

**Climate Change Survey for the Agricultural  
Campus in Bible Hill, NS**

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## **Executive Summary**

This report provides an analysis of climate change issues at the Dalhousie Agricultural Campus in Bible Hill, Nova Scotia. The aim of this study was to identify problems on the campus related to climate change in order to be able to provide solutions and recommendations for mitigation and adaptation. The method chosen for data collection was an online survey, which was open to everyone affiliated with the Agricultural Campus including students, staff and faculty as well as nearby residents. The survey asked participants about their experiences with extreme weather events on campus, such as snow and rainstorms, and how (if at all) this affected them. Two of the biggest climate change issues identified on the campus were transportation and energy use. In conclusion, the survey allowed us to pinpoint risk areas on campus such as the Haley House or the Cox Institute, which are in need of repairs. Also, we found that cancelled classes and poor transportation were two of the most notable areas affected when severe or extreme weather events occur. While it is important to make small, less costly adjustments on campus, such as changing to more efficient lights, Dalhousie's AC should also consider more creative action, such as carpooling incentives, shuttle service, and green roofs. Some of the final recommendations made to the Agricultural Campus were to review research done in other provinces where similar problems have been faced, as well as to work closely with the Truro municipality to assess the areas of transportation needs in order to create a more efficient, safe transport system.

## **Introduction**

Climate change is defined by the Intergovernmental Panel on Climate Change as “a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.” (Intergovernmental Panel on Climate Change (IPCC), 2007). Climate change is influenced by a number of factors, but is most notably distinguished by an increase in greenhouse gas emissions (Canada’s Action on Climate Change, 2012). Characterized by changing environmental features, climate change is reducing glaciers, raising seawater levels, and causing soil to erode. Instigating an increase in unusual and severe weather phenomena, heat waves, forest fires, flooding, and heavy storms are all accelerating in severity and speed.

Climate change is a highly contentious topic; certain scientists argue that the earth has many heating and cooling cycles and climate change is simply a naturally occurring process, while others strongly believe that the current warming cycle of the earth is directly caused by human influences (Houghton, 2007). It is widely accepted that humans first began to have an impact on our climate and environment with the introduction of agriculture and farming, then again with the Industrial Revolution and the introduction of machinery (Pearce, 2006). Humans have developed other environmentally harmful activities including the cutting down of trees and burning of fossil fuels. These are amplified by our population growth, producing a wicked problem (Department of Health and Environmental Control. (n.d.); Schiermeier, 2011). Studies have shown that anthropogenic climate change has more than doubled the likelihood of severe weather events occurring, most notably those involving precipitation (Schiermeier, 2011). As a result of our changing climate, melting of ice flows and glaciers, and increased precipitation, ocean levels are rising. Many lakes and rivers are overflowing and causing low-lying areas to be flooded, which inevitably destroys the land for human use (Schiermeier, 2011). One of the largest concerns in relation to climate change and flooding is the irreversible melting of the Greenland ice sheet, as well as other ancient glaciers. This could raise global sea levels by several meters – enough to flood many low lands, currently home to billions of people, as well as wildlife and unique habitats (Pearce, 2006).

Within the past decade, Nova Scotia has experienced some extreme weather events, such as Hurricane Juan in 2003 and “White Juan” in 2004. Both of these storms were characterized by high winds and heavy amounts of precipitation. Hurricane Juan recorded wave heights of up to 19.9m, with winds of up to 85 knots. Point Pleasant Park on the Halifax Harbour saw water rise by 1.64m causing extensive damage to the park and lowland areas (Xu, 2012). Almost entirely surrounded by water, Nova Scotia holds inland flooding as a major concern (Nova Scotia Environment, 2009). The province is working on adaptation strategies to prepare for the risks that climate change will bring (Climate Change, 2013).

Situated at the mouth of Cobequid Bay on the Bay of Fundy, the town of Truro is neighbor to some of the highest tides in the world, which rise twice a day. Given the right conditions; timing, spring high-tides, rising sea-levels combined with heavy rainfall and gusting winds, Truro may inevitably be the site of a disastrous event (Singh, Walters, & Ollerhead, 2007). Recent devastation caused by extreme weather was in the fall of 2012. Truro was inundated with torrential rains that washed out roads and basements causing extensive damage (Pembrandt, CBC, 2012; Arsenault, Herald, 2012). Further to this, the area has also seen 100-year weather events; the Saxby Gale of 1869 recorded waves that over-topped the dykes (11.5 m) by almost a meter and flooded out the lowlands. The province soon prioritized the area and dedicated funds to a climate change and flood prevention plan (Gorban, 2012).

The possibility of a future event like the Saxby Gale is not unlikely. A perfect condition created by the Saros Cycle, an astronomical event, occurs every 18.3 years, coupled with higher tides and wind gusts, make it only a matter of time before we see another event of this scale (Webster, Kongwongthai, Crowell, 2012). Furthermore, with predicted sea-level rise, it could be even more disturbing for the Truro area. There is some exciting research being developed on how to adapt to lessen the effects of climate change on coastal areas. Re-investing in salt marshes protects the land, creates sanctuaries and gives heavily thwarted sea water the chance to break before it hits the big towns.

## **Objectives**

This research project aims to conduct a climate change survey and assessment for Dalhousie's newest campus, the Agricultural Campus (AC). Since climate change issues, such as extreme weather, could seriously impact the AC and the surrounding region. Therefore, the scope of this project will focus on the perceptions and potential risks of damage that climate change may cause on the campus. The research process will involve an online survey and a document review.

This process will focus on four objectives specific to the Agricultural Campus:

1. What students, staff, faculty and nearby residents perceive climate change to be.
2. Where weaknesses in infrastructure and services are in regards to the risks of climate change.
3. What processes and practices have been implemented to address climate change issues.
4. What recommendations can be made to improve adaptability and resilience.

## **Purpose**

The purpose of this study is to gain information specific to the Agricultural Campus and its surrounding areas of Bible Hill regarding climate change. The information collected will include results of people's perception of climate change and what areas of the campus need to be targeted in order to adapt and mitigate to this global phenomenon. Dalhousie's Office of Sustainability will use the results from this survey, along with recommendations of changes, to improve the Agricultural Campus. The ultimate goal of the Office of Sustainability is to include the school in Dalhousie's Climate Change Plan. This will allow changes to be made specifically for this campus instead of Dalhousie as a whole.

## **Research Methods**

The research methods for this study consist primarily of an online survey and a document review. The intended outcome of using these methods was to gain a general perspective of climate change at the Agricultural Campus.

## **Survey**

The main research tool that was utilized was an online survey. The survey is very similar to the one conducted on Dalhousie University's Halifax campuses in 2010. However this survey will be directed towards climate change issues specifically related to the Agricultural Campus in Truro. Online surveys facilitate a cost effective process that results in a heterogeneous sample (Atchison, 2008, p.156). Another reason why an online survey was conducted was because our client [Rochelle Owen] intends to use the gathered data for planning future climate change adaptation strategies at Dalhousie's newest campus. The online survey method results in a more diverse population sample size. In this survey, it included students, faculty, alumni, staff, and members of the surrounding community. We collaborated with Dalhousie's Sustainability Office to both gain perspective and to provide useful information for their future projects. The survey was conducted through Dalhousie's electronic survey program, *Opinio*, and all questions were pre-approved through the Sustainability Office and sent via email. This was to ensure that any information retrieved could be used to enhance previous climate adaptation and mitigation surveys done regarding the Halifax campuses in 2010. Our questionnaire was emailed on March 17, 2013 and stayed live until March 27, 2013. We sent the survey to individuals affiliated with the AC, who then forwarded the survey link to other people. Please see Appendix E for these people.

We conducted a pilot test survey to measure the validity and reliability of our online survey. Our online survey is reliable because it provides consistent measurements from one participant to the next. The findings and process can easily be replicated. The survey instrument measures and presents the intended outcomes of our study, which involves documenting perception of climate change and vulnerabilities of built and natural infrastructure on the agricultural campus. We provided trustworthiness through our research by providing logical traceable procedures and documents. We had assistance from our mentor Rebecca during every step of the process.

## **Limitations**

The most apparent limitation of this project is its time frame. This limits a number of different things such as, the amount of time to complete the project – build a survey, send it out and analyze the results. In addition to this, another important limitation to note is the amount of

people who responded to the survey and how these people related to the campus. Even though the survey was sent out to many different sources, there was no control over who responded. An incentive of a \$50 Sobey's gift card was used to attempt to draw more people to completing the survey. But, with "Climate Change" in the title, and depending on what groups of people actually received the link for the survey, it is possible that there was a bias in the results. Of the amount of completed surveys received, many of them provided the feedback the project was looking for. This could mean that the majority of respondents were people who are genuinely interested in seeing certain changes to adapt and mitigate to climate change at their campus.

Other than time, one of the greatest limitations involved in this project were the current weather events. This academic year, there have been a few snowstorms and a fair amount of rainstorms. A portion of the results received was answers from students in their first year. This means they may not have experienced major weather events in the area and therefore have not been affected by them. In addition to this, the academic research had to be based on past information and analyses. Together, this limits the collected information to past records and the memories of respondents.

### **Delimitations**

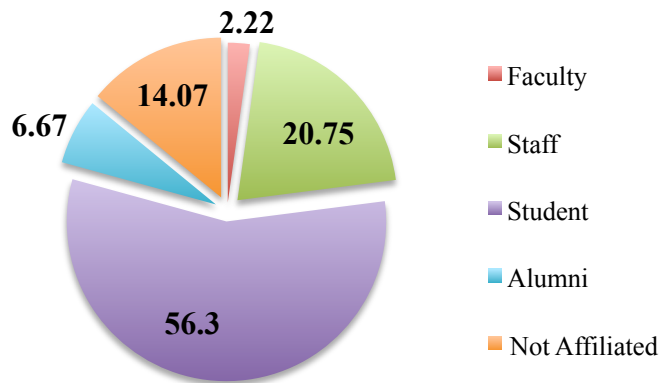
There were a number of delimiting factors in this project. These included, the amount of time the survey was live for and the lack of reminder emails containing the survey link. The survey was live for only a week (March 14 to March 28, 2013). With a longer time frame, more people would have had the opportunity to complete the survey. Through Opinio, it was apparent that surveys were being completed right until the last few days. If the survey had been open longer, the chance of having more respondents would have increased. Often with online surveys, a reminder link is sent out 1-3 times after the original email was sent. This was not done in this project. The survey was not sent directly to students, staff, faculty and people living around the campus. It was sent to a few people who pushed the survey out to a variety of others. Because of this, it would have been too difficult and confusing to send out reminder emails. Reminder emails with the survey link may have given more result. Again, there would have been a higher chance of having more respondents.



## **Results:**

Before any recommendations for adapting to a changing climate could be made, the vulnerabilities of Dalhousie's agricultural campus needed to be identified. A survey of the general campus community was selected as a tool to gather opinions on potentially vulnerable areas. The concepts extreme weather or extreme weather event were used as points of reference for survey respondents. Questions were designed that asked participants about their experience with extreme weather (e.g. hurricanes, snow storms, flooding) at the agricultural campus. The survey itself was created using the Opinio software. It consisted of 21 questions and was live from March 13, 2013 to March 27, receiving 139 responses. Here are the following results:

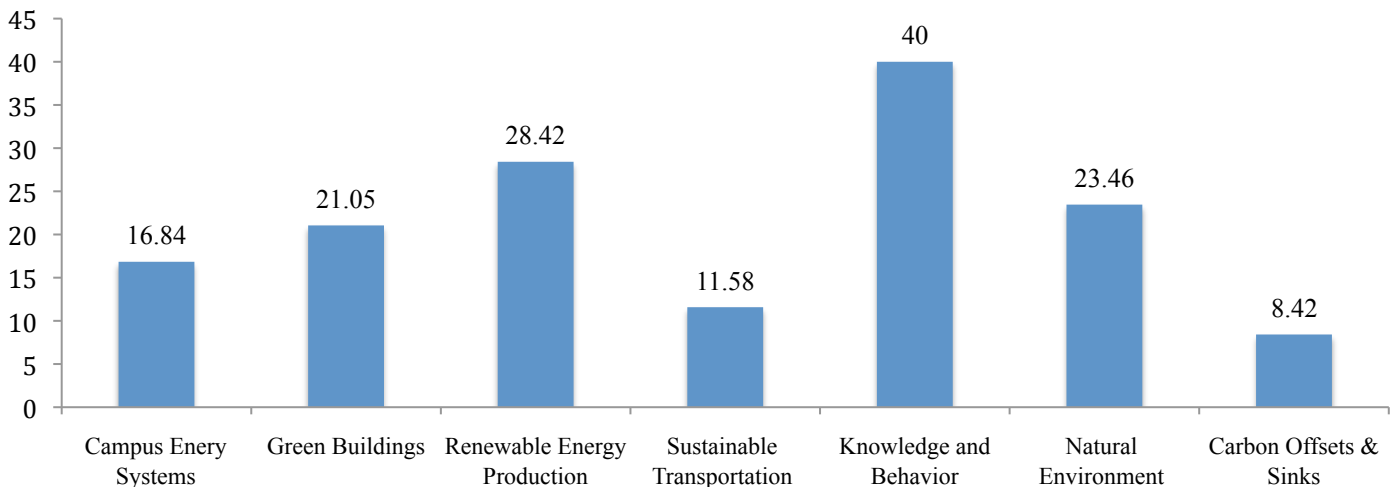
### **What department do you currently work/study in?**



*Figure 1: Percentage of respondents by Dalhousie AC affiliation*

### **To reduce greenhouse gases and adapt to climate change, Dalhousie is focusing on seven main strategies. How do you feel about the impotence of these?**

**Please place in order of importance: 1 being of highest importance and 7 being lowest.**



*Figure 2: Percentage of strategies deemed 'highest importance'*

### What ideas do you have for reducing energy on campus?

The most common response to this question involved reducing energy and improving energy-efficient infrastructure in buildings, this could include things such as retrofitting all campus buildings to comply with LEED standards, lighting and heating upgrades, installation of solar panels, water-intake from the roof, and improved insulation, especially around windows. Another prominent response group was in favor of improving the public's attitude towards sustainability and changing social norms - at least one respondent claimed they believed it would be beneficial to have a competition between the residences to see who can use the least amount of energy. Others responded that making the available parking areas smaller would encourage carpooling among students and faculty, or that less paper needs to be used on campus by staff, students, and faculty. Another large response group indicated that they felt technology was the best investment in terms of reducing energy on campus - many responses mentioned the installation of motion-censored lights and faucets (taps, showers) in all buildings, and replacing old fixtures & technology with newer systems, from the on-campus computers to refrigerators and other appliances. Some other responses to this question included an increase in research and improved public transportation.

### Are you in favor of producing energy through the following renewables on campus? Please select all that apply.

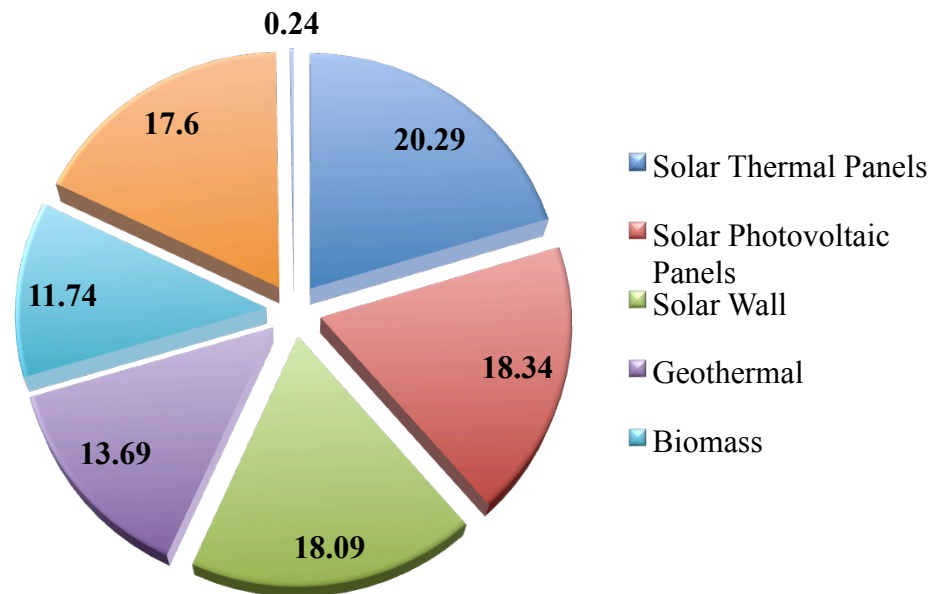


Figure 3: Percentage of favored responses

### Do you have other suggestions for reducing GHG emissions?

The majority of responses based around transportation issues. Respondents felt that driving should be discouraged, while promoting other means of transportation such as walking, biking, and carpooling - and offering incentives to do so. The implementation of a shuttle service to campus was also suggested. A large response category was in favor of "greening" the campus by planting more trees and shrubs, and the creation of gardens and green spaces. Another interesting response was that the campus should purchase, and sell, less over-packaged products (in terms of food, books, supplies, etc).

### In what ways, if any, have you been impacted by climate change?

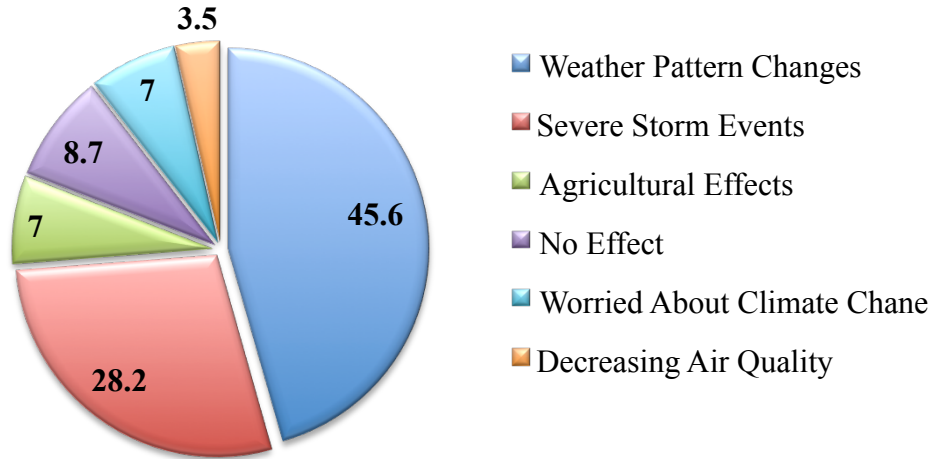


Figure 4: Percentage of specific impacts mentioned in responses

### What types of storms or weather events have you experienced on campus?

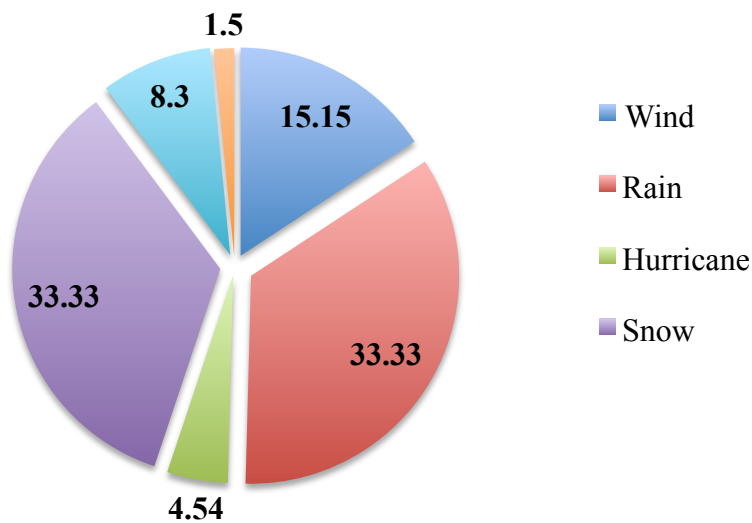


Figure 5: Percentage of specific weather events experienced on campus

### What effects did the storm have on you?

An overwhelming majority of responses to this question involved being impacted by the weather patterns and the events of the storm. Many responses indicated that people had trouble getting to and from class and work, often resulting in a lack of attendance. The roads in many areas were icy or flooded and all transportation was difficult. Respondents claimed they were very cold and wet - often soaked through to their clothes and shoes. Some respondents did report leaking, and power outages as well. Overall, the responses varied greatly - most reported that the weather stalled their daily lives (class, work, other activities) and made them feel uneasy when commuting, while others claimed their routines were not interrupted, one respondent even claimed he continued to do his cross-country running during the storm and enjoyed the extreme weather. Another issue noted in the responses is that of the well-being of livestock as well as machinery on and around campus during severe weather events - ice or flooding could endanger the animals, or potentially damage machinery.

### What effects did the storms or weather events have on campus?

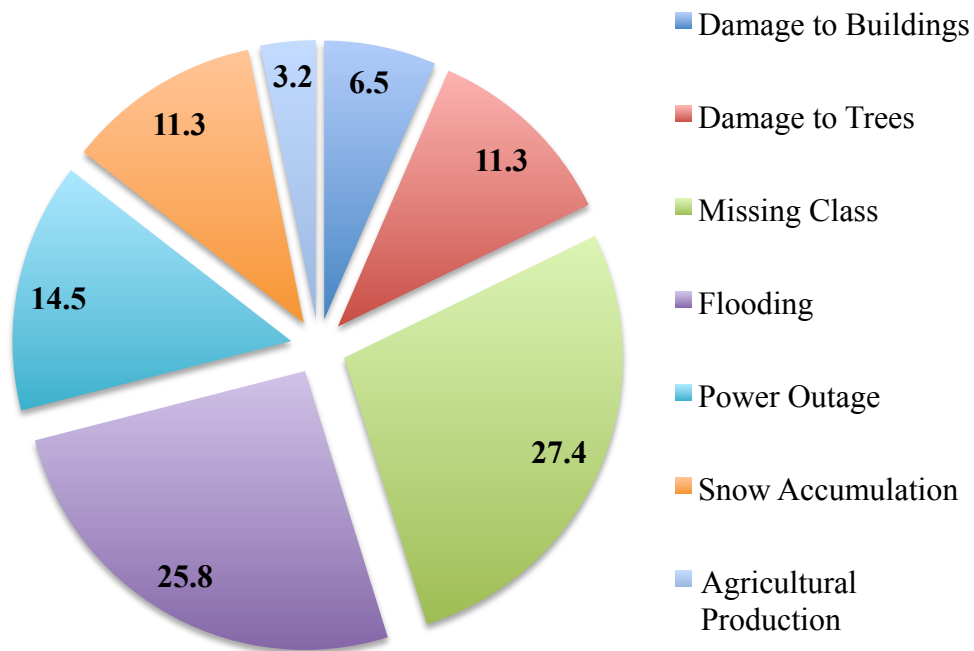
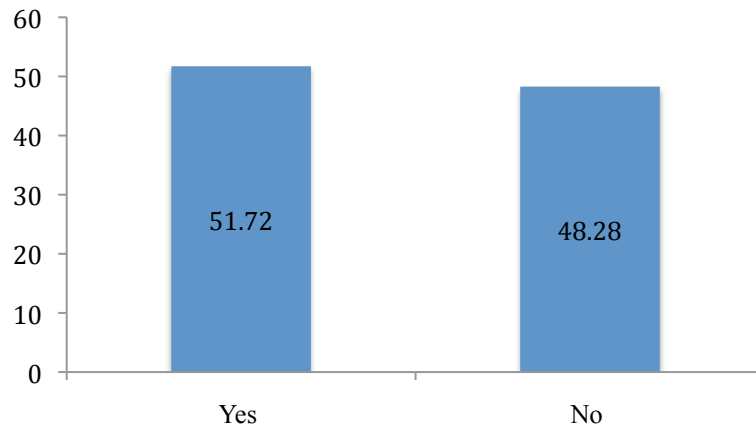


Figure 6: Percentage of specific effects mentioned in responses

**During heavy rains, have you noticed water pooling in areas on campus?**

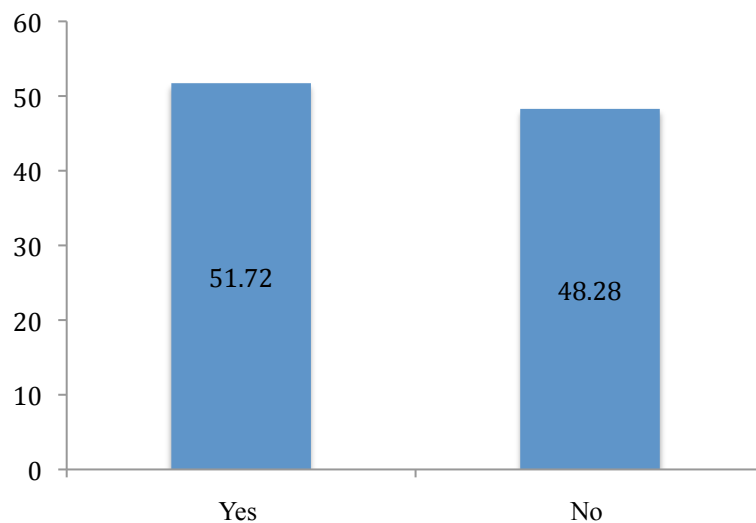


*Figure 7: Percentage of 'yes' and 'no' responses*

Respondents generally noticed pooling of water at built areas [e.g. sidewalks, driveways, parking lots, entrance to buildings, roads, lawns].

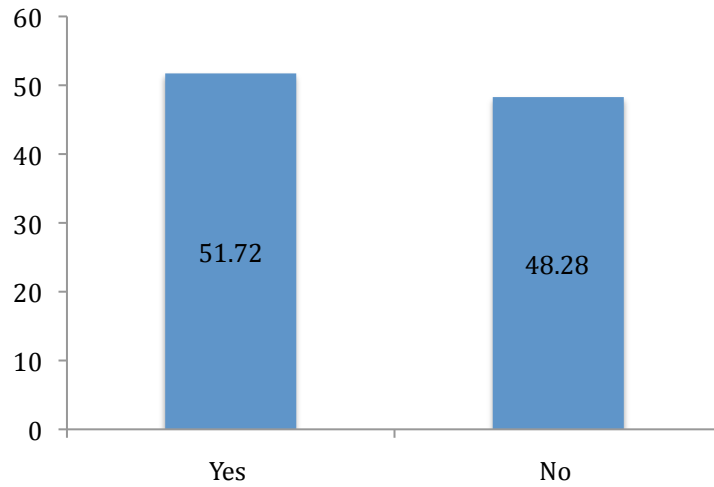
Respondents also noticed pooling of water by natural features [e.g. base of hills, cow pastures]

**In your time on campus, have you experienced disruptions in services due to the weather? (Classes cancelled, health services stopped, etc.)**



*Figure 8: Percentage of 'yes' and 'no' responses*

**In your time on campus, have you noticed any vulnerabilities in the buildings? (i.e. leaks, cracks)**

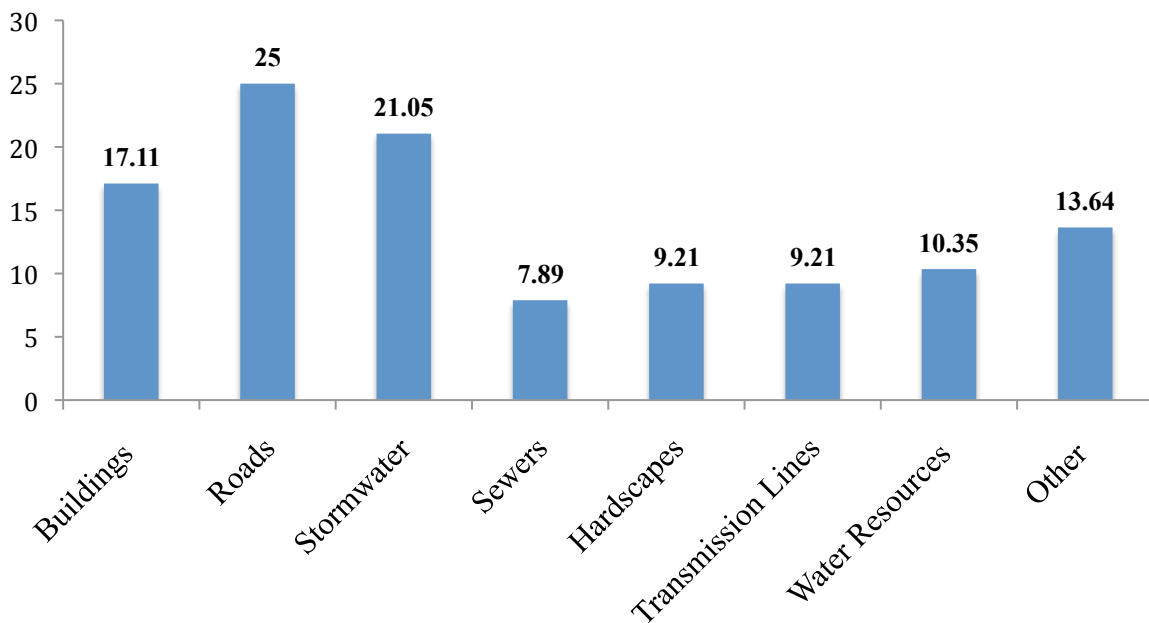


*Figure 9: Percentage of 'yes' and 'no' responses*

Leaking water in various buildings on campus was mentioned by a significant amount of respondents [e.g. Cummings Hall, Jenkins Hall, Library, Residences, Cox Building].

**If an extreme weather event were to occur today, which of the following infrastructures are most likely to be damaged on campus by the event?**

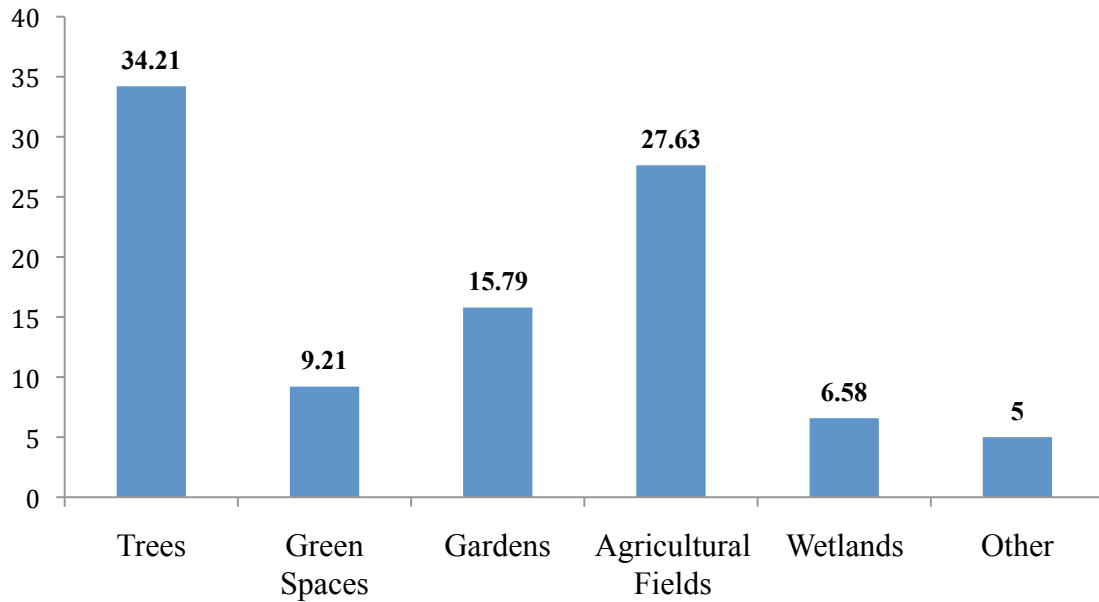
**Please rank the following: 1=most vulnerable to damage, 8=least vulnerable to damage**



*Figure 10: Percentage of specific infrastructure deemed 'most vulnerable'*

**If an extreme weather event occurred today, which of the following natural elements would be most vulnerable in terms of damage?**

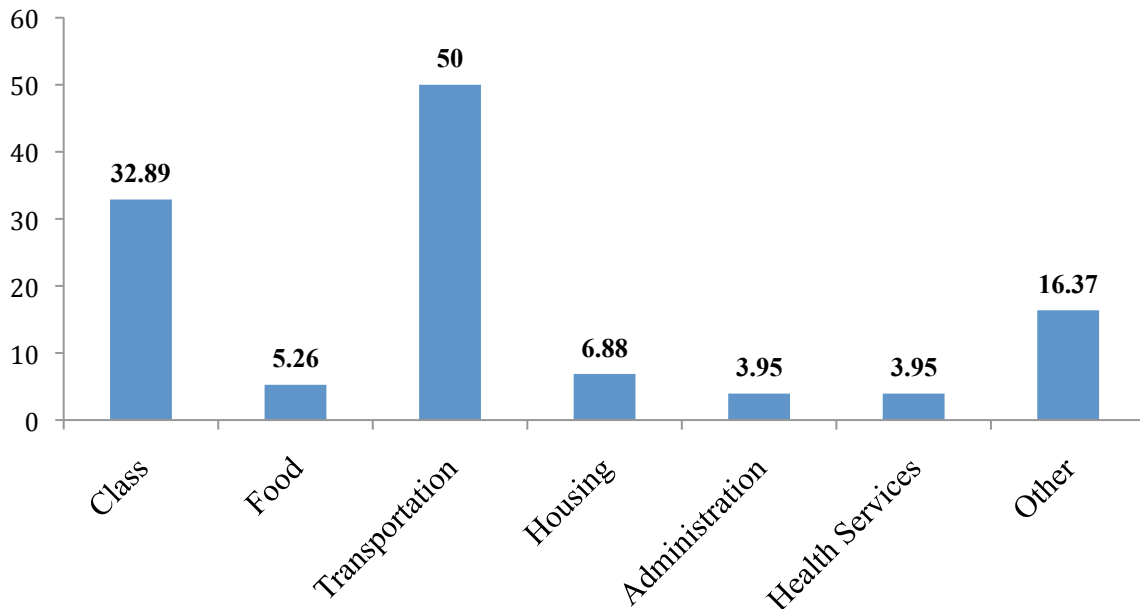
**Please rank each category: 1 = most vulnerable, 7 = least vulnerable**



*Figure 11: Percentage of specific natural elements deemed 'most vulnerable'*

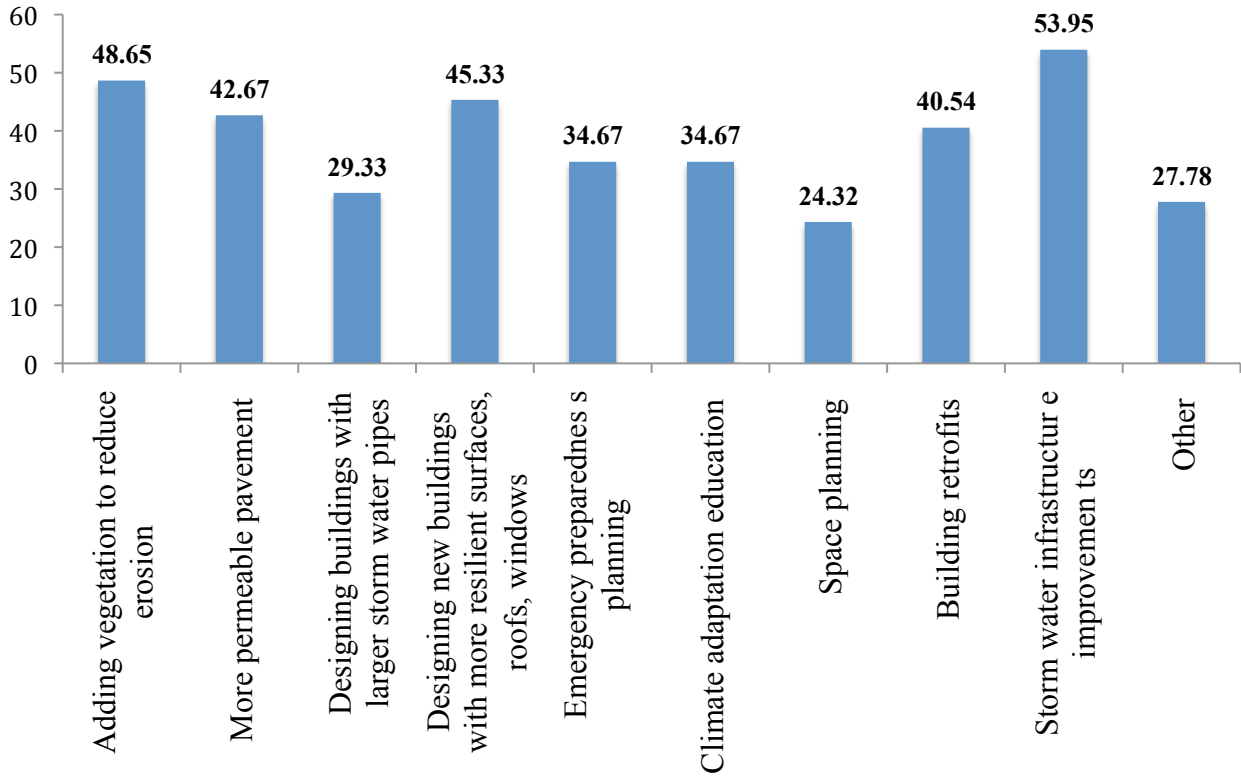
**If an extreme weather event occurred today, which services would be the most vulnerable to disruption?**

**Please rank each category: 1 = most vulnerable, 7 = least vulnerable**



*Figure 12: Percentage of specific infrastructure deemed 'most vulnerable'*

**Do you have any suggestions for climate adaptive improvements for the campus?  
Please rate in order of importance: 1 = not important, 5 = very important**



*Figure 13: Percentage of suggestions deemed 'very important'*

## **Discussion**

With the signing of the Climate Change Statement of Action in 2010, Dalhousie University was obligated to produce a Plan to help mitigate and adapt to the risks of that climate change imposes (Climate Change, 2010). Through the dedication of the Office of Sustainability, Dalhousie has implemented the Climate Change Plan and has incorporated research that was conducted on the Halifax campuses. In September 2012, The Agricultural College in Truro was amalgamated into Dalhousie and became the Agricultural campus. Adherent to the Statement of Action, the campus needed to complete research to determine the vulnerabilities of the built and natural environment and to gauge the risks, perceptions impacts of the population. This research was to initiate the AC into Dalhousie's Climate Change Adaptation and Mitigation Plan.



From the survey we were able to determine the general perception of respondents towards climate change and how it affected them. The top answers for the campus vulnerabilities were transportation at 50% and class cancelation at 32%. In the event of more frequent and severe storms, as IPCC predictions infer, this kind of disruption will only increase without adaptive strategies in place (IPCC, 2007). The AC is located in Bible Hill, just outside Truro and it can be assumed that many students, staff and faculty commute. While transportation may not necessarily be a university issue, it identifies as a major problem when the education of students is impeded. This particular issue should be viewed as a major complication of climate change that the Dalhousie AC must recognize and adapt to.

Seeing that transportation was also viewed as one of the top areas to reduce ghg's, this information can be applied as a source to pull from in building strategies for mitigate further perturbation of climate change. Increasing sustainable, active transportation produces many positive externalities from health improvement to cultural cohesion through accessibility and connection. It is also is a major influence in strategizing the paradigm shift over fossil fuel reliance (Newman, Kenworthy & Vintila, 1995). What is interesting from the collected data of this survey is that there is a psychological disconnect between energy consumption and the use of the personal vehicle. While reducing car use was viewed as the top way to reduce ghg's, there were far fewer responses in regards to car reduction when asked about reducing energy. Assuming that many people drive to and from the campus, transportation was overlooked as high source of energy consumption that was not reported, either people were unaware of this or did not think of as a source of energy consumption at the time of responding. Further study into this might promote some interesting research.

There were countless ideas in reducing energy and ghg's on the campus and some of these suggestions such as changing lights bulbs, activating hibernating setting on computers can be done at minimal costs and we feel these are places to start. While these sorts of "common" changes can be interpreted as less impactful, they are a start to reducing energy consumption. More useful suggestions that imply the use of natural lights, such as skylights, though are initially more costly, have a greater overall impact, which underscore our reliance on fossil fuels (Lorenzoni, Nicholson-Cole & Witmarsh, 2007).

With a third of respondents aware that a shift in behavior is important to reducing energy it interacts with the underlying causes of anthropogenic climate change and is often seen as a major barrier to mitigating and adapting (Lorenzoni, Nicholson-Cole & Witmarsh, 2007). This can be interpreted as a positive outcome of this survey, exposing the willingness of the campus population to interact with adaptive changes needed. Also interesting is that under reducing energy only 5 responses focused increasing active transportation.

The Cox institute and the Haley House were noted as the most vulnerable building, suffering such disrepair as leaking basements, drafty windows and poor insulation. Attention to these vulnerabilities is needed to prevent conditions from worsening, especially where water pooling was noticed near buildings, where foundations exposed to repeated and prolonged water pressures may crack and cause future damage.

## **Conclusion**

In conclusion, some recommendations have been laid out for further action. More observation must take place on the Agricultural Campus, in order to create validity and reliability. It would be beneficial to be able to see the campus and visit some of the identified problem areas such as the basement of the Cox Institute, “Trueman Lake,” to name a few. It is also important that older buildings in disrepair are fixed, such as the Cox Institute and Haley House. These buildings can be a liability if there are structural issues or if damage goes unfixed, especially in the case of any future severe and extreme weather.

It is also recommended that the University begins to build potential relationships with the municipality of Truro. The biggest problem area that was identified by survey participants was transportation, in terms of being a large contributor to GHG emissions. This seems to be the aspect that has the most room for improvement on campus. Almost all of the survey participants reported having difficulty getting to and from campus, and other places around Truro, especially during storms. By working with the municipality, some of the issues brought up in the survey results can be addressed, such as carpooling or a shuttle service. This being said, it may also be beneficial to set up a focus group on campus who’s target population would be interested in helping to create a deeper understanding of the needs assessed in this report on the Agricultural Campus.

As a University, we have an obligation and duty to reduce our energy consumption, GHG emissions, and to develop behavioral and attitudinal changes to improve climate change mitigation and adaptation strategies. The Dalhousie Climate Change Plan is a great start, however it is clear that much more needs to be done in order to empower decision-makers and to validate that climate change is a very real threat and requires all of our attention, as well as funding to truly bring changes that will impact our future.

It is important that Truro is included in Dalhousie's Transportation Demand Management Assessment in order to better determine the appropriate actions. In Dalhousie's assessment it was assumed that most people drive to and from campus, when in fact it is not actually known for certain. If the Agricultural Campus works side by side with the Truro municipality, it can address transportation issues and come up with new solutions to the campuses transportation problems. Many survey participants had some ideas about ways to improve the transportation system on campus. Suggestions were made about an incentive for carpooling, adding more "pedestrian friendly" areas, cutting back on parking space, and the installation of a shuttle to and from campus. In British Columbia, Simon Fraser University completed a feasibility study for implementing a Gondola project. This is an interesting concept and an area of further investigation that may prove to be beneficial due to the limits and hazards associated with extreme, severe weather and the restrictions this places on road transportation. The costs are relatively low and it is an effective way to improve ridership, while also reducing GHG emissions (Tupper, 2009)

Another recommendation for further research is to review the literature and research conducted in Quebec on climate change mitigation and adaptation. The province of Quebec has done extensive research into this area after the Saguenay Floods of 1996 and the ice storms of 1998 – it may be relevant to review what steps the province has made in terms of relating it to the climate change and transportation issues at hand on the Agricultural Campus (Segiun & Berry, 2008).

## References

- Atchison, C., Palys, T. (2008) *Research Decisions: Quantitative and Qualitative Perspectives*. Nelson Education Ltd. Toronto, Canada
- Adger, N. W., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change* 15(2), 77-86. Retrieved from: <http://www.sciencedirect.com.ezproxy.library.dal.ca/science/article/pii/S0959378004000901>
- Arsenault, D., & McIntyre, M. (2012, September 24). Basement, roads flooded in truro. *Chronicle Herald*. Retrieved from: <http://thechronicleherald.ca/novascotia/139105-basements-roads-flooded-in-truro>.
- Climate Change Nova Scotia. (2013). Retrieved from: <http://climatechange.gov.ns.ca/content/home>.
- Greenberg, D., Wade Blanchard, Bruce Smith & Elaine Barrow (2012): Climate Change, Mean Sea Level and High Tides in the Bay of Fundy, *Atmosphere-Ocean*, 50:3, 261-276
- Department of Health and Environmental Control. (n.d.). *FYI: DHEC's Office of Solid Waste Reduction and Recycling. A Brief Introduction to Climate Change*. Retrieved from: [http://www.scdhec.gov/environment/lwm/recycle/pubs/fyi\\_climate\\_change.pdf](http://www.scdhec.gov/environment/lwm/recycle/pubs/fyi_climate_change.pdf)
- Fumin Xu & William Perrie (2012): Extreme Waves and Wave Run-up in Halifax Harbour under Climate Change Scenarios, *Atmosphere-Ocean*, 50:4, 407-420.
- Gorban, M. (2012, December 18). Truro putting part of flood plan into place. *The chronicle herald*. Retrieved from: <http://thechronicleherald.ca/novascotia/269449-truro-putting-part-of-flood-plan-into-place>
- Houghton, D. (2007). *Global Climate Change: Basics, Challenges, and International Impacts*. Retrieved from: <http://www.rc.swls.org/www.old/talks/climatechange2007.pdf>
- HRM Spatial Inc. & Dalhousie University (2013) *Campus Map: Agricultural Campus*. Retrieved from: <http://campusmaps.dal.ca/?campus=agricultural>
- Intergovernmental Panel on Climate Change. (2007). *Synthesis Report*. Retrieved from: [http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf)
- International Energy Agency. (2013). *Climate Change*. Retrieved from: <http://www.iea.org/topics/climatechange/>
- Knox, J. C. (1993). Large increases in flood magnitude in response to modest changes in climate. *Nature* 361, 430 – 432. doi:10.1038/361430a0
- Newman, P., Kenworthy, J., & Vintila, P. (1995). Can we overcome automobile dependence: Physical planning in an age of urban cynicism. *Cities*, 12(1), 53-65.
- Nova Scotia Environment. (2009). *Toward a Greener Future: Nova Scotia's Climate Change Action Plan*. Retrieved from: <http://climatechange.gov.ns.ca/doc/ccap.pdf>
- Pearce, F. (2006, September 1). Introduction: Climate Change. *NewScientist*. Retrieved from: <http://www.newscientist.com/article/dn9903-instant-expert-climate-change.html>
- Seguin, J. & Berry, P. Health Canada (2008). *Human health in a changing climate: A Canadian assessment of vulnerabilities and adaptive capacity* (HC Pub.: 4111). Ottawa, Ontario: Publications Health Canada
- Schiermeier, Q. (2011). Increased flood risk linked to global warming. *Nature* 470, 316. Retrieved from <http://dosen.narotama.ac.id/wp-content/uploads/2012/03/Increased-flood-risk-linked-to-global-warming.pdf>

- Singh, K., Walters, B., & Ollerhead, J. (2007). Climate change, sea-level rise and the case for salt marsh restoration in the Bay of Fundy. *Environmental journal*, 35(2), 71-84.
- Tuttin, M. (2012, September 10). Dikes burst in truro as rain swamps. *The Canadian press*. Retrieved from: <http://atlantic.ctvnews.ca/dikes-burst-in-truro-as-rain-swamps-n-s-rivers-1.949820>.
- Toope, S., Stevenson, M., Turpin, D., Cozzetto, D., Barnsley, R., Cahoon, A. (2013) Climate Change statement of action for Canada. Retrieved from: <http://www.climatechangeaction.ca/pdfs/ClimateChangeActionStatement-English.pdf>
- Tupper, B. (2009). *Proposed Burnaby mountain gondola project: Initial feasibility study*. (UniverCity on Burnaby Mountain). Retrieved from: [http://university.ca/wp-content/themes/Univercity/media/GONDOLA\\_FEASIBILITY\\_STUDY\\_FINAL\\_EMAILABLEhttp://university.ca/](http://university.ca/wp-content/themes/Univercity/media/GONDOLA_FEASIBILITY_STUDY_FINAL_EMAILABLEhttp://university.ca/)
- Vasseur, L., & Catto, N. (2007). *From impacts to adaptation: Canada in a changing climate 2007*. Retrieved from: <http://www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/assessments/132>
- Webster, T.L., and Forbes, D.L., (2005). Using airborne lidar to map exposure of coastal area in maritime canada to flooding from storm-surge events: A review of recent experience. Canadian Coastal Conference. p. 1-11.
- Webster, D., Kongwongthai, M., & Crowell, N. (2007). An evaluation of flood risk to infrastructure across the chignecto isthmus. Atlantic Climate Adaptation Solution Association. *Applied geomatics research group*, 1-44.

## **Acknowledgements**

We would like to thank several individuals for contributing and assisting us towards our research survey about the AC. We give special thanks to Rochelle Owens and Rebecca Mcneil who provided assistance towards our scope of our research and supplied all contacts that were needed. We would also like to thank Angus Gibson, Kevin Morin and Craig Reesor, current students and alumni of the AC who posted our survey to numerous Facebook groups that generated a greater amount of participates.

**Appendix A:**  
**Ethics Form**

ENVIRONMENTAL SCIENCE PROGRAM  
FACULTY OF SCIENCE  
DALHOUSIE UNIVERSITY  
(version 2010)

APPLICATION FOR ETHICS REVIEW OF RESEARCH INVOLVING HUMAN  
PARTICIPANTS  
UNDERGRADUATE THESES AND IN NON-THESIS COURSE PROJECTS

**GENERAL INFORMATION**

1. Title of Project: Climate Change Survey of AC Campus
2. Faculty Supervisor(s) Rebecca McNeil Department Environment, Sustainability, Society e-mail:  
Rebecca.mcneil@dal.ca ph:
3. Student Investigator(s) Samuel Reeves, Connor Wallace, Meagen Bernier, Lauren Stuppiello,  
Krista Holman Department Environment, Sustainability, Society e-mail:  
[samuel.reeves@dal.ca](mailto:samuel.reeves@dal.ca) [mg332541@dal.ca](mailto:mg332541@dal.ca) [cn982864@dal.ca](mailto:cn982864@dal.ca) [chasingblu@gmail.com](mailto:chasingblu@gmail.com)  
[lauren.stuppiello@hotmail.com](mailto:lauren.stuppiello@hotmail.com) ph:
4. Level of Project: Non-thesis Course Project [  ] Undergraduate [  ] Graduate [  ]  
Specify course and number: 3502 ENV5/SUST Campus as a Living Lab
5. a. Indicate the anticipated commencement date for this project: **January. 10, 2013**  
b. Indicate the anticipated completion date for this project: **April. 12, 2013**

**SUMMARY OF PROPOSED RESEARCH**

**1. Purpose and Rationale for Proposed Research:** *Briefly describe the purpose (objectives) and rationale of the proposed project and include any hypothesis(es)/research questions to be investigated*  
-The purpose of this project is to conduct research concerning climate change and potential consequences that can occur at the AC campus at Bible Hill, Nova Scotia. Climate Change has been scientifically proven to be a global problem that can increase the frequency and severity of weather events among other things. These weather events are problematic for civilizations like the AC campus in Truro that are established along coastlines and flood plains. Our research question is: **What current practices and infrastructure is the AC campus doing to adapt to the various factors implicated with climate change? What recommendations can be made to improve adaptability and resiliency?**

**2. Methodology/Procedures**

a. *Which of the following procedures will be used? Provide a copy of all materials to be used in this study.*

[  ] Survey(s) or questionnaire(s) (mail-back)

- Survey(s) or questionnaire(s) (in person)
- Computer-administered task(s) or survey(s)]
- Interview(s) (in person)
- Interview(s) (by telephone)
- Focus group(s)
- Audio taping
- Videotaping
- Analysis of secondary data (no involvement with human participants)
- Unobtrusive observations
- Other, specify \_\_\_\_\_

**b. Provide a brief, sequential description of the procedures to be used in this study. For studies involving multiple procedures or sessions, the use of a flow chart is recommended.**

*Interview with Rochelle and document review of past Climate Survey → Interview with Tim Webster → Send Online Questionnaire to Opinio to be distributed to AC college employees, faculty and staff → Visit Agricultural Campus → Observational Mapping Assessment at AC campus → Interview with Harold Cook (AC Dean) → Interview with Facilities Representative*

**3. Participants Involved in the Study: Indicate who will be recruited as potential participants in this study.**

Dalhousie Participants:

- Undergraduate students
- Graduate students
- Faculty and/or staff

Non-Dal Participants:

- Adolescents
- Adults
- Seniors
- Vulnerable population\* (e.g. Nursing Homes, Correctional Facilities)

\* Applicant will be required to submit ethics application to appropriate Dalhousie Research Ethics Board

**b. Describe the potential participants in this study including group affiliation, gender, age range and any other special characteristics. If only one gender is to be recruited, provide a justification for this.**

- The potential participants in this study would be in the age range of 18-65, affiliated with Dalhousie University or Nova Scotia Community College.

**c. How many participants are expected to be involved in this study?** 50

**4. Recruitment Process and Study Location**

**a. From what source(s) will the potential participants be recruited?**

- Dalhousie University undergraduate and/or graduate classes

- Other Dalhousie sources (specify) \_\_\_\_\_
- Local School Boards\*
- Halifax Community
- Agencies
- Businesses, Industries, Professions
- Health care settings\*
- Other, specify (e.g. mailing lists) \_\_\_\_\_ \*

*Applicant may also require ethics approval from relevant authority, e.g. school board, hospital administration, etc.*

**b. Identify who will recruit potential participants and describe the recruitment process.** Provide a copy of any materials to be used for recruitment (e.g. posters(s), flyers, advertisement(s), letter(s), telephone and other verbal scripts in the appendices section.

-Our group will conduct the recruitment of potential participants by sending out an online survey to the students of the AC campus. We will also phone the individuals that we plan on interviewing.

**5. Compensation of Participants: Will participants receive compensation (financial or otherwise) for participation?**

Yes  No  If Yes, provide details:

**6. Feedback to Participants**

**Briefly describe the plans for provision of feedback and attach a copy of the feedback letter to be used.** Wherever possible, written feedback should be provided to study participants including a statement of appreciation, details about the purpose and predictions of the study, contact information for the researchers, and the ethics review and clearance statement. Note: When available, a copy of an executive summary of the study outcomes also should be provided to participants.

-After completion of the interviews we plan on sending out emails that will include a statement of appreciation, details about the purpose of the study, contact information, the ethics review and clearance statement. After completion of the survey we will provide the same via email to the participants.

**POTENTIAL BENEFITS FROM THE STUDY**

**1. Identify and describe any known or anticipated direct benefits to the participants from their involvement in the project.**

-After completion of participation, participants will have a better understand of their knowledge of climate change and flood risk.

**2. Identify and describe any known or anticipated benefits to society from this study.**

-Society can benefit from this study because the final report will provide evidence of the current state of the AC campus's flood strategies and also will provide evidence to support future plans to prevent flooding and other issues relevant to climate change.



## **POTENTIAL RISKS TO PARTICIPANTS FROM THE STUDY**

- 1. For each procedure used in this study, provide a description of any known or anticipated risks/stressors to the participants. Consider physiological, psychological, emotional, social, economic, legal, etc. risks/stressors and burdens.**

No known or anticipated risks Explain why no risks are anticipated:  
We do not think there are any risks/stressors for participants because we are only collecting their perspective towards climate change and flood risk relevant to the AC campus.

Minimal risk \* Description of risks:

Greater than minimal risk\*\* Description of risks:

*\* This is the level of risk associated with everyday life. \*\* This level of risk will require ethics review by appropriate Dalhousie Research Ethics Board*

- 2. Describe the procedures or safeguards in place to protect the physical and psychological health of the participants in light of the risks/stresses identified in Question 1.**

-The safeguard we put in place to protect the physical and psychological health of the participants is all questions and producers are voluntarily answered, no questions are required to be answered. Due to the producers being voluntarily completed it is up to the participant to answer the questions he/she feels comfortable to answer.

## **INFORMED CONSENT PROCESS**

Refer to: <http://pre.ethics.gc.ca/english/policystatement/section2.cfm>;

- 1. What process will be used to inform the potential participants about the study details and to obtain their consent for participation?**

Information letter with written consent form; provide a copy

Information letter with verbal consent; provide a copy

Information/cover letter; provide a copy

Other (specify) \_\_\_\_\_

- 2. If written consent cannot be obtained from the potential participants, provide a justification.**

## **ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF DATA**

- 1. Explain the procedures to be used to ensure anonymity of participants and confidentiality of data both during the research and in the release of the findings.**

- We will ensure anonymity of participants and confidentiality of data both during the research and in the release of the findings by storing the information on a password locked computer. The online survey will be conducted through the Dalhousie's secure survey program Opinio. Participants will not be asked for any identifying information.

- 3. Describe the procedures for securing written records, questionnaires, video/audio tapes and electronic data, etc.**

- We will secure all data collected by keeping it on a password locked computer.

- 4. Indicate how long the data will be securely stored as well as the storage location over the duration of the study. Also indicate the method to be used for final disposition of the data.**

Paper Records

- Confidential shredding after \_\_\_\_\_
- Data will be retained until completion of specific course.
- Audio/Video Recordings
- Erasing of audio/video tapes after \_\_\_\_\_
- Data will be retained until completion of specific course.
- Electronic
- Erasing of electronic data after \_\_\_\_\_
- Data will be retained until completion of specific course.
- Other \_\_\_\_\_

(Provide details on type, retention period and final disposition, if applicable)

**Specify storage location:** Group members computer, Opinio survey program.

**Appendices: ATTACHMENTS** Please **check** below all appendices that are attached as part of your application package:

- Recruitment Materials:** A copy of any poster(s), flyer(s), advertisement(s), letter(s), telephone or other verbal script(s) used to recruit/gain access to participants.
- Information Letter and Consent Form(s).** Used in studies involving interaction with participants (e.g. interviews, testing, etc.)
- Information/Cover Letter(s).** Used in studies involving surveys or questionnaires.
- Materials:** A copy of all survey(s), questionnaire(s), interview questions, interview themes/sample questions for open-ended interviews, focus group questions, or any standardized tests used to collect data.

**SIGNATURES OF RESEARCHERS** \_\_\_\_\_

\_\_\_\_\_  
Signature of Student Investigator(s) Date

\_\_\_\_\_  
Signature of Student Investigator(s) Date

\_\_\_\_\_  
Signature of Student Investigator(s) Date

\_\_\_\_\_  
Signature of Student Investigator(s) Date

\_\_\_\_\_  
Signature of Student Investigator(s) Date

\_\_\_\_\_  
Signature of Student Investigator(s) Date \_\_\_\_\_

\_\_\_\_\_  
Signature of Student Investigator(s) Date

**FOR ENVIRONMENTAL SCIENCE PROGRAM USE ONLY:** Ethics proposal been checked for eligibility according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans

---

Date

Signature

---

Date

Signature

**Appendix B:**  
**Funding Form**



## **ENVS/SUST 3502 Funding Proposal Form**

DSU Sustainability Office

[www.dsuso.ca](http://www.dsuso.ca)

### **Project Title**

- Climate Change Survey of AC Campus

### **Goal**

- What is the desired outcome of your research project?  
  
-To conclude climate change risks, specifically flood risks for the AC campus.

### **Description**

- In one paragraph, please describe the research project and the elements of the project requiring funding.  
  
-For our research project we are traveling to the AC campus in Truro, Nova Scotia to conduct several interviews and to observe the campus. We are acquiring funding for the trip to and from the AC campus. Group members do own cars but we are looking for funding to go towards to the gas and mileage.

### **Budget**

- Amount requested (Maximum \$100 of or up to \$50 for food and incentives)
- Provide a detailed budget outlining how the funds will be employed (list each item that you require and its price).
  - Gas and car maintenance  $\$0.35 \times 200\text{km} = \$70$
  - \$6 per person for meal support (5 people) = \$30
  - Amount requesting \$100

### **Contact Info**

- Please provide a contact for your group including name and email address.
- Please provide a recipient (full name) of the funding cheque, if granted.
  - Samuel Reeves email: [samuel.reeves@dal.ca](mailto:samuel.reeves@dal.ca)
  - Samuel Anthony Reeves

Submit proposal to the DSU Sustainability Office via Rob McNeish (Policy & Communications Officer) at [dsu.sustain@dal.ca](mailto:dsu.sustain@dal.ca) with the subject line “ENVS/SUS 3502 Funding Proposal Form”

## **Appendix C:**

<p>Dalhousie University SUST 3502 Campus as a Living Lab Climate Survey Group Project</p>
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### **Informed consent form for the Climate Survey Group of SUST 3502, Campus as a Living Lab**

Researchers are Samuel Reeves, Connor Wallace, Krista Holman, Lauren Stuppiello and Meagan Bernier

This research is in collaboration with the Dalhousie Office of Sustainability and has been funded by the Dalhousie Student Union Sustainability Office.

#### **This Informed Consent Form has two parts:**

- **Information Sheet (to share information about the study with you)**
- **Certificate of Consent (for signatures if you choose to participate)**

**You will be given a copy of the full Informed Consent Form**

#### **Part I: Information Sheet**

##### **Introduction**

We are a group of students in SUST 3502 Campus as a Living Lab (Winter 2013), conducting a series of interviews and survey's on climate change and the risks associated for the Agricultural College, Truro in conjunction with the Dalhousie Office of Sustainability. This interview will be conducted in confidence; with your permission we will use the information to write a final report on our findings. If you have any concerns or questions regarding this form please ask and we will be happy to explain or clarify.

##### **Purpose of the research**

Information gained through this interview will be used to write a final report and expand the previous adaptation study conducted on the Halifax campuses in 2010. We will be using this information to draft a final report and make recommendations on how the Agricultural Campus might adapt and/or mitigate risks associated with climate change.

##### **Type of Research Intervention**

This research involves an interview that will take about one half hour..

##### **Participant Selection**

You have been chosen to take part in this series of interviews because we feel you have both experience and local knowledge of the campus that will contribute to our understanding of the perception of climate change.

##### **Voluntary Participation**

You may choose to participate or not. Participation is voluntary. At any time you may change your mind. You may request that the information provided not be used in the research study at any time in the process, until the final draft of the report is finished and handed in. The choice you make will have no repercussions.

##### **Procedures**

A. We will ask questions regarding climate and the campus and use questions we have developed at an earlier time as a guide. You may elaborate on any answers and may ask us questions at any time. We will record the

interview to retain the information. Once the final report has been written, the recorded interview will be deleted.

**Risks**

We feel that because the information is not so much personal or sensitive material that there is little risk associated with this series of interviews.

**Benefits**

There will be no direct benefit to you but your participation is likely to aid in developing strategies to adapt to climate change in the future.

**Confidentiality**

This research will be conducted in confidence. We will only use your personal information, if you give your permission. You may withdraw any information at any time, however, we will be writing a report based on the data you provide.

**Who to Contact**

Should you have questions, concerns, clarifications please feel free to contact  
Krista Holman by email Holman.k@dal.ca

**This proposal has been reviewed and approved by \_\_\_\_\_, which is a committee whose task it is to make sure that research participants are protected from harm.**

**Part II: Certificate of Consent**

I have been invited to participate in the Climate Survey research on the Dalhousie Agricultural College. The information I provide may be used to produce a final report. Until that final report is produced I have the ability to withdraw from participating.

**I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study**

**Print Name of Participant** \_\_\_\_\_

**Signature of Participant** \_\_\_\_\_

**Date** \_\_\_\_\_  
**Day/month/year**

*If illiterate <sup>1</sup>*

**I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.**

---

<sup>1</sup> A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb print as well.

**Print name of witness** \_\_\_\_\_

**Signature of witness** \_\_\_\_\_

**Date** \_\_\_\_\_  
Day/month/year

**Statement by the researcher/person taking consent**

**I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:**

- 1.
- 2.
- 3.

**I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.**

**A copy of this ICF has been provided to the participant.**

**Print Name of Researcher/person taking the consent** \_\_\_\_\_

**Signature of Researcher /person taking the consent** \_\_\_\_\_

**Date** \_\_\_\_\_  
Day/month/year

**Appendix D:**  
**Online survey**

**Climate Change Survey (AC)**

*All participants who complete this short survey will have the opportunity to be entered into a draw for a \$50 Sobey's gift card! Please click "Finish" at the end of the survey for your chance to enter.*

*Students in Campus as a Living Lab course will be compiling a report based on survey responses. This information will be used by the Office of Sustainability in the development of campus climate change plan.*

*Survey will take approximately 10-15 minutes. All information will be kept anonymous. This survey will be open from Friday March 15 to Wednesday March.27<sup>th</sup>*

1. In which of these groups do you currently belong?

- Faculty
- Staff
- Student
- Alumni
- Not affiliated with the Agricultural Campus

2. How long have you been working/studying on the Agricultural Campus?

- Less than a year
- 1-2 years
- 3-4 years
- 5-6 years
- 7+ years
- Not applicable (N/A)

3. What department do you currently work/study in?

- Human Resources
- Finance
- Dean's Office
- ITS
- Registrar
- Ancillary Services
- Business and Social Services
- Engineering
- Environmental Science
- Plant and Animal Science
- Continuing Education
- Not Applicable (N/A)
- Other



Climate change is a “a change of climate which is attributed directly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (IPCC, 2007).

The following questions focus on reducing greenhouse gases and adapting to changes in climate.

4. To reduce greenhouse gases and adapt to climate change, Dalhousie is focusing on seven main strategies. How do you feel about the importance of these?

-Please place in order of importance: 1 being of highest importance and 7 being lowest of importance.

- Campus Energy Systems
- Green Buildings
- Renewable Energy Production
- Sustainable Transportation
- Knowledge & Behaviour
- Natural Environment
- Carbon Offsets and Sinks

5. What ideas do you have for reducing energy on campus?

6. Are you in favour of producing energy through the following renewables on campus? Please select all that apply.

- Solar thermal panels (heating)
- Solar photovoltaic panels (electricity)
- Solar Wall (heating)
- Geothermal
- Biomass (some wood is currently burned at the plant)
- Wind
- Other

7. Do you have other suggestions for reducing Greenhouse Gas (GHG) emissions?

8. In what ways, if any, have you been impacted by climate change?

The following questions refer to weather impacts on campus and in the town of Truro.

9. Were you on campus during heavy storms?

- Yes
- No

10. What types of storms were they?

11. What effects did the storms have on you?

12. What effects did the storms have on the campus?

13. During heavy rains, have you noticed water pooling in areas on campus?

-Yes

-No

-If yes, where?

14. In your time on campus, have you experienced disruptions in services due to the weather? (Classes cancelled, health services stopped, etc.)

-Yes

-No

-If yes, what were they?

15. In your time on campus, have you noticed any vulnerabilities in the buildings? (ie. Leaks, cracks)

-Yes

-No

16. In what buildings did you see any vulnerabilities and what were they?

17. If an extreme weather event were to occur today, which of the following are most likely to be damaged on campus by the event?

Please rank the following: 1=most vulnerable to damage, 8=least vulnerable to damage

-Buildings

-Roads and Associated Structures

-Storm-Water Systems

-Sewer Systems

-Hardscapes (ie. Paved Areas)

-Transmission Lines

-Water Resources

-Other

18. If an extreme weather event occurred today, which of the following would be most vulnerable in terms of damage?

Please rank the following: 1=most vulnerable to damage, 8=least vulnerable to damage

-Trees

-Green Space

-Gardens

-Agricultural Fields

-Wetlands

-Other

19. If an extreme weather event occurred today, which services would be most vulnerable to disruption?

Please rank the following: 1=most vulnerable to damage, 8=least vulnerable

- Class
- Food
- Transportation
- Housing
- Administration
- Health Services
- Other

20. Do you have any suggestions for climate adaptive improvements for the campus?

Please rate in order of importance: 1=not important, 5=very important

- Adding vegetation to reduce erosion
- More permeable pavement
- Designing buildings with larger storm water pipes
- Designing new buildings with more resilient surface, roofs, windows
- Emergency preparedness planning
- Climate adaption education
- Space planning
- Building retrofits
- Storm water infrastructure improvements
- Other

21. Final Comments

**Appendix E:**  
**Primary Recipients of Online Survey Link**

These people received the original email with the link to the online survey. They then passed along to anyone they could who were either affiliated with the campus, or live in surrounding areas.

**1. Rochelle Owen who sent the email to:**

AC Athletics Director: Pushed survey out to students

Communications Staff

Facilities Staff

Sustainability Committee

People of the town of Truro (1 contact)

People of the village of Bible Hill (1 contact)

**2. Students/Alumni who posted the link on multiple Facebook groups:**

Angus Gibson

Craig Reesor

Kevin Morin