Water Conservation on Dalhousie's Studley Campus:

An Audit of Dripping Faucets and Assessment of Attitudes Towards Water Waste

ENVS 3502 Final Report
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Executive Summary

This research project is made up of two components; the water audit component in which the volume of water wasted from dripping taps was assessed and the survey component in which the level of awareness and concern of the Dalhousie community towards water waste was assessed.

In water audit component, the amount of water lost from each leaking public faucet was measured using a drip gauge and recorded. The location, aerator type, reason for potential dripping and faucet style for all of the faucets found in public kitchenettes and washrooms was also recorded. Analysis of these data revealed that a total of 81.5 L ± 45.5 L of water per day is lost through dripping faucets in the three buildings of interest with the majority of the water waste occurring in the Student Union Building. A positive correlation between aerator presence and lift-style handles a lower rate of dripping was identified. These results indicate the need to renovate the Student Union Building with new faucets to decrease the amount of water being wasted on campus. In selecting new faucets, motion sensor-operated and lift-style handles should be considered.

In the survey component, 100 members of the Dalhousie community participated in an intercept survey with questions designed to assess their level of awareness and concern towards dripping faucets on campus. Analysis of the survey results revealed a very low level of awareness of dripping taps in the Dalhousie community. Among respondents with a high level of awareness, the majority also had a high level of concern towards dripping taps, but not high enough to motivate them to report the dripping faucets with mechanical problems. Non-student respondents (ie. building staff) and respondents associated with the Science faculty consistently showed a higher level of awareness and concern towards dripping taps. Over half of the Dalhousie community as represented in the survey respondents did not know whom to contact in order to report a dripping faucet. These results reveal the need for a campaign in the form of signs near public faucets to inform community members of the issue of water waste and whom they should contact to report a broken faucet.

Finally, this research project illuminates the need for further research into water waste on Dalhousie's Studley campus. Other parts of the water system such as toilets, urinals, water fountains, private kitchen faucet and connecting pipes need to be assessed for leaks. In addition, the influence of signs and awareness campaigns on Dalhousie community member's awareness and concern towards water conservation issues needs to be researched in order to gain a better understanding of how sustainable actions can be encouraged. A water audit of greater scope together with research into the effectiveness of awareness campaigns will empower the Dalhousie community to reduce the amount of water wasted on campus.

Introduction

The demand on freshwater resources to support growing populations is becoming increasingly severe, pushing issues of freshwater scarcity and conservation to the forefront of international and federal decision-making processes. As a requirement for human life, agriculture, industry and energy generation among others, freshwater resources need to be managed efficiently as the world's population increases and the climate changes. The need to address freshwater management issues is reflected in the Millennium Development Goals, of which many require improved management of freshwater in order to be achieved (GIWA, 2006).

Prior to the twentieth century, human demand for water was relatively small compared to its availability in most parts of the world, but this has changed with increases in population, industry and climate change (GIWA, 2006). According to the United Nation's Global International Waters Assessment (2006), freshwater scarcity now affects more than a billion people and by 2020, it is predicted that two-thirds of the world will be affected. By 2025, 62.5% of the world's population will be living in countries experiencing water stress (using more than 20% of their available resources) largely due to climate change (Arnell, 1999). Currently, freshwater is being managed in an unsustainable way in the majority of regions that participated in the GIWA (2006) assessment.

The issue of freshwater scarcity has not always been of significant concern in Canada, which ranks in the top five countries for per-capita water supplies (Gleick, 2000), but this too is changing. Areas such as the western prairie provinces which lie in the Rocky Mountain rain shadow are experiencing significantly reduced flows in major rivers and this water shortage will only get worse with climate change and increased development (Schindler & Donahue, 2006). Canada is also one of the world's biggest exporters of virtual water, or products that are produced using water (Mekonnen & Hoekstra, 2011). While virtual water currently makes up 15% of the world's water, this is expected to increase as freshwater becomes increasingly scarce on a global scale. Thus, Canada is not immune to the issue of freshwater scarcity and effective management of freshwater resources in Canada will increasingly become a priority in the coming years.

In Canada, about 65% of water used in homes is used in the washroom (Project Blue, 2008). According to the United States Environmental Protection Agency (2013), 15% of household water use in the U.S. is for washroom faucets specifically. In thinking about conserving water on a household or building basis, improving the management of water use in washrooms can have a significant impact. One way to improve the efficiency of faucets is to install aerators, which can save up to 40% of water used for hand washing in washrooms (BC Hydro, 2012). Over the course of a year, a 1.5 gmp aerator can have an estimated savings of 11,000 liters of water (Sarac et al., 2002). Another way to conserve water in a washroom setting is to fix dripping taps which can waste as much as 50 litres of water a day (Alberta, 2013). These efforts to manage water more sustainably in homes or businesses however are dependent on a level of public awareness and concern for the conservation of freshwater resources.

Two of the factors that motivate people to make environmentally conscious choices are concern and awareness of the issues. Though research into factors that

influence people to change their behaviors is complex, a correlation between environmental attitude and behavior has been identified (Wall, 1995). If people care about the issue, they are more likely to change their behaviors. Specifically, a study of households in Gold Coast city in Australia found that people who had positive environmental and water conservation attitudes consumed significantly less water, especially with behaviorally-influenced uses such as showers and washroom taps (Willis et al., 2011). Interestingly, in a meta-study of environmental attitudes and behaviors in twenty-one countries, Canada was found to have the fifth highest correlation between environmental concern and action (Wright, 1998). Though the correlation was still relatively weak, the study showed that people with a higher level of environmental concern are more likely to choose the more sustainable option, especially when it does not cost more. Not surprisingly, a lack of awareness was found to be the second biggest barrier to making environmentally conscious decisions in a university setting in a survey done in the UK (Dahle & Neumayer, 2001). An understanding of the importance of concern and awareness together with an acknowledgement of the issue of freshwater scarcity is the basis for this research project at Dalhousie University.

Due to their significant size, universities can be large consumers of freshwater resources (Creighton, 1998) and Dalhousie is no exception. With over thirty buildings on the Studley campus, each with their own washroom facilities, the potential amount of water wasted through leaky faucets is significant. Initiatives made to conserve water in washrooms at Dalhousie also can serve to teach and demonstrate good environmental principles to students (Creighton, 1998). Though Dalhousie is gradually retrofitting outdated infrastructure and requiring all new buildings to meet LEED certification (Dalhousie, 2013), many existing buildings have older faucets that may be leaking and wasting water. Some of the older faucets may no longer fully turn off and others may be inclined to leak if the handle is not turned firmly. This study seeks to quantify the amount of water wasted through leaky faucets in three buildings on the Studley campus and to identify the level of concern and awareness among the population of Dalhousie, which is influencing their behaviors towards leaking taps.

The purpose of this research project is to gain an understanding of the amount of water wasted from dripping public faucets at Dalhousie University and of the attitude of the Dalhousie community towards water waste. Of particular interest is the total volume of water wasted through dripping taps in each building and any correlation between the amount of water wasted and the gender of the washroom, presence of aerators, reason for leaking or type of faucet. With regards to attitudes towards water waste, this project assesses the level of awareness and concern towards dripping faucets. These goals are accomplished through a two part research project focused on three buildings on Dalhousie's Studley campus: the Rebecca Cohen Arts Centre, the Goldberg Computer Science Building and the Student Union Building.

The first part of the research project is an assessment of all the public faucets in the three buildings to determine how much water is being wasted through dripping. The second part of the research project is an assessment of the awareness and concern level of the Dalhousie community towards water waste through an intercept survey. This report includes the methods used, the results of the research, a discussion of their significance and implications and recommendations for actions and further research to be undertaken.

Methods

Part A: Determining the Volume of Water Wasted

The first goal of our research was to collect data pertaining to the water wasted from leaking faucets in public sinks in three buildings on campus. We obtained maps for the three buildings we studied; the Goldberg Computer Science building, the Rebecca Cohen Arts Centre, and the Dalhousie Student Union Building. We went to each building on March 14, 2013 and visited every floor. We looked for signs indicating a public washroom or kitchenette; making note of the floor and gender of the washrooms. These washrooms are open to the public as long as the building is open, so we did not face any limitations in this aspect.

We performed our data collection in the early afternoon during class hours in order to get an accurate picture of the dripping taps when the washrooms and kitchenettes are in use and to avoid the highest traffic times such as the lunch hour and between classes. As the research group was comprised entirely of females, we found that this time range allowed for entering male washrooms with minimal inconvenience. At each sink we filled out a table that we prepared for the test (Appendix A), recording the location of the tap, whether or not it was leaking, the handle type, whether or not an aerator was present and the aerator number if present. If a faucet was leaking, we first measured the volume water lost with a drip gauge with liters per day inscribed on the side. To do this, we held the gauge under a leaking tap for five seconds and recorded the water level in the gauge as indicated in liters per day. We then attempted to turn off the dripping faucet and recorded whether or not it was possible to stop the dripping.

Once all of the information was collected, we entered it into an excel spreadsheet to organize it. We calculated the total volume of water in each building as well as in the three buildings cumulatively. We also calculated the volume of water lost depending on the gender of washroom, handle type, reason for dripping and aerator presence. We then displayed these results in pie and column charts.

Once we determined how much water is wasted we calculated the cost of this water waste. According to Rochelle Owen, the Director of Dalhousie's Office of Sustainability, the cost of water at Dalhousie is $1.56 per meter cubed, or 1000 liters (Nova Scotia Utility, 2012). Using this quoted cost and our calculated total volumes of water wasted, we found the cost of the water wasted per day and per year in the three buildings on Dalhousie's Studley campus.

Limitations for this part of the research project include the influence on faucet users on the amount of water being wasted through dripping. When we conducting our water measurements, members of the community would occasionally need to use the faucets changing their status from dripping to not dripping or vice versa. Delimitations include focusing on public faucets in the three buildings on the Studley campus for the purpose of keeping the research to a manageable size.

Part B: Determining the Awareness and Concern Level

The second goal of our research was to collect qualitative data pertaining to the awareness and concern level of the Dalhousie community regarding dripping faucets. In order to collect this data, we conducted intercept surveys (Appendix B) in the three buildings of interest. We began the data collection process by consulting maps of the buildings to determine our areas of interest, notably washrooms and public kitchenettes with a high volume of users.

To begin, a team of two researchers was posted outside washrooms during peak hours, between 12pm and 2pm. During this interval of time, a larger proportion of the Dalhousie community was on campus than earlier in the morning or later in the afternoon due to the nature of class schedules. Also, staff and students were more likely to be available during this time because it is during the lunch hour. Researchers focused their time outside washrooms that had a high volume of users, located on the main floors of buildings. The research teams asked members of the Dalhousie community exiting the washrooms if they were willing to complete a survey. Every person exiting the washroom was asked to complete a survey, until the required sample size was met. Participants were offered a chocolate as an incentive to complete the short survey.

This mechanism allowed for heterogeneity of the population while meeting the attribute requirements of interaction with Dalhousie buildings and water features on campus. The total sample size for all three buildings was 100 participants, or approximately 33 participants per building. Due to time considerations, this sample size was a delimitation imposed upon our project. Limitations included the short time frame accorded to our research, as well as members of the community declining to complete a survey for various reasons. Researchers spent an equal amount of time in front of men's washrooms and women's washrooms to ensure an equal opportunity for responses by men and women. The methods were repeated on three different occasions in the three different buildings to assure reliability.

The survey distributed to members of the community once they had agreed to participate contained six questions and was printed onto one sheet of paper. Participants were asked survey questions by the researcher in order to facilitate completion. Research has shown that face-to-face contact between researcher and participant provides higher response rates (Palys & Atchison, 2008). Surveys conducted face-to-face also allow the clarification of any ambiguities that might arise. Other benefits to the survey method include providing respondent anonymity, being able to collect a lot of data quickly, having a low cost in comparison to other techniques and being easy for data coding and compilation (Wright, 2013, p. 25).

The survey was created to collect information in the three areas of interest for this research project. The first component of the surveys was participant demographic information including sex and university faculty. These questions were included in the survey to determine if the factors of sex and area of study influence the awareness and concern level for dripping taps. The second component was designed to assess the awareness level of dripping taps, particularly identified through the question "When using this building's facilities, such as washrooms or public kitchens, do you notice dripping taps?" For the purpose of this study, awareness is defined by how observant participants are of dripping taps. The third area of study is concern level which was

assessed by identifying the respondents' inclination to attempt to turn off dripping faucets and then report dripping taps that could not be turned off completely. The final question asked respondents to identify whom they should contact to report a broken faucet in order to assess the knowledge level of the Dalhousie community in this area. At the end of the survey, the researchers explained to the participant the potential amount of water wasted from a dripping tap per day as a form of catalytic validity.

The analysis method for this data was in the form of descriptive statistics presented through frequency tables which summarize the number and percentage of persons in each analytical category (Palys and Atchison, 2008). For each building the respondents' demographics of sex and area of study were illustrated using pie charts based on the frequency tables. The level of awareness was depicted in a column graph based on a frequency table of the responses to the third survey question in which respondents report how often they notice dripping taps.

The level of concern was depicted through the analyses of the final three survey questions. The results of the fourth survey question regarding respondents' inclination to attempt to turn off dripping taps are organized first into a frequency table and then displayed in a column graph, with a higher inclination to turn off taps indicating a higher level of concern. The results of the fifth survey question regarding respondents' inclination to report the taps with mechanical problems were also organized into a frequency chart and displayed in a column graph with a higher inclination to report the taps indicating a higher level of concern. Finally, the results from the sixth survey question in which respondents were asked to state to whom they would report taps with mechanical issues were grouped into categories (ie. administrative staff, building maintenance staff, don't know, etc.), organized in a frequency table and then displayed in a pie chart. A larger number of responses identifying the correct reporting method indicates a higher level of concern.

The survey questions relating to awareness and concern level (questions three through six) have been analyzed for each building as well as for each sex and university faculty to determine if there is a correlation between these factors and awareness and concern levels for dripping taps. The survey results from the three buildings have also been combined and displayed in column graphs to depict the overall awareness and concern level of the Dalhousie community to dripping taps. The findings are presented in the results section of this report.

Results

Part A: Determining the Volume of Water Wasted

Amount of Water Lost from Dripping Faucets and their Locations

In our water audit of the public faucets in the Goldberg Computer Science Building, the Rebecca Cohen Arts Centre and the Dalhousie Student Union Building, we found that dripping taps lost a total of 81.5 L ± 45.5 L of water per day. With the cost of water at Dalhousie being $1.56 per meter cubed, this amount of water loss accounts for 12.7 cents ± 7.1 cents a day or $46.41 ± $25.91 per year of Dalhousie's budget being wasted. The majority of the water loss, 63.5 L/day ± 27.5 L/day occurred in the Student Union Building, 9.0 L/day ± 9 L/day of water was lost in the Arts Centre and no water was lost in the Computer Science Building (Figure 1).

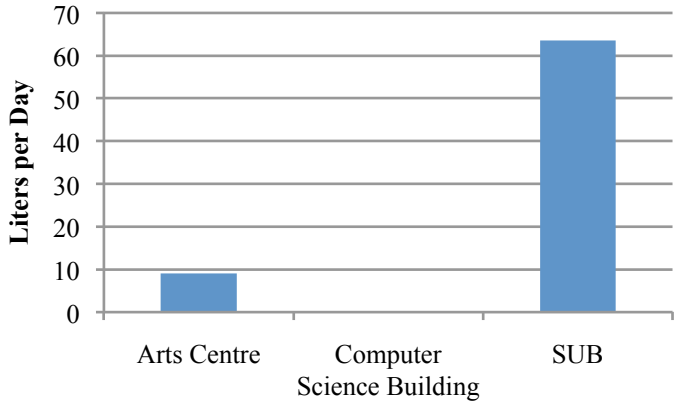

Figure 1. Amount of Water Lost from Dripping Taps in Each Building.

Out of the 74 faucets in the three buildings that were tested, eight or 11% were dripping (Figure 2).

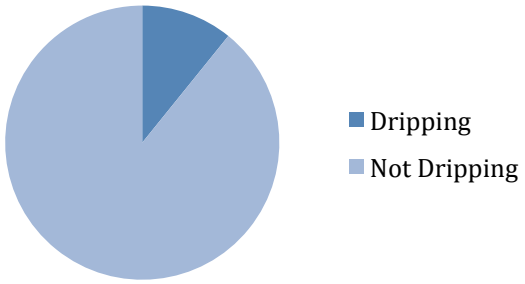

Figure 2. Proportion of Dripping Taps to Not Dripping Taps in the Three Buildings Studied.

Seven of these dripping faucets were located in the Student Union Building, one was located in the Arts Centre and none were found in the Computer Science Building. In the three buildings combined, 62.5% of the dripping faucets were located in women's washrooms, 37.5% were located in men's washrooms and none were found in public kitchenettes.

Aerators

Out of the 74 faucets tested in the three buildings, 66 or 89% had aerators present (Figure 3). All of these aerators were the same, number "A112.18.1m." The proportion of aerators present to aerators absent was lower among the dripping faucets (Figure 4). In this category, 75% of faucets had aerators present.

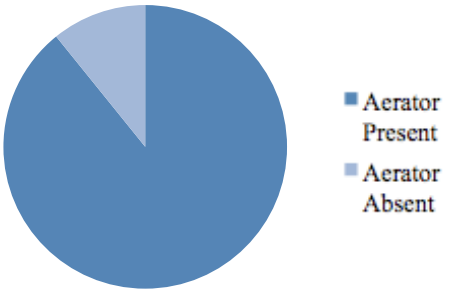

Figure 3. Proportion of Faucets Tested with Aerators Present.

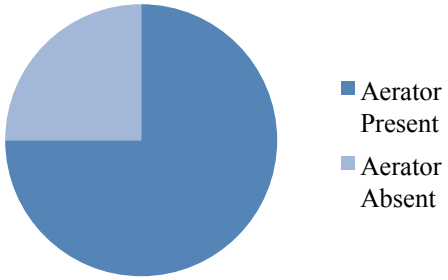

Figure 4. Proportion of Dripping Faucets with Aerators Present.

Reason for Dripping

Out of the eight dripping taps, four were found to have mechanical problems that prevented them from turning off completely. The remaining four have the behavioral issue of not having been turned off completely by the last user.

Handle Type of Dripping Faucets

Seven out of the eight dripping faucets, or 87.5%, had a twist-style handle (Figure 5). The remaining one dripping faucet had a lift-style handle.

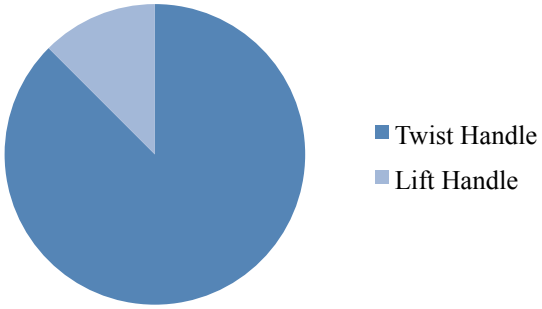

Figure 5. Proportion of Dripping Faucets with Twist vs. Lift Style Handles.

This high proportion of dripping faucets with twist-style handles is despite the fact that only 25 out of the 74 faucets tested had twist-style handles. This means that 28.0% of the faucets with twist-style handles tested were dripping and 2.1% of faucets with lift-style handles were dripping.

Part B: Determining the Awareness and Concern Level

Respondent Demographics

A total of 100 members of the Dalhousie community participated in the intercept survey; 34 in the Student Union Building, 34 in the Computer Science Building and 32 in the Arts Centre. When asked to identify their sex, 50% of responded as female, 48% were male and 2% preferred not to say.

Respondents were associated with variety of the university faculties including 28% from Arts, 20% from Science and 18% from Computer Science (Figure 6).

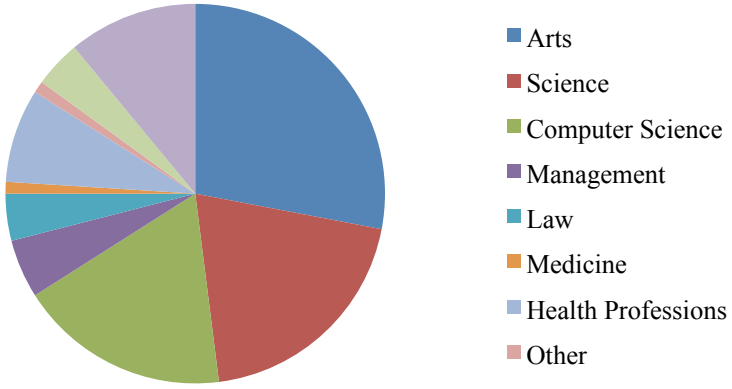

Figure 6. Faculties of Respondents.

Awareness Level

When asked if they notice dripping taps, just under half of the respondents answered that they do not notice them (Figure 7). More specifically, 26.5% of respondents notice dripping taps, 25.5% sometimes notice them, 44.9% notice them and 3.1% aren't sure.

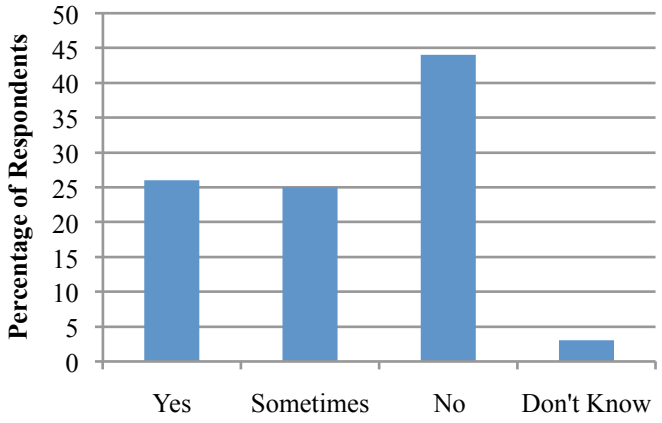

Figure 7. Response to Question, "Do you notice Dripping Taps?"

A high level of awareness, indicated by answering "yes" to noticing dripping taps, was found in Science students and non-students (non-students include administrative staff, facilities management staff and custodial staff). More specifically, 55.0% of

Science students, 54.6% of non-students, 33.3% of Health Professions students, and 25% of Law students noticed dripping faucets. Only 5.6% of Computer Science students noticed dripping taps and no students from the Management or Graduate Studies faculties noticed dripping taps.

A higher level of awareness was found in females as 36% of female respondents answered “yes” to noticing dripping taps compared to 15% of male respondents with the same response.

The highest level of awareness was found in respondents in the Arts Centre where 34.4% of respondents notice dripping taps, followed by 30.0% in Student Union Building and then by 14.7% of respondents in the Computer Science Building.

Concern Level

The concern level of respondents to dripping faucets was measured first by asking whether they would attempt to turn off a dripping faucet if they noticed one. In response to this question, 67.3% of respondents who notice dripping faucets answered that they always try to turn them off (Figure 8).

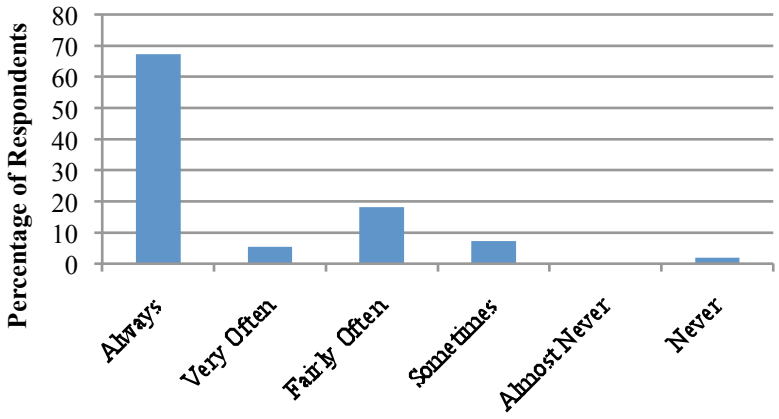

Figure 8. Response to Question, "Do you try to turn of dripping faucets?”

A high level of concern, indicated by answering “always” when asked if respondents try to turn off dripping faucets, was found in 73% of non-students followed by 55% of Science students. In the Computer Science and Health Professions faculties, 33% of respondents always try to turn off dripping taps. Between 20 and 25% of Arts, Management, Law and Graduate Studies respondents had a high level of concern for dripping taps.

The level of concern was almost equal between male and female respondents as 35.4% of male respondents and 36.0% of female respondents try to turn of dripping faucets.

The level of concern was highest in respondents in the Student Union Building with 84.2% of respondents who notice dripping faucets attempting to turn them off, followed by 66.7% in the Computer Science Building and 52.4% in the Arts Centre.

The level of concern was measured secondly by asking respondents whether they would report a dripping faucet if they noticed one. In response to this question, 54.5% of

respondents who notice dripping faucets answered that they would not report one, 27.3% answered that they would report one and 18.2% answered that they were not sure (Figure 9).

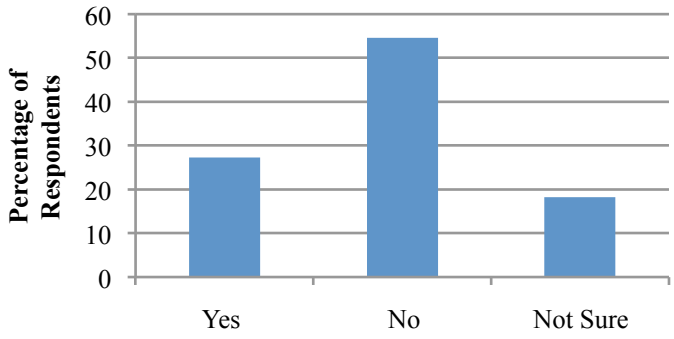

Figure 9. Response to Question, "Would you report a dripping faucet?"

This level of concern indicated by willingness to report a dripping faucet was by far the highest in nonstudents, 63.6% of whom would report one. This high level of concern was followed by 25.0% in Science students,11.1% in Health Professions students and 7.1% in Arts students. None of the respondents from the faculties of Computer Science, Management, Law or Graduate Studies would report a dripping faucet.

The level of concern was again almost equal in male and female respondents, as 14.6% of male respondents and 14.0% of female respondents would report a dripping tap.

Finally, the level of concern indicated by a willingness to report a dripping faucet was highest in respondents in the Arts Centre. Out of the respondents in the Arts Centre who notice dripping taps, 38.1% of them would report one, followed by 31.6% of those in the Student Union Building and then by 6.7% of those in the Computer Science Building.

Level of Knowledge of Reporting Dripping Faucets

When asked who they should contact to report a dripping faucet, 53.9% of respondents did not know the answer (Figure 10). The second most common answer was the appropriate response, as 19.6% of respondents knew they should contact Facilities Management. Other common answers included the buildings' front desk or a custodial staff.

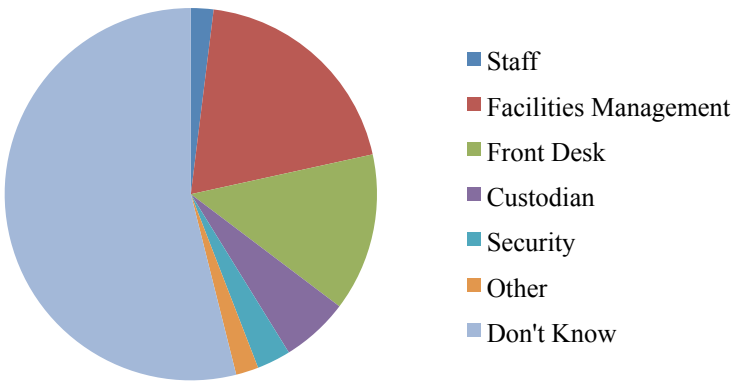

Figure 10. Response to Question, "Who would you contact to report a dripping faucet?"

Respondents associated with the Law faculty had the highest level of knowledge of who to contact to report a dripping faucet as 25.0% of Law faculty respondents answered that they should contact Facilities Management. This level of knowledge was followed by 20.0% in Science students and 18.2% in nonstudents. In both Computer Science and Health Professions faculties, 11.1% of respondents knew to contact Facilities Management and no respondents from the Management or Graduate Studies faculties knew whom to contact.

The knowledge the Facilities Management should be contacted in order to report a dripping faucet was slightly higher in male respondents at 20.8% than in female respondents at 18.0%.

The highest level of knowledge of who to contact to report a dripping faucet was found in respondents in the Student Union Building as 26.5% of respondents in the SUB knew to contact Facilities Management. This was followed by 15.6% of respondents in the Arts Centre and 14.7% of respondents in the Computer Science Building who knew to contact Facilities Management.

Discussion

Part A: Determining the Volume of Water Wasted

Our aim in this section of our research project was to determine the amount of water wasted through dripping faucets in the three buildings on Dalhousie's Studley campus and whether there were any correlations between gender of washroom, aerator presence, reason for dripping, faucet type and the volume of water lost. We found that the three buildings lost a combined 81.5 L ± 45.5 L of water on a daily basis from dripping faucets. While this amount of water waste certainly requires attention, it is significantly less than amount of water that could potentially be wasted by this number of dripping taps, as one dripping faucet can waste up to 50 liters of water a day (Alberta, 2013).

The Student Union Building was found to waste the most water, losing 63.5 L ± 27.5 L a day compared to the Arts Centre which lost 9.0 L ± 9.0 L a day and the Computer Science building which lost no water. These findings could be due in part to the age of each building. Both the Student Union Building and the Arts Centre were built in 1968, while the Computer Science building was built in 1999. Also, the Student Union Building has had the highest level of traffic over the years as students from all faculties use the building, leading to much strain on the infrastructure. Regardless, the findings of our research project indicate a need for renovations to the faucet infrastructure in the Student Union Building.

Another noteworthy finding is the gender of the washroom with the greatest number of leaking taps. The women's washrooms housed 63% of all leaking taps which may be the result of a higher frequency of use. It follows that women's washrooms should be assessed more frequently than men's washrooms for dripping taps in order to reduce the amount of water waste.

The data regarding the presence of aerators revealed that faucets without aerators have a higher rate of dripping than those with aerators present. In addition, aerators save a significant amount of water when the faucet is running (Sarac et al., 2002). For these two reasons, faucets at Dalhousie should be checked regularly to ensure the aerators are still in place.

The results also indicated that half of dripping taps had mechanical problems that prevented them from being turned off completely, while the other have had simply not be turned off all the way by the most recent user. Faucets should be assessed regularly and replaced if they are not functioning properly, but more importantly members of the Dalhousie community need to be informed of how they can report faucets with mechanical problems, as discussed in Part B of this section. In order to address faucets dripping for behavioral reasons, the installment of motion sensing faucets should be considered. If the faucets turned off automatically, the problem of water waste due to users failing to turn off taps completely would be eliminated.

It was also found that of the leaking taps, the majority (88%) were taps that had a twist-style handle as opposed to a lift-style handle. This indicates that if the buildings were to convert all taps to those that flip open and closed as opposed to twist, the university could potentially save thousands of liters of water every year.

Part B: Determining the Awareness and Concern Level

Higher levels of awareness and concern towards environmental issues motivate people to act sustainably (Wright, 1998). Therefore, the second goal of our research was to measure the awareness and concern level of the Dalhousie community for dripping taps. Through intercept surveys, we were able to determine the influence of sex and faculty upon awareness and concern levels for dripping taps. The most significant findings gathered through surveying relate to awareness and reporting.

Just under half of respondents answered that they do not notice dripping taps, indicating a very low level of awareness of dripping taps. This is significant, as a lack of environmental awareness and interest has been considered to prevent the 'greening' of campuses (Dahle and Neumayer, 2001). Since the majority of the dripping faucets were in the Student Union Building which is used by staff and students from all faculties, it is concerning that there is such a low level of awareness of dripping faucets when there is a high likelihood of an interaction with a dripping faucet for the average Dalhousie community member.

In regards to concern level, 67.3% of respondents who notice dripping taps reported that they always try to turn off a dripping tap. This indicates a high concern level for dripping taps amongst those people who have a high level of awareness of dripping taps. While the desire to turn off a tap if it were dripping was high, over half of respondents who notice dripping taps said they would not report a dripping tap. This low rate of willingness to report a dripping faucet is likely due to a lack of knowledge of whom to contact and how to best do so.

Our survey results showed that over half of respondents did not know whom to contact to report a faucet with mechanical problems and 26.5% of respondents had an incorrect idea of whom to contact. Only 19.6% of respondents knew to contact Facilities Management. These results indicate a need for the Dalhousie community to be informed of the appropriate people to contact when they encounter a faucet that is not functioning properly. One way to do this would be through signs in washrooms and near public sinks.

Of note, the survey results revealed that Science students and non-students consistently had higher levels of awareness and concern towards dripping taps. This is likely due to a higher level of education about water conservation issues and a higher level of familiarity with the buildings' facilities. Again this reveals a need for the Dalhousie community to be better informed and educated about the issue of water waste from dripping taps and the best course of action to take when they find a faucet with mechanical problems causing it to leak.

These results are consistent with previous research into the influence of environmental awareness and concern on behavior. While research into factors that influence people to change their behaviours is multifaceted, a link between environmental attitude and behaviour has been identified (Wall, 1995). People that care about the issues are more likely to change their actions. In a study of households in Gold Coast city Australia, it was found that people who had positive environmental and water conservation attitudes consumed significantly less water, especially with behaviorally-influenced uses such as showers and washroom taps (Willis et al., 2011). Furthermore, a lack of awareness was found to be the second biggest barrier to making environmentally

conscious decisions in a university setting, according to a survey done in the UK (Dahle & Neumayer, 2001). In order to reduce water waste through dripping faucets at Dalhousie, community members need to be informed about the issue of water waste and how they can help reduce it by turning taps off completely and reporting broken faucets.

Conclusion

This research project has identified a significant amount of water waste from dripping faucets in Dalhousie's Student Union Building and a low level of awareness in the Dalhousie community to dripping faucets and of whom to contact to report a faucet that is not functioning properly.

Recommendations for Action

- Retrofit the Student Union Building with new faucets
- Replace aerators on taps where they have gone missing
- Consider installing motion sensing faucets
- Consider installing lift-style faucets as opposed to twist-style faucets
- Initiate an awareness campaign in the form of signs near public taps including the following information:
    - the amount of water wasted from dripping faucets
    - a reminder to turn off taps completely
    - instructions to contact Facilities Management to report a broken faucet
    - the phone number of Facilities Management

Recommendations for Further Research

Further research into the amount of water wasted on the Dalhousie University Studley Campus should be done on a broader scale. Assessment of water waste by toilets, urinals, water fountains, private sink faucets and pipes needs to be undertaken. Special consideration needs to be given to the water system in the Student Union Building which this research project found to have a higher rate of water waste. By increasing the scope of the research, there would be a better representation of the water waste situation at Dalhousie University.

Secondly, the influence of environmental education on awareness and concern level needs to be further investigated. This research project revealed a low awareness level of the overall population at Dalhousie University in regards to dripping taps. However science students and non-students showed a higher level of awareness and concern and were most likely to notice and turn off a dripping tap. This seems to indicate a correlation between education or familiarity with the buildings' facilities with a higher level of concern and awareness. Further research is needed this relationship between education and level of awareness and concern. By using informational materials (i.e posters) that demonstrate the environmental effects of a dripping faucet, researchers can measure if they have an impact on the population. A better understanding could be gained by measuring the awareness and concern level of the Dalhousie community before and after exposure to the educational posters to see if there has been a change. The results of these observations could gauge the influence of informational materials on the environmental awareness and concern level of the Dalhousie community. This understanding could then be applied more broadly to sustainability initiative across the Dalhousie campus.

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Appendix A: Data Collection Chart

Table 1 Data chart used for examining leaking faucets in three buildings located on the Studley campus at Dalhousie University, Halifax Nova Scotia.

Building:						
Tap #/location	Leaking (y/n)	Handle Type	Vol leaked/year	Hard to close (y/n)	Aerator present (y/n)	Aerator #

Appendix B: Survey

Survey: Dripping Tap Awareness and Concern Level

Thank you for taking the time to complete this survey for ENVS/SUST 3502: Campus As A Living Laboratory. The primary objective of this survey is to measure the awareness and concern level of the Dalhousie community in regards to dripping taps.

This survey should only take about two minutes of your time. All information provided will be confidential and anonymous. If you have any questions about the survey, please contact Emily Caddell at emilycaddell@dal.ca

1. **Please identify your sex.**
___Male ___Female ___Prefer not to answer

2. **Please identify your major of study/faculty/occupation:**

3. **When using this building's facilities, such as washrooms or public kitchens, do you notice dripping taps?**

___Yes, I have noticed dripping taps ___I have sometimes noticed dripping taps

___No, I have never noticed dripping taps ___I don't know

4. **If you answered yes to the previous question, do you attempt to turn off the tap to stop the leak?**

___Always ___Very Often ___Fairly Often ___Sometimes
___Almost Never ___Never

5. **If the tap continued to drip once you have attempted to turn it off (i.e. due to mechanical issues) would you report it?**

___Yes ___No ___No strong opinion

6. **Who would you contact to report a dripping tap?**

Did you know that a dripping tap can waste up to 50 liters of water a day, which is equivalent to the amount of water per person per day that is required to ensure basic needs for drinking, cooking and cleaning? (World Water Assessment Programme, 2012).

Appendix C: Ethics Application

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: Water audit, Studley Campus

2. Faculty Supervisor(s) Tarah Wright **Department ENVS**
email: Tarah.Wright@dal.ca **ph:**

3. Student Investigator(s)

Emily Caddell	emilycaddell@dal.ca	
Meagan Ellacott	mg715221@dal.ca	
Cyndel Kelly	cy507991@dal.ca	902-448-5663
Larisa	lr272659@dal.ca	
Marisha Pluta	marisha.pluta@dal.ca	

Department: ENVS

4. Level of Project: Non-thesis Course Project [ ] Undergraduate [X] Graduate [ ]
Specify course and number: 3502 ENVS/SUST Campus as a Living Lab

5. a. Indicate the anticipated commencement date for this project: March 13 2013
b. Indicate the anticipated completion date for this project: April 4 2013

SUMMARY OF PROPOSED RESEARCH

1. Purpose and Rationale for Proposed Research: Measure the awareness and concern of individuals found at Dalhousie University.

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)
[x] 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.***

Surveys will be handed to community members (including students, faculty) to fill out. Interviewer will not be watching participant fill form out.

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

Dalhousie Participants:
[X] Undergraduate students
[X] Graduate students
[X] Faculty and/or staff

Non-Dal Participants:
[X] Adolescents
[X] Adults
[X] 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.***

Random individuals found in the buildings being researched. No preference will be given.
c. *How many participants are expected to be involved in this study?*
_____*100*_____

4. Recruitment Process and Study Location
a. ***From what source(s) will the potential participants be recruited?***
[x] 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.***
No Recruitment, random sampling.

5. Compensation of Participants*:* **Will participants receive compensation (financial or otherwise) for participation?**
Yes [ ] No [X] 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.

No feedback given. Anonymous information will be used.

POTENTIAL BENEFITS FROM THE STUDY

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

Identify level of need for additional information needed in public washrooms.

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

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.

[X] No known or anticipated risks Explain why no risks are anticipated:
[ ] 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.

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
[X] 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.

Data will be anonymous, and the interviewer will not watch as the participant fills out the survey.

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

1. 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.

[X] Paper Records
[X] Confidential shredding after __April 4 2013____
[ ] 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.
[X] Electronic
[X] Erasing of electronic data after __April 4 2013____
[ ] Data will be retained until completion of specific course.
[ ] Other

_____

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

Specify storage location: _Megan Ellacott's house- 1959 Vernon street, apt

B_____

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.

[X] **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 February 22nd, 2013
Emily Caddell

Signature of Student Investigator(s) Date February 22nd, 2013
Meagan Ellacott

Signature of Student Investigator(s) Date February 22nd, 2013
Cyndel Kelly

Signature of Student Investigator(s) Date February 22nd, 2013
Larisa Lensink

Signature of Student Investigator(s) Date February 22nd, 2013
Marisha Pluta

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

_____

Signature Date

_____

Signature Date