

# Higher Learning – Greening the Kenneth Rowe Roof

ENVS 3502 – The Campus as a Living Laboratory  
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## *Abstract*

The Kenneth C. Rowe building on the Dalhousie University campus was designed to support a greenroof. The greenroof was never installed due to a lack of funding. Higher Learning is a group of Environmental Science students who are dedicated to the future implementation of a greenroof on the Rowe building. In this study, Higher Learning identifies and offers solutions to the economic hurdles which prevent greenroof installation by examining faculty support and opinion. Faculties from the chosen departments were provided with a questionnaire, which concluded that from those participating, there existed support. On the contrary, the results did reveal that the faculties were not in favour of their departments diverting funds for the purpose of a greenroof, nor were they interested in the research opportunities associated with it. There was, however, opportunity for a greenroof to be incorporated into existing class curriculum. A long list of classes was identified as being able to do so. There were many economic opportunities which were aroused from this study in the form of increased enrollment and new classes. The next steps towards greenroof implementation would first be contacting potential donors of the project, some of whom were identified with our questionnaire and second, developing a design which is suited to the Halifax Climate.

## **1.0. Introduction**

### ***1.1. Background Information- Results from the 2006 Feasibility Analysis:***

In 2006, a group of Dalhousie students conducted a feasibility analysis entitled *Greening the Rowe Roof: A Feasibility Analysis*. This was an extensive report which focused on implementing a Greenroof on the Kenneth R. Management Building. The goal of the research was to determine whether greenroof installation would be socially, economically and environmentally beneficial, and what institutional barriers prevented initial greenroof development.

The report concluded that a Greenroof would be economically beneficial in the long-run; therefore, Dalhousie should implement an intensive, accessible Greenroof without planters. Based on criteria such as storm water management, water filtration, reduction in energy consumption, biodiversity preservation, habitat preservation, and urban heat island effect moderation, this type of Greenroof had the highest benefit rate of 16 - 46% (Feasibility Analysis, 2006). The amount of student support for this type of roof was also the highest, having 36% of the 200 students interviewed in support for an intensive, accessible roof (Feasibility Analysis, 2006).

The greenroof was not implemented due to economic barriers and lack of funding. The construction of the Rowe Building itself went over budget and thus, the Greenroof was not constructed. No supplemental funding for the project was ever allotted. Nevertheless, student support for a Greenroof is strong and the next step is to research the faculty support to see if they too are in favour of a Greenroof.

### ***1.2 Higher Learning- Who we are:***

***“Higher Learning” is a group of seven Environmental Science students taking part in the greening the campus initiative. The purpose of our research is to begin the process of examining and overcoming the barriers to the installation of a Greenroof on the Kenneth Rowe Building on Dalhousie University’s Studley campus.***

### ***1.3 Research problem:***

***To determine whether or not there is faculty support for a greenroof on the Rowe building. This problem is worth exploring because there is no sense in starting a project such as a greenroof if we do not have the support of the faculty. The faculties***

*are important because they are generally a part of the University community for much longer than the students. They also hold more weight in the decision making process. Since there are many economic problems we would like to know if there are potential classes that can utilize a greenroof. New classes generate money for the school.*

#### ***1.4 Purpose of this study:***

Higher Learning feels that greenroof implementation on the Dalhousie Campus would encourage the Dalhousie sustainability movement, allowing for substantial environmental, social, and health benefits. A greenroof will also act as a tool to educate the public on the importance of natural ecosystems.

Economic gain can be achieved with a greenroof. For instance: incorporating a greenroof into class structure, the green roof could be used for research projects; and the greenroof could be used as a formal social space. Many of the income generating processes involved the faculty, which made us realize that their involvement in this project was very important. In addition, faculty presence will long out live the current study body and their voice tends to be more influential in the Dalhousie community.

One of the barriers to installation in the study performed last year is that there would be a lack of maintenance staff to insure the upkeep of the greenroof once those interested had graduated and moved on. With the support of the faculty, there would be ensured interest of students in the years to come to perform the tasks of upkeep.

## **2.0. What is a Greenroof?**

A Greenroof is a roof that has been designed and constructed to support vegetation. In today's literature there are two general descriptions of a green roofing system: An Extensive Greenroof and an intensive Greenroof.

### *Extensive Greenroof*

A Greenroofing system that is not intended for regular human usage nor is it even intended to be seen on a regular basis. It is designed to have minimal maintenance with a growing medium, or more correctly known as a substrate, of a depth between 2 and 15 cm or 0.8 and 6 inches. The plants are generally sedums and grasses.

### *Intensive Greenroof*

A Greenroofing system that is accessible to humans and can be used much like an ordinary garden at ground level. Thus maintenance is expected by individual. An intensive Greenroof has a substrate of at least 15cm or 6 inches,

which allows it to support a variety of plants, such as agricultural crops. This Greenroof system is much heavier in weight than that of an extensive Greenroof, thus a building must have the ability to hold the added weight. This may result in increased expenditures.

### ***2.1. The Benefits of a Greenroof System:***

A greenroof on the Rowe Building would contribute to the greening of the campus initiative in the following ways:

#### ***Environmental***

- Management of storm water runoff
  - All towns and cities have two impervious structures; rooftops and asphalt (roads, side walks, parking lots etc.). During average rainfall on a town or city, around 75 percent of the water is lost directly as surface runoff, compared to forested areas, where roughly 5 percent is lost due to surface runoff. (Dunnett & Kingsbury, 2004, 33). This can be detrimental to streams, rivers and lakes.
  - Greenroofs can retain 50 to 90 percent of typical rainfall on a roof, depending of course on type of green roof (Hydrotech, 2005).
  - Provides an excellent habitat for birds, butterflies, and bees (Kortright, 2001)
- Reduction in energy use to cool and heat a building
  - Through added insulation, energy that is used to heat or cool a building is diminished, resulting in the conservation of energy.
- Improvement of air quality
  - Studies have shown that urban planting allows for the trapping and the absorption of air pollutants. In particular, nitrous oxides, VOCs, and particles of matter, converting them into oxygen through the process of photosynthesis (Kortright, 2001).
- Reduction of the 'Urban Island Heat' (UIH) effect
  - Vegetation on roof tops will reduce the re-radiation of heat from buildings and streets.
  - Through evapo-transpiration, moisture re-enters the atmosphere and cools cities in the process (Draper, 2002; 452).
  - The increasing temperatures of cities can result in heat related illness and mortality, particularly for the elderly.
  - To see real results in the reduction of UIH effect, greenroofs need to be implemented on a large scale

## *Economic*

- Reduction in energy results in cost savings
  - Greenroofs provide insulation for the building itself, in turn reducing its energy requirements needed to heat and cool the building.
  - Indoor temperatures have been shown to be 3-4 °C (6-8°F) lower under a greenroof when outdoor temperatures are between 25 to 30 °C (77-86°F) and in the winter heat loss is minimized through added insulation on the roof (Dunnnett & Kingsbury, 2004, 33), in turn saving money on the climate control of the building.
- Potential for agricultural use
  - Intensive greenroofs have the potential to grow agricultural crops, which would not only reduce huge transportation costs and environmental damages, but also provide an organic source of food which could be sold at local markets or consumed by the residents of the building. Dalhousie University it could create its own organic market.
  - Example: the Fairmount Waterfront Hotel in Vancouver, which uses the herbs, flowers, and vegetables grown on its rooftop, saving the kitchen an estimated 30,000 dollars a year (Green Roofs for Healthy Cities, 2005).
- Improvement of property value
  - This is particularly true for dense city centers where green space is scarce.
- Potential to Out-live conventional roof tops
  - Example: a London department stores roof waterproof membrane had been covered by a green roof for 50 years was still in excellent condition. This could be a serious threat to the contemporary 10 to 15 year style of roofing (Kortright, 2001).
  - This is a long term cost saving scheme.

## *Social*

- Aesthetic and Therapeutic
  - Greenroofs bring green space back into city centers, reconnects people with nature.
  - This aesthetic appeal has been proven to promote good health through horticultural therapy (Kortright, 2001).
- Holistic approach: a buildings place in its environment
  - Provides an essential holistic perspective that a building is not only a structure but a part of the environment and thus affects it in some way or another. Greenroofs can provide people with a better understanding of the importance of green space in cities
- Formal social space
  - May be used as a place for social gatherings
- Strengthens Communities



- Creates community green roof projects which in turn provide skills, fitness, and leadership. Also provide food which could create agricultural shared communities/neighbourhoods (TFPC, 2006) or, for Dalhousie University, an organic market.
- These benefits vary depending on the type and design of the green roof. All types would be beneficial for Dalhousie and the Greening the Campus movement.

### ***Educational***

- Potential for a working living laboratory
  - Gives student and teachers the opportunity to work in living laboratory and provides hands on experience
- Potential for a research tool
  - This living laboratory provides students and teachers with a research tool. This is important for Dalhousie because there is not a lot of research done on the kinds of plants that are suitable for rooftops in the eastern coastal climates.
  - This would promote Dalhousie as a reliable source for greenroofing knowledge.
- Potential for new classes
- Improvement of Dalhousie's images as a sustainable university
  - Something that Dalhousie is lacking compared to other top universities in Canada and world.

Greenroof technologies have a plethora of benefits; however there are reasons that have stopped future development. The main reason is the upfront cost associated with its installation as well as the lack education. Greenroofs need to be installed on buildings that are capable of holding their weight and many old building do not have this capability.

### **3.0. Methods**

Our goal was to identify and overcome barriers to greenroof installation on the Kenneth C. Rowe building of the Dalhousie University campus. Higher learning was initially going to try and implement a greenroof on the new proposed Student Union Building; however, it was brought to our attention that the Kenneth Rowe building had already been designed to hold an intensive roof and last year a group from the ENVS 3502 class had completed a feasibility analysis. Their study was reviewed and it was clear that faculty support must be present if a greenroof were to survive on campus.

A self-administered questionnaire was chosen as the main qualitative and quantitative research method. The questionnaire would allow insight into faculty interest, support and opinion. The questionnaire was dispensed to and completed by specific faculty members at Dalhousie University. The questionnaire was well articulated, consisting of open-ended questions, which would help stimulate comments and remarks<sup>1</sup>. Our group wanted to avoid single response questions, because we had placed so much emphasis and significance this questionnaire.

Once we had completed the questionnaire, we decided to use a non-probabilistic sampling technique, more precisely, snowball sampling. We targeted eleven departments, recognizing that it was a very heterogeneous population; therefore we identified which participants were most appropriate. This method creates a bias in our sample because the study targets those who we knew would be more responsive than others. This method, referred to as purposive sampling, was used to seek out those individuals who are known to be environmentally conscious. On the survey there was a space provided where the faculty member could let us know about other faculty member who would be interested in partaking in this project. We then proceeded to contact and distribute surveys to those individuals the faculty recommended.

Seventy faculty members from all departments and faculties at Dalhousie were sent an e-mail requesting their participation in the questionnaire. The following data comes from 29 (41%) of the 70 people contacted. The remaining 41 who were contacted are not included in our data for the following reasons: they did not respond, they were unable to participate for various reasons or we were unable to pick up completed surveys. The faculty was given 5 days to complete the questionnaire. We later realized that this time frame was unrealistic to the participants' schedule.

The surveys were collected and analyzed with an excel spreadsheet. Unfortunately, the number of returned completed questionnaires was not sufficient enough to enter into a survey analysis program which would have been provided by the professor. We had to go through all of the data ourselves tabulating all of the data.

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<sup>1</sup> Please see Appendix b for an attached copy of the questionnaire

Our delimitations were specifically implemented throughout our researching process. We chose to limit the study to the faculty because the student support was already sampled in a previous study. First, we chose the Rowe building which limited our focus. Secondly, we chose only specific professors, which limited our resource base, and thirdly we chose a time frame that was unrealistic. Lastly, the group chose only to do a survey, which restricted and possibly skewed our results. On the other hand, the major limitations of this project were: lack of time, the difficulty of working with a group of seven, and unresponsiveness or lack of cooperation from faculty.

### ***3.1 Preliminary Information on respondents***

Below is a list of which department each of the participating faculty members belong to.

|                                                          | Number |
|----------------------------------------------------------|--------|
| Environmental Programs                                   | 4      |
| Earth Sciences                                           | 3      |
| Sociology & Social Anthropology                          | 3      |
| Biology                                                  | 2      |
| School of Planning                                       | 2      |
| Civil & Resource Engineering                             | 2      |
| School of Architecture                                   | 1      |
| Cities & Environmental Unit – Faculty of Arch & Planning | 1      |
| Environmental Engineering                                | 1      |
| Process Engineering & Applied Science                    | 1      |
| School of Public Administration                          | 1      |
| School of Business                                       | 1      |
| Economics                                                | 1      |
| Faculty of Health Professionals                          | 1      |
| English                                                  | 1      |
| Law                                                      | 1      |
| Philosophy                                               | 1      |
| Math & Stats                                             | 1      |
| N/A                                                      | 1      |
|                                                          | 29     |

**Table 1:** Department/Faculty Breakdown of Respondents

Below is a list of the position of the participating faculty.

|                     | Number |
|---------------------|--------|
| Assistant Professor | 9      |
| Professor           | 3      |
| Associate Professor | 3      |
| Director            | 2      |

|                                    |    |
|------------------------------------|----|
| Lecturer                           | 2  |
| Instructor                         | 2  |
| Dean                               | 2  |
| Retired Professor                  | 1  |
| Chair                              | 1  |
| Community Planner                  | 1  |
| Marketing & Communications Manager | 1  |
| Environmental consultant           | 1  |
| N/A                                | 1  |
|                                    | 29 |

**Table 2:** Position Breakdown of Respondents

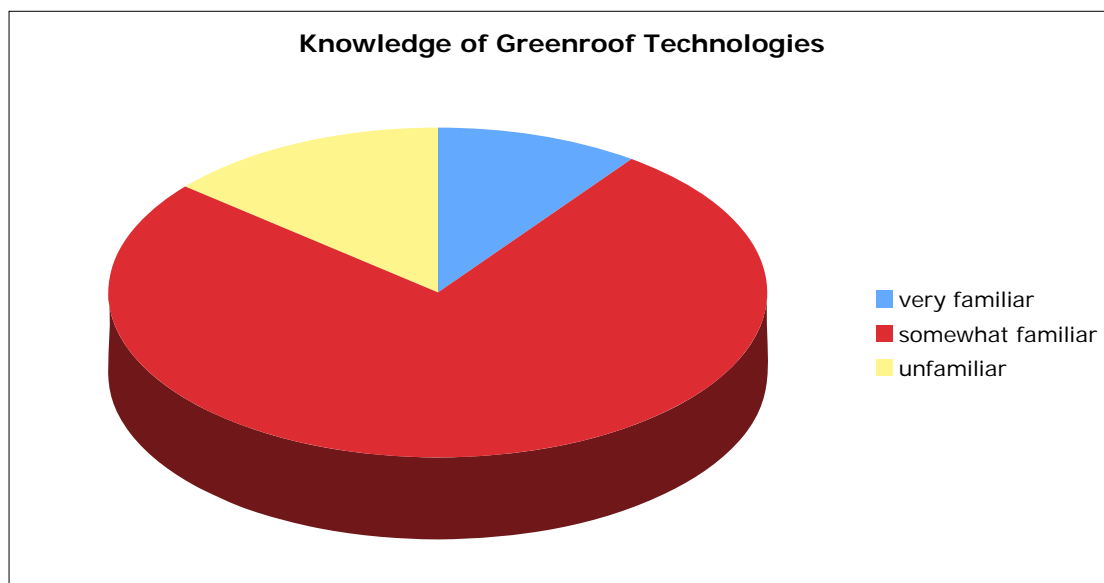
## 4.0 Results

### *Question 1:*

#### *Rate your knowledge of greenroof technologies*

|                   | Number | Frequency |
|-------------------|--------|-----------|
| Very familiar     | 3      | 10%       |
| Somewhat familiar | 22     | 76%       |
| Unfamiliar        | 4      | 14%       |
| <b>TOTAL</b>      | 29     | 100%      |

**Table 3:** Knowledge of Greenroof Technologies



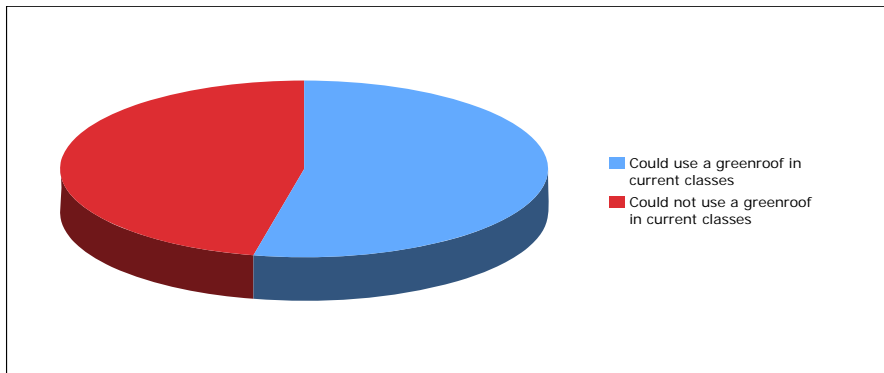
**Figure 1:** Knowledge of Greenroof Technologies

**Question 2:**

***Do you teach any classes that could possibly use a greenroof on Dalhousie campus?***

|                                                               | Number | Frequency |
|---------------------------------------------------------------|--------|-----------|
| Could make use of a greenroof in a currently taught class     | 14     | 48%       |
| Could not make use of a greenroof in a currently taught class | 15     | 52%       |
| <b>TOTAL</b>                                                  | 29     | 100%      |

**Table 4:** The use of a greenroof in current classes taught at Dalhousie



**Figure 2:** Percentage of respondents who could make use of a greenroof in a class currently taught at Dalhousie

Current Classes that could Potentially use a Greenroof:

- |                                                                |                                                  |
|----------------------------------------------------------------|--------------------------------------------------|
| ARCH 4211/4212: Building Systems Integration                   | ENVS 1000: Introduction to Environmental Studies |
| BIOL 3060: Environmental Ecology                               | ENVS 2001: Analytical Environmental Science      |
| BIOL 3066: Plant Ecology                                       | ENVS 3001: Environmental Science Field School    |
| BIOL/PLAN 3225: Plants in the Human Landscape                  | ENVS 4001: Environmental Impact Assessment       |
| CIVL 6117: Water Quality Management                            | ERTH 1080/1090: Introduction to Geology          |
| ECON 3335: Environmental Economics                             | GEOG 1035: Introduction to Human Geography       |
| ECON 5031: Economics for Resource and Environmental Management | PHIL 2480: Environmental Ethics                  |
| ECON 5516: Resource and Environmental Economics                | PHIL 2485: Technology and the Environment        |
| ENVE 3000: Fundamentals of Environmental Engineering           | PLAN 3010: Urban Ecology                         |
| ENVE-CHEE 4772: Environmental Assessment and Management        | SOSA 3060: Social Change & Development           |
|                                                                | SOSA 4018: Alternative Ecologies                 |

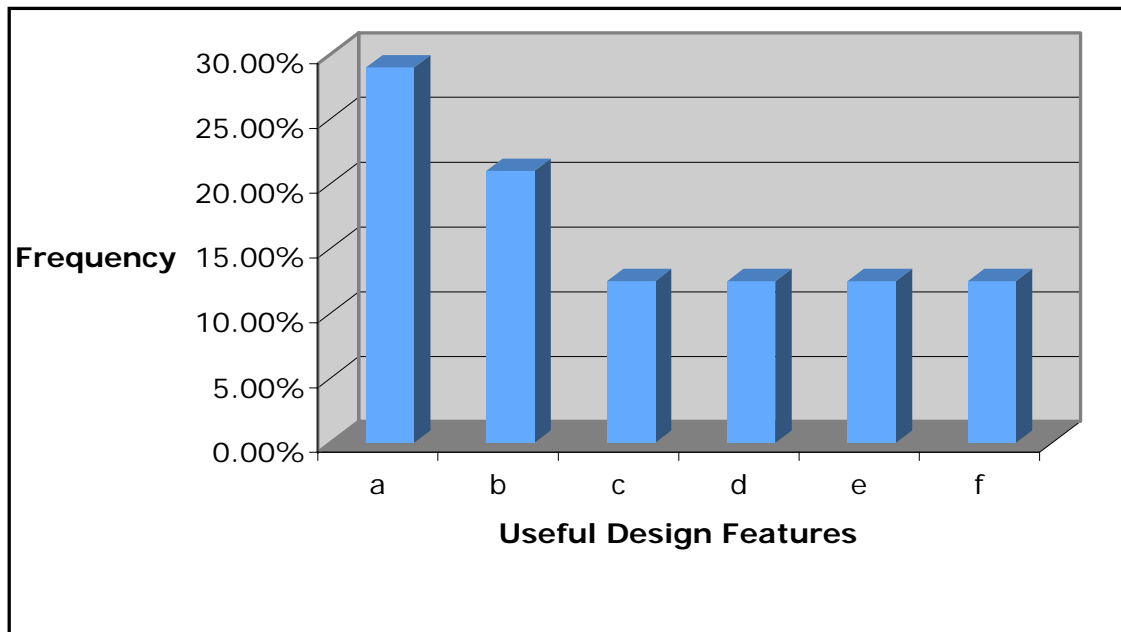
**Question 3:**

***What design features would be useful for you current teaching responsibilities?***

|                               | Number | Frequency |
|-------------------------------|--------|-----------|
| a) Indigenous/ native species | 5      | 21%       |
| b) Agricultural crops         | 3      | 12.5%     |
| c) Medicinal plants           | 3      | 12.5%     |
| d) Model succession           | 3      | 12.5%     |
| e) Forest ecosystem           | 3      | 12.5%     |
| f) Other                      | 7      | 29%       |
| <b>TOTAL*</b>                 | 24     | 100%      |

**Table 5:** Design Features that would be Useful for Current Teaching Responsibilities

\*the 14 respondents who responded that they could make use of a Greenroof in their current class from the last question circled all that applied.



**Figure 3:** Design Features that would be Useful for Current Teaching Responsibilities

Other

Legal issues  
 Technology involved /roof design  
 Ecosystem benefits  
 Roof garden

Storm water runoff management & drainage  
 Soil characteristics/organisms

**Question 4:**

***Do you know of any other classes that you don't teach in your faculty or other faculties that could potentially use a greenroof in heir curriculum plan?***

|                                                                              | Number    |
|------------------------------------------------------------------------------|-----------|
| Respondents who see potential for a Greenroof in future classes at Dal       | 15        |
| Respondent who do not see potential for a Greenroof in future classes at Dal | 14        |
| <b>TOTAL</b>                                                                 | <b>29</b> |

**Table 6:** The Potential Use of a Greenroof in Classes Taught at Dalhousie

Suggested classes that could benefit from a Greenroof at Dalhousie

BIOL 2601: Flora of Nova Scotia

BIOL 3066: Plant Ecology

BIO: 3068: Agro ecosystems

BIOL 3527: Entomology

BIOL 3601: Nature Conservation

CIVL 3310: Engineering Hydrology

CIVL 3515: Structural Systems

ENVI 1100: Introduction to  
Environmental and Resource

Management

ENVI 5480: SRES – Environmental  
Ethics

PLAN 2001: Landscape Analysis

PLAN 3001: Landscape Ecology

PLAN 3010: Urban Ecology

PLAN 3020: Landscape Design

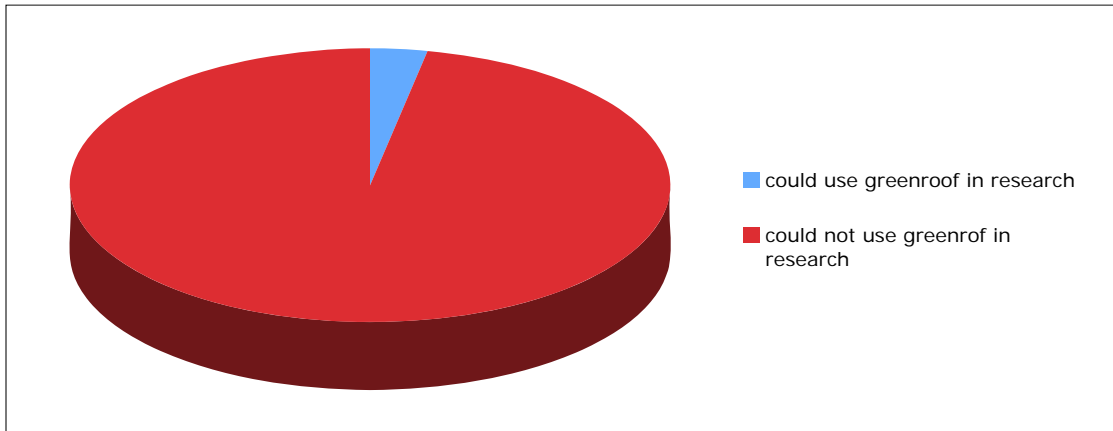
PLAN 3225: Plants in the Human  
Landscape

**Question 5:**

***Do you currently conduct research that could use a greenroof at Dalhousie University?***

|                                                              | Number | Frequency |
|--------------------------------------------------------------|--------|-----------|
| Conducts Research that could make use of a Greenroof         | 1      | 3%        |
| Does not Conduct Research that could make use of a Greenroof | 28     | 97%       |
| <b>TOTAL</b>                                                 | 29     | 100%      |

**Table 7:** Respondents who Currently Conduct Research that could make use of a Greenroof



**Figure 4:** Percentage of Respondents who Conduct Research that could make use of a Greenroof

**Question 6:**

***Would you be willing to include greenroof infrastructure costs in the development of grant proposals to support your research?***

|                                                                | Number |
|----------------------------------------------------------------|--------|
| Would be willing to include Greenroof Infrastructure Costs     | 0      |
| Would not be willing to include Greenroof Infrastructure Costs | 1      |
| <b>TOTAL*</b>                                                  | 1      |

**Table 8:** Willingness to Include Greenroof Infrastructure Costs in Grant Proposals

\*Based on the 1 respondent who said they conduct research that could use a greenroof from the previous question

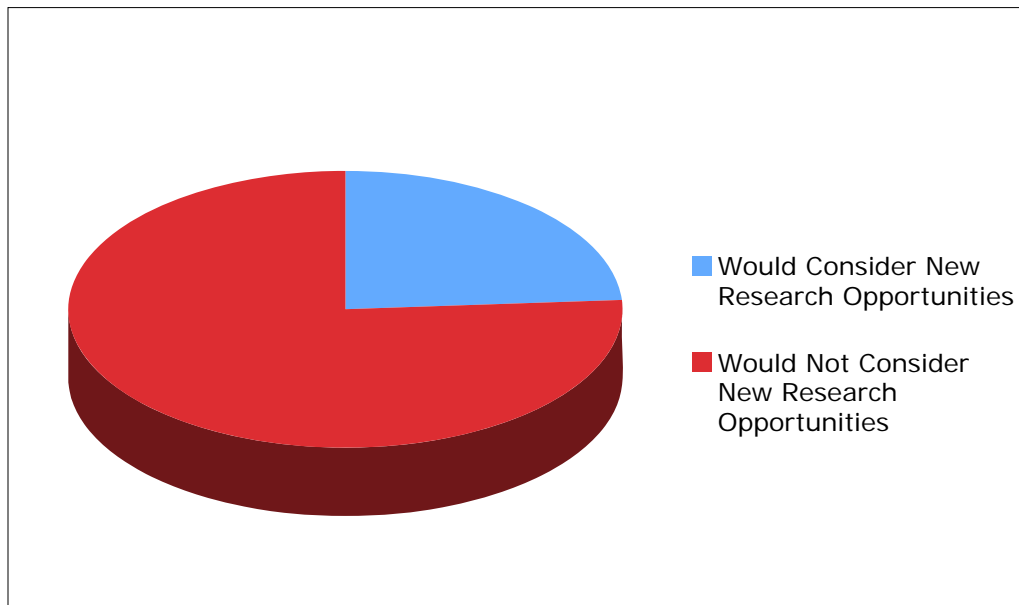


**Question 7:**

***Would you consider new research opportunities for yourself if a greenroof were available for research purposes at Dalhousie?***

|                                               | Number    | Frequency   |
|-----------------------------------------------|-----------|-------------|
| Would Consider New Research Opportunities     | 7         | 24%         |
| Would Not Consider New Research Opportunities | 22        | 76%         |
| <b>TOTAL</b>                                  | <b>29</b> | <b>100%</b> |

**Table 9:** Respondents who would Consider New Research Opportunities if a Greenroof were available



**Figure 5:** Percentage of Respondents who would Consider New Research Opportunities if a Greenroof were available

**Question 8:**

***Do you know of any funding opportunities (external or internal) that could help facilitate the creation of a green roof at Dalhousie?***

Suggested Funding Opportunities

Environment Canada

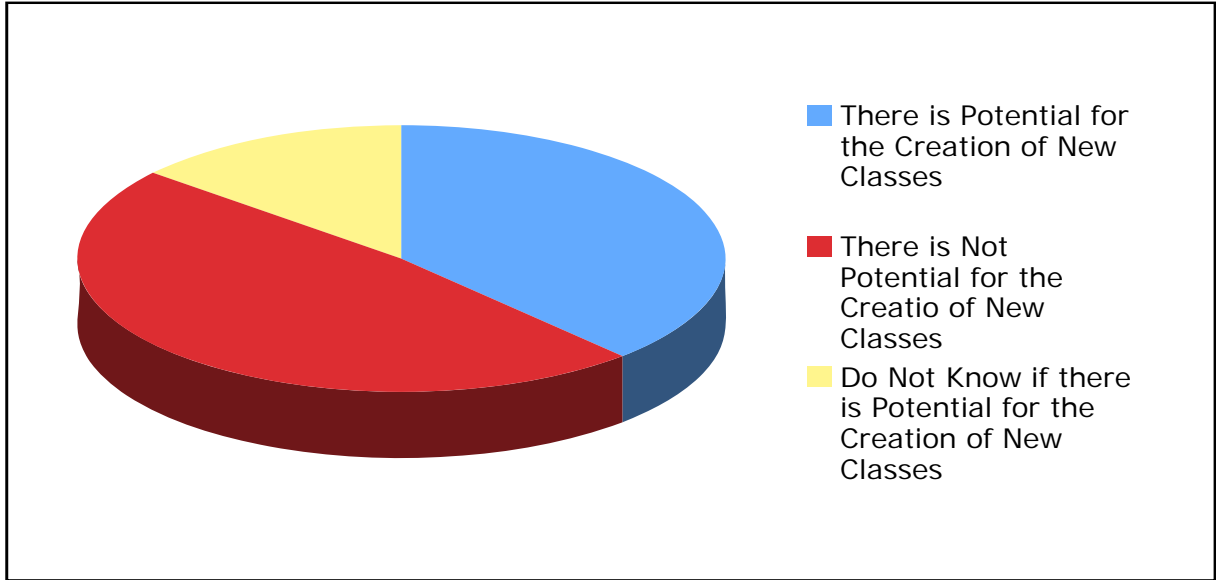
Canadian Foundation of Innovation

**Question 9:**

***In your opinion, would the availability of a greenroof create potential for the creation of new classes within you faculty?***

|                                                                   | Number    | Frequency   |
|-------------------------------------------------------------------|-----------|-------------|
| There is Potential for the Creation of New Classes                | 11        | 38%         |
| There is Not Potential for the Creation of New Classes            | 14        | 48%         |
| Do Not Know if there is Potential for the Creation of New Classes | 4         | 14%         |
| <b>TOTAL</b>                                                      | <b>29</b> | <b>100%</b> |

**Table 10:** Potential for the Creation of New Classes based on the Installation of a Greenroof



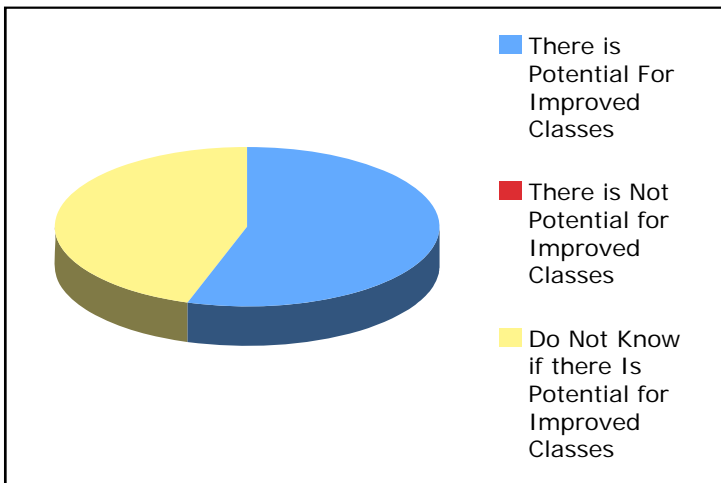
**Figure 6:** Percentage of Respondents who see Potential for the Creation of New Classes based on the Installation of a Greenroof

**Question 10:**

*In your opinion, could existing classes be improved or enhanced by the installation of a green roof?*

|                                                        | Number | Frequency |
|--------------------------------------------------------|--------|-----------|
| There is Potential For Improved Classes                | 16     | 55%       |
| There is Not Potential for Improved Classes            | 0      | 0%        |
| Do Not Know if there Is Potential for Improved Classes | 13     | 45%       |
|                                                        | 29     | 100%      |

**Table 11:** Potential for Improved Classes based on the Installation of a Greenroof



**Chart 7:** Percentage of Respondents who see Potential for the Improvement of Classes based on the Installation of a Greenroof

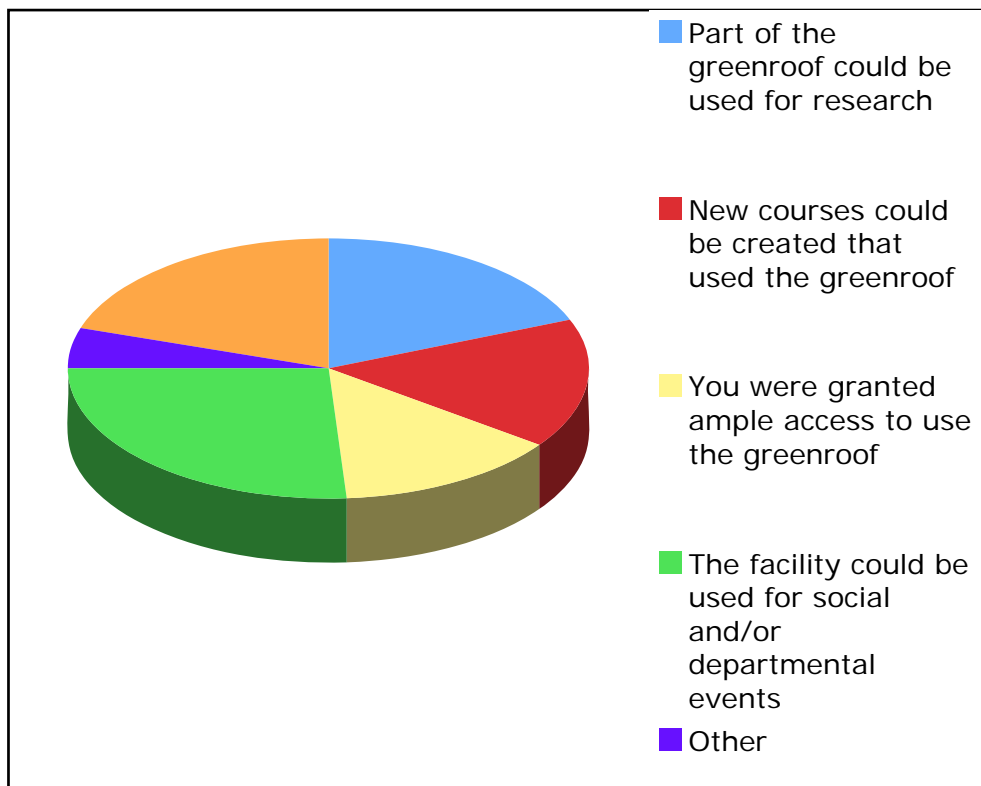
**Question 11:**

**Would you be in favour of your faculty budget diverting funds to a greenroof project if:**

|                                                                  | Number    | Frequency   |
|------------------------------------------------------------------|-----------|-------------|
| Part of the greenroof could be used for research                 | 11        | 19%         |
| New courses could be created that used the greenroof             | 9         | 16%         |
| You were granted ample access to use the greenroof               | 8         | 14%         |
| The facility could be used for social and/or departmental events | 15        | 26%         |
| Other                                                            | 3         | 5%          |
| No                                                               | 12        | 20%         |
| <b>TOTAL*</b>                                                    | <b>58</b> | <b>100%</b> |

**Table 12:** Reasons for Respondents in favour of Diverting Funds from Faculty Budget

\*Respondents circled all that applied



**Figure 8:** Reasons for Respondents in favour of Diverting Funds from Faculty Budget

Reasons for Respondents not Being in Favour of Diverting Funds

Respondent not on main campus

SMU already has one

The focus should be on retrofitting older buildings

Respondent does not know enough about greenroofs to offer an informed opinion

Respondent has no control over budget

Department has a very restrictive budget

### Other Reasons for Respondents Being in Favour of Diverting Funds

Maintenance issues

Exemplify the values of management without borders and as such could be used in marketing text and images for the faculty and its programs

Marketing Dal as an “green” school that practices what it preaches

Reduces Dal’s ecological footprint

Work with proposed DISI initiatives

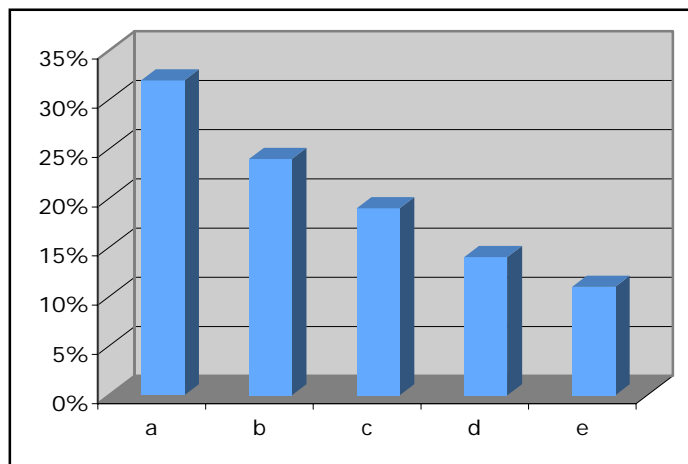
### **Question 12:**

***On a personal level, what would be the most exciting feature of having a greenroof at Dalhousie?***

|                                       | Number    | Frequency   |
|---------------------------------------|-----------|-------------|
| a) Increasing sustainability          | 22        | 32%         |
| b) Improving Dalhousie’s public image | 17        | 24%         |
| c) Aesthetics                         | 13        | 19%         |
| d) Health benefits                    | 10        | 14%         |
| e) Other                              | 8         | 11%         |
| <b>TOTAL*</b>                         | <b>70</b> | <b>100%</b> |

**Table 13:** Features of a Greenroof which respondents deem attractive

\* Respondents circled all that applied



**Figure 9:** Features of a Greenroof that Respondents deem attractive

### Other Features of Greenroofs that Respondents Deem Attractive

Increased energy efficiency

Wonderful pedagogical tool

Leadership opportunities

Educational aspect/ living classroom

Garden area for student/staff recreation

Pride of student & faculty

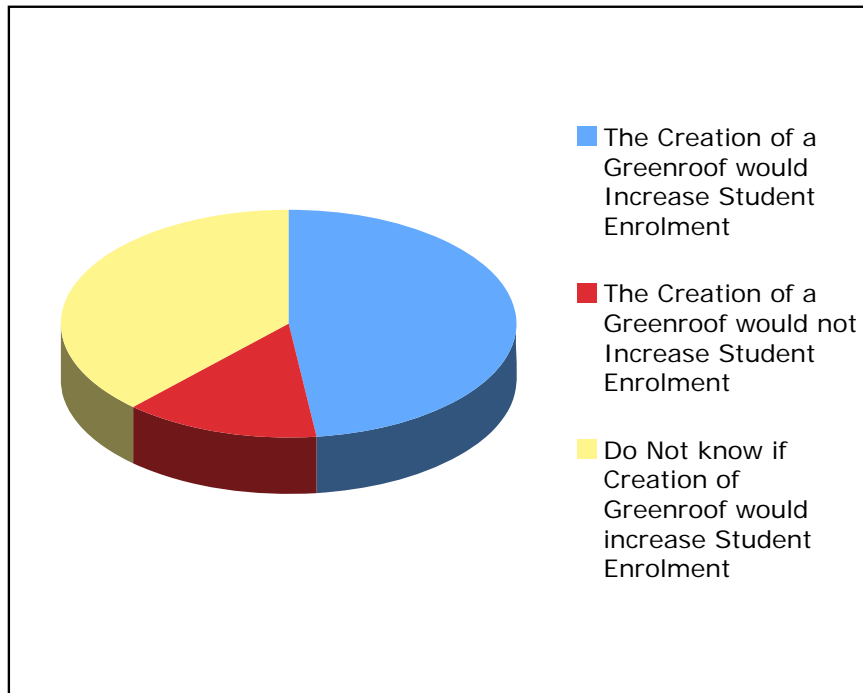
Don’t know

**Question 13:**

***Do you think that the creation of a greenroof on Dalhousie campus would increase prospective student interest in attending the university?***

|                                                                       | Number | Frequency |
|-----------------------------------------------------------------------|--------|-----------|
| The Creation of a Greenroof would Increase Student Enrolment          | 14     | 48%       |
| The Creation of a Greenroof would not Increase Student Enrolment      | 4      | 14%       |
| Do Not know if Creation of Greenroof would increase Student Enrolment | 11     | 38%       |
| <b>TOTAL</b>                                                          | 29     | 100%      |

**Table 14:** Prospective Student Interest Based on the Creation of a Greenroof



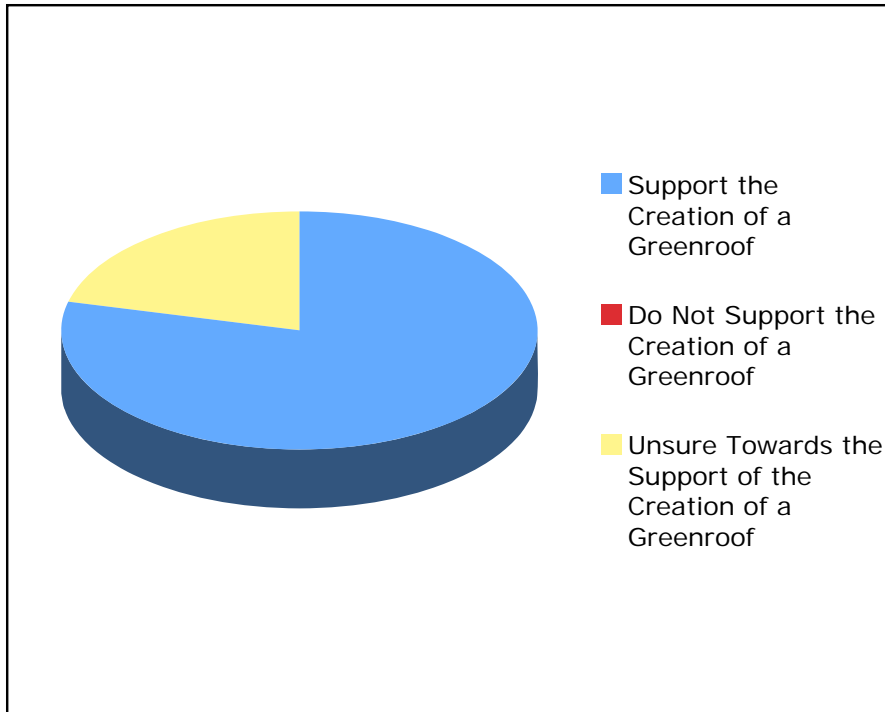
**Figure 10:** Perspective Student Interest Based on the Creation of a Greenroof

**Question 14:**

***Would you support the creation of a greenroof on the Rowe building?***

|                                                           | Number | Frequency |
|-----------------------------------------------------------|--------|-----------|
| Support the Creation of a Greenroof                       | 23     | 79%       |
| Do Not Support the Creation of a Greenroof                | 0      | 0%        |
| Unsure Towards the Support of the Creation of a Greenroof | 6      | 21%       |
|                                                           | 29     | 100%      |

**Table 15:** Faculty Support for the Creation of a Greenroof



**Figure 11:** Faculty Support for the Creation of a Greenroof

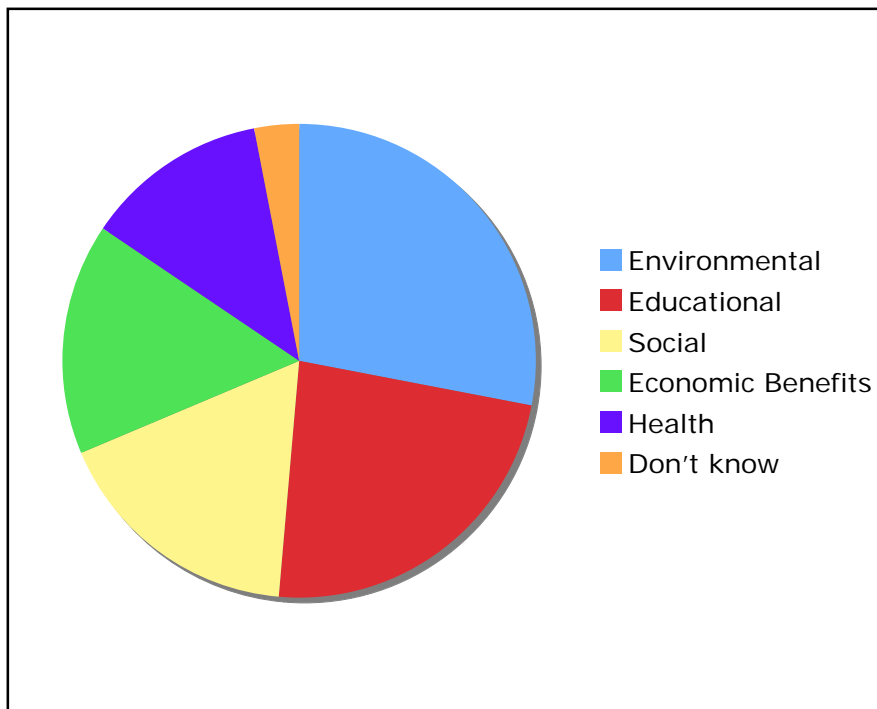
***Question 15:***

***What would be the main reasons for your support of a greenroof on the Rowe building?***

|                   | Number | Frequency |
|-------------------|--------|-----------|
| Environmental     | 25     | 28%       |
| Educational       | 21     | 23.5%     |
| Social            | 15     | 17%       |
| Economic Benefits | 14     | 16%       |
| Health            | 11     | 12.5%     |
| Don't know        | 3      | 3%        |
| <b>TOTAL*</b>     | 89     | 100%      |

**Table 16:** Main Reasons for supporting the Creation of a Greenroof

- Respondents circled all that applied



**Figure 12:** Main Reasons for Supporting the Creation of a Greenroof

## **5.0. Discussion**

### **5.1. Support**

Upon analyzing the data collected with the questionnaires, there is evidence of much faculty support. For instance, 79% of the faculty participants were in support of greenroof installation (Fig 11). The most popular reason for greenroof support would be for the environmental benefits, although the educational and social benefits were close behind.

### **5.2. Funding**

Higher Learning discovered that the faculties were unsure whether or not the installation of a greenroof would increase the enrollment of the university. If enrollment were increased by greenroof installation, Dalhousie would benefit economically. A little more than half of those sampled said that they would be in favour of their faculty budget diverting funds to a greenroof project. This is not a significant amount. This suggests that although the faculty may not be opposed to the greenroof, they do not want the funding to come from their faculty in particular.

### **5.3. Uses**

Those who were in support of their faculty department diverting funds would use the greenroof for a primarily social space rather than a research area. For instance, 84.6% of those questioned said that they would not use the greenroof for the purpose of

research. One of the most significant findings was the long list of potential uses among the classes that already exist. There was a notable interest in indigenous and native species as a greenroof design feature that current classes could use. Unfortunately there is no funding potential with classes which already exist. The only way to benefit the university economically would be if there were new classes created, in which the greenroof was incorporated in the class material.

## **6.0. Case Study – York University’s Greenroof**

In 2002 an extensive Greenroof was installed upon the Computer Science Building at York University in Toronto. The building was designed to function at a 50% energy reduction in comparison to standard contemporary buildings which would result in an estimated \$125,000,000 over the building’s 75-year lifespan (Concrete Thinking, 2007).

The objectives of the Greenroof were to:

- evaluate the potential of rooftop gardens to reduce the quantity and improve the quality of storm water runoff
- quantify the storm water management benefits of Greenroofs at a watershed scale through scenario modeling
- provide recommendations on the design and maintenance of Greenroofs to maximize benefits related to storm water management and biodiversity

The roof was constructed with two sections: a traditional section covered with shingles and the second covered by a garden consisting of wildflowers and a 140 mm substrate. Both surfaces had a 10% slope. The rooftop was used for research and over a period of 23 rainfalls, approximately 2 years, both surfaces were monitored for the following:

- Rainfall
- Surface runoff quantity
- Air temperature
- Relative humidity
- Soil temperature
- Soil moisture levels

Also, inventories of flora, fauna, and insects were conducted to evaluate the ecological benefits of the Greenroof.

The results of the research on the quantity of runoff over the monitoring period showed:

- the rooftop garden reduced runoff volumes by 63%



- the animal retention rate increased during the spring-fall events but more work needs to be done on studying the runoff retention capacity during winter rainfall and snowmelt events
- the gardens ability to retain storm water decreases as storm size and antecedent moisture content increases and temperature decreases
- The best retention rates occurred in the hot summer months, followed by spring, fall, and winter respectively

The results of the Greenroof's impact on water quality demonstrated improved water quality in comparison to the shingled roof in terms of:

- Suspended soils
- Nitrate
- E. Coli
- Heavy metals – copper, zinc, cadmium, and lead
- Polycyclic aromatic hydrocarbons

The impact of the Greenroof on biodiversity:

- Led to an increase in native plants from 18 to 29 over the two years
- Revealed that the Greenroof could be conducive to the establishment of conservative or rare native plants of local concern
- Uncovered a total of six bird species were using the roof, two of which were breeding on the site

There were however a number of potential, unforeseen problems with the Greenroof, including:

- The garden's runoff, relative to the conventional roof, had higher loads of constituents typically found in soil, such as potassium, magnesium, and phosphorus
- Among these constituents, phosphorus was the only variable to pose a threat to receiving waters
- Phosphorus concentrations decrease significantly after the first year of monitoring
- The growing medium used on the York roof had abnormally high concentrations of phosphorus – growing media with high phosphorus should be avoided

## **7.0. Conclusion**

The lack of willingness to divert funds leads us to conclude that although there is significant interest in implementing a greenroof throughout many departments and many faculties, the financial support for a greenroof must come from sources outside of the university, or at least outside of faculty budgets. The interest of the faculty at Dalhousie

in this project indicates that with further research and alternative financial support faculty may remain interested in the implementation of a greenroof for years to come.

### **7.1. Recommendations:**

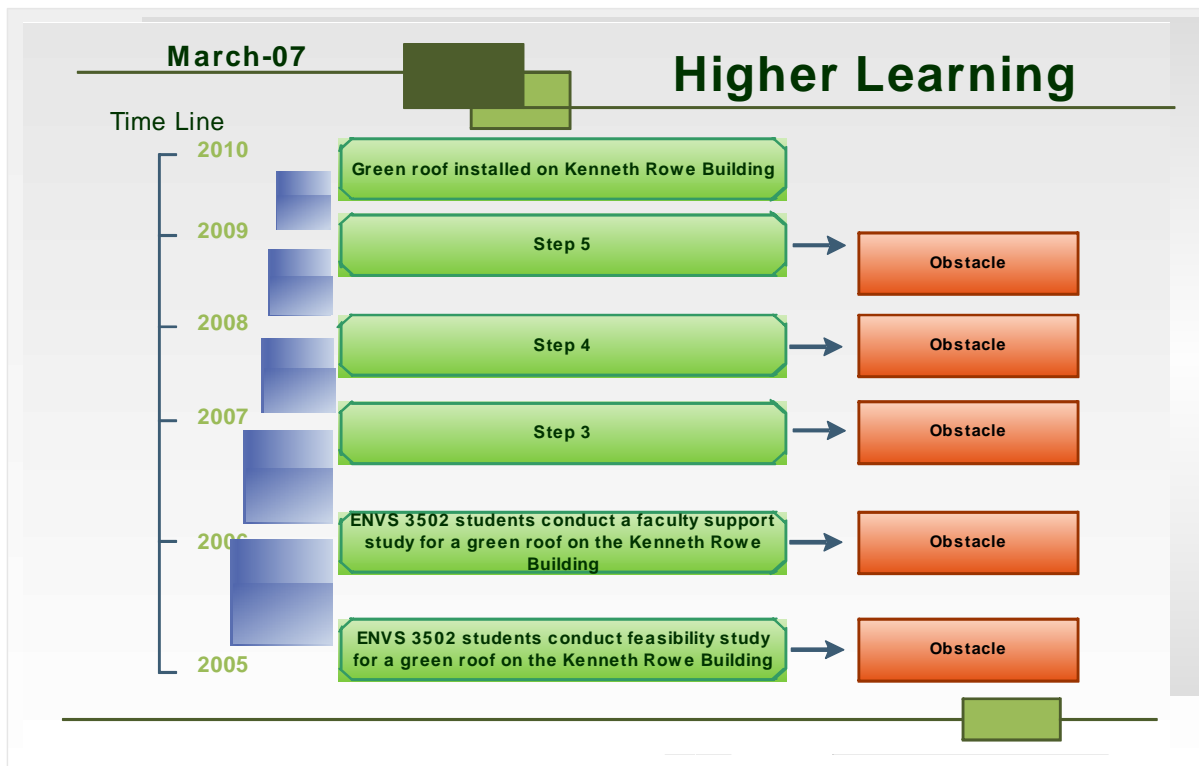
Our recommendations include:

- examining external funding opportunities – find sources outside of the university faculties, such as government funding for green initiatives, private funding, alumni funding, environmental groups, etc.
- provide a campaign that educates Dalhousie’s population of the benefits of having a greenroof on campus – so that each faculty understands why it is important to invest in such a project.
- developing a design for Halifax’s climate – research which species of animal and plant life may be supported, identify features that will enhance sustainability of Halifax buildings. This will enable supporters to provide concrete facts and figures regarding financial costs and benefits for decision makers as well as the environmental impact of a greenroof.
- developing an interest group – create a central group whose members are inherently interested in and responsible for seeing the project reach its completion. Having an organized unit to support and lobby for the project makes it easier for decision makers, supporters, and other persons interested in the project to find information regarding the greenroof and its progress.
- associate with other interested parties – build strength by collaborating with other groups interested in the same or similar initiatives (i.e. DISI, CESAR).
- continue pursuing faculty to help the reliability of the findings.

### **7.2. The Process**

The act of implementing a Greenroof on the Rowe Building cannot happen overnight. Instead, it is a lengthy process that requires several steps (refer to Figure 1). We have created a model that helps illustrate this process and indicate where our project stands in regards to the greater picture. The 2005 Feasibility Analysis was the first step in the process which determined that there is great support from the students for a

Greenroof; however, economic barriers prevented its implementation. From this, we decided to research faculty's stance on this issue and whether or not there were economic returns that could be created through faculty support. Upon completing our research, we think that the next step in the process of implementing a Greenroof would be to research ways of fundraising money from internal and external actors. This could then lead to the implementation of a Greenroof, or perhaps this will still require a few more steps until the end product is achieved. Nevertheless, we do believe that this process is a beneficial one, with an achievable goal.



**Figure 13:** Process of Implementing a Greenroof on the Rowe Building

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## 9.0 Appendices

### 9.1 Appendix a

#### Introduction Letter

#### Higher Learning: Greening the Kenneth Rowe Building

Environmental Problem Solving II – ENVS 3502

Winter Semester 2006/2007

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*Higher Learning* is a group of students participating in Dr. Tarah Wright's Environmental Problem Solving course, "The Campus as a Living Laboratory". The goal of the class is to undertake projects that contribute to the greening of the campus. We are conducting a study to assess the benefits to faculty and the level of faculty support in implementing a green roof on the Kenneth Rowe management building. It has been brought to our attention that you would be an appropriate participant for this questionnaire, as your knowledge could aid in our endeavors.

The Kenneth Rowe building was designed to hold an intensive accessible green roof system, however installation was not fulfilled due to economic barriers. Our group feels that Dalhousie should continue research and investment in a green roof system as it would hold environmental, economic, and social benefits for the university community.

An intensive accessible green roof system has many environmental, economic, social and educational advantages. Environmental benefits include the management and purification of storm water runoff, a potential decrease in the *urban island heat effect* and improved air quality. From an economic point of view, green roof systems have the potential to provide increased insulation, in turn reducing energy requirements needed to heat and cool the building that they are installed upon. Furthermore, the aesthetic value of a green roof provides social benefits in its ability to bring the community together to educate and increase awareness of the need for green space in an urban setting, as well as provide a therapeutic public space for community interaction. Lastly, the implementation of a green roof could provide faculty and students with a unique learning environment.

We would like to thank you for taking the time to complete the questionnaire and advise you that your information will be exceptionally useful to our findings. A group member will collect the survey from you at your convenience. Furthermore, due to time restrictions we would be very appreciative if you could have the survey completed by Monday March 20, 2007 at 4:00pm. Thank you again for your participation and please do not hesitate to contact us with any further questions.

Very best regards,

Rebecca Tye Charles Riddell Adeline MacNaughton Kevin Copley  
Megan Tardif-Woolgar Elisabeth Delaney Chloe Gillis

9.2 Appendix b

**GREEN ROOF QUESTIONNAIRE**

Environmental Problem Solving II – ENVS 3502

Winter Semester 2006/2007

**Participant Information**

Name: \_\_\_\_\_

Organization: \_\_\_\_\_

Position: \_\_\_\_\_

Date: \_\_\_\_\_

**Questionnaire**

1. Rate your knowledge of green roof technologies.

- a. very familiar
- b. somewhat familiar
- c. unfamiliar

2. Do you teach any classes that could potentially use a green roof on Dalhousie campus?

Yes (please list any)                      No (skip to question 4)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

3. What design features would be useful for your current teaching responsibilities: (circle all that apply)

- a. agricultural crops
- b. medicinal plants
- c. model succession
- d. forest ecosystem
- e. indigenous/native species
- f. other: \_\_\_\_\_

4. Do you know of any other classes that you don't teach in your faculty or other faculties that could potentially use a green roof in their curriculum plan?

Yes (please list any)                      No



- b. increasing sustainability
- c. aesthetics
- d. improving Dalhousie public image
- e. other: \_\_\_\_\_

13. Do you think that the creation of a green roof on Dalhousie campus would increase prospective student interest in attending the university?

Yes

No

Don't know

14. Would you support the creation of a green roof on the Rowe Building?

Yes

No

Don't know

15. What would be the main reasons for your support of a green roof on the Rowe Building? (circle all that apply)

- a. environmental
- b. social
- c. health
- d. educational
- e. economic benefits
- f. all of the above

Thank you for taking the time to fill out this survey.

I, \_\_\_\_\_, agree to participate in the aforementioned survey.

I agree that my responses will remain confidential and my identity will remain anonymous in the publication of any resulting documents.

or

I agree that my name and responses may be used for publication of any documents.

**Signature:** \_\_\_\_\_

**Date:** \_\_\_\_\_

### ***9.3 Appendix c***

#### **Follow Up E-Mail**

Dear, (name of participant)

I would like to take this opportunity to thank you for your participation in our faculty questionnaire concerning greening the Rowe roof. Your responses and comments are an important part of our research as we strive to find the most feasible options for the financing of a green roof implementation.

Thank you,  
Higher Learning



#### ***9.4 Appendix d***

##### **Thank you Letter**

Dear, (name of participant)

I would like to take this opportunity to thank you for your participation in our faculty questionnaire concerning greening the Rowe roof. Your responses and comments are an important part of our research as we strive to find the most feasible options for the financing of a green roof implementation.

Thank you,

Higher Learning