6)

Display This Question:
If What year are you in school? = Faculty/Staff

Q23 Which college do you work for?

- Business (4)
- Education (7)
- Engineering (8)
- Family, Home, and Social Sciences (9)
- Fine Arts and Communications (10)
- Humanities (11)
- Law (12)
- Life Sciences (13)
- Nursing (14)
- Physical and Mathematical Sciences (15)
- Religious Studies (16)
- Other (6)

Display This Question:
If What year are you in school? != Faculty/Staff

Q24 Do you currently work?

- Yes, on campus (1)
- Yes, off campus (2)
- Yes, both on and off campus (4)
- No (3)

Q25 What is the highest level of education obtained by one of your parents?

- No college/post-secondary education (1)
- Trade school (6)
- Some college (2)
- Associate's degree (8)
- Bachelor's degree (3)
- Master's degree (4)
- Doctorate or professional degree (5)
- Other: (7) _____

End of Block: Demographics