April 17, 2023

Nathan Splinter
Manager, Energy and Sustainability
Queen's Facilities, 355 King Street West, Kingston, Ontario, K7L 2X3
Topic: Sustainable Engineered Landscape Final Report

Dear Mr. Nathan Splinter,

Attached below is the report entitled *Sustainable Engineered Landscape Final Report*. The document is intended to describe the results of the Sustainable Engineered Landscape Project for you and your team at Queen's Facilities as well as recommend further action that can be implemented for the project. The report also includes updates on discussions and information found in the previously provided *Sustainable Engineered Landscape Workplan* and *Sustainable Engineered Landscape Progress Report.*

This report contains necessary background information along with a description of the project definition, including project objective, constraints, and stakeholders. The report also contains a summary of compiled research and site investigations completed on Queen's campus. A select number of sites on campus were evaluated for potential redesign using an evaluation matrix developed based on Xpect Green's engineering judgment and feedback from you and your team. Preliminary designs were developed for the selected location and evaluated using another evaluation matrix developed by Xpect Green. These evaluations were used to produce a final site design which is presented in this report. The other major component of the project was a set of recommended updates to the Queen's Building Design Standards based on the campus vision described in the Queen's Campus Master Plan. The recommended updates are described in the report along with a mock-up of the updated standards. The mock-up is provided as an example of the potential implementation of these updates. A finalized version of the project schedule is included with the course requirements of a Work Breakdown Structure, Gantt Chart, and Responsibility Assignment Matrix. Rough estimations of project costs and an analysis of potential project risks are also included. The final section discusses potential recommendations that can be implemented were the project to move forward. The group dynamics observed during the course of the project completion are also included as a course requirement.

We hope that this report clearly details the results of the Sustainable Engineered Landscape Project and provides a vision for future naturalization projects on campus. If you have any questions, concerns, or comments regarding the contents of this report, please feel free to contact our Communications Lead, Brooke Sampson, at brooke.sampson@queensu.ca and we can discuss through email, in person, or video meeting.

Best Regards,

Team Xpect Green

Queen's University

Sustainable Engineered Landscape

Final Report

CIVL 460: Civil Engineering Design and Practice IV
April 17th, 2023

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Our signature below attests that this submission is our original Work:
Following professional engineering practice, we bear the burden of proof for original work. We have read the Policy on Academic Integrity posted on the Civil Engineering departmental website (https://engineering.queensu.ca/policy/academic-integrity) and confirm that this work is in accordance with the Policy.

Signatures:	Nathan Fitzpatrick	**Date:**	April 17 2023
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Acknowledgements

Team Xpect Green would like to acknowledge everyone that helped make the completion of the Sustainable Engineered Landscape Project possible. The Team would like to thank the Facilities Department at Queen's University, including Nathan Splinter, Llynwen Osborne, Marlow Sara Benson, Tony Gkotsis, Philip Wright, and Alexandra Rae Peet, for developing the project and providing additional information, resources, and feedback for the team during the completion of the project. The team would also like to thank Professor Sean Watt and the rest of the CIVL 460 teaching team for developing the course content and providing feedback on course deliverables. Finally, Xpect Green would like to thank Team Manager Juliana Reinert for providing the Team with constant support and encouragement during the completion of the project. Without the time and effort she has invested, the completion of this project would not have been possible.

Executive Summary

This report outlines the work completed for the Sustainable Engineered Landscaping project for the Facilities Department at Queen's University during the 2022/2023 academic year. The goal of the project was to develop and present a proof-of-concept for recommended updates to the Queen's Building Design Standards that promote the campus vision for naturalized landscapes described in the Queen's Campus Master Plan. The client intends to use the recommended updates to the Queen's Building Design Standards and proof-of-concept to promote greater consideration for the natural environment when designing new projects on campus. The proof-of-concept design will be used to demonstrate to Queen's University that the recommended updates are feasible and will benefit the University.

This project required completing preliminary research on topics relating to the development of naturalized landscapes such as planting, erosion control, retaining walls, coastal design, climate innovation, and social innovation. Research was also completed on the Queen's Building Design Standards and Queen's Campus Master Plan so that recommended updates to the Standards would reflect the campus vision as established in the Master Plan. Site investigations of campus were completed in the early stages of the project to identify persistent problems and areas that needed naturalization. Using an evaluation matrix developed by Xpect Green, with feedback from Queen's Facilities and surveyed students, five sites were evaluated to select a location suitable for producing the proof-of-concept design. The matrix scored each site based on social opinion, impact on surrounding environment, current adherence to the Queen's Campus Master Plan, current condition, and availability of funding. Through the evaluation matrix, the

concrete area between Watson Hall, MacCorry Hall, Jeffery Hall, and Harrison-LeCaine Hall was selected as an ideal location for developing a proof-of-concept design.

Three preliminary designs, focusing on either Stormwater Management, Naturalized Green Spaces, and Human Need, were produced for the selected site. These three designs were assessed using another evaluation matrix developed by Xpect Green, with feedback from surveyed students. The matrix scored each site design based on pedestrian health & safety, pedestrian accommodations, aesthetics, green zone magnitude, maintenance requirements, and groundwater management. The weighted evaluation of each of the designs was used to produce a final site design that incorporated all three of the design focuses to varying degrees.

Along with the proof-of-concept design, recommended updates were made for the Queen's Building Design Standards, with a focus on updating Division 32 – Exterior Design. The recommended updates included changing some of the existing sections of the division and adding a new section that discusses mechanisms for groundwater management. An example updated Division was produced to demonstrate how these recommended updates could be implemented.

The report also contains a finalized project schedule including a Work Breakdown Structure, Responsibility Assignment Matrix, and Gantt Chart. An estimation of potential project costs and an analysis of risks involved in the project were included. The final section of the report describes recommendations for implementing the project along with a discussion of observed group dynamics. The Appendices of the report contain additional information about the project including logbook meeting minutes, site investigation photos, and a breakdown of individual team member work hours.

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1.0 Introduction

Team Xpect Green was granted the opportunity to propose a solution to the Sustainable Engineered Landscape Project for the Facilities Department at Queen's University. The goal of the project was to recommend updates to the Queen's Building Design Standards (QBDS) that promote the campus vision for naturalized landscapes described in the Queen's Campus Master Plan (QCMP) and develop a proof-of-concept to demonstrate how these recommended updates could be applied to an actual site on Queen's campus.

One of the major components of the work completed for the project during the Fall Term was the identification of a section of campus with appropriate conditions to support the naturalization of the landscaping. Factors that were considered for site identification included ground conditions, drainage, and existing underground infrastructure. Research was collected on topics related to the naturalization of landscaping on campus including planting, erosion control, retaining walls, coastal design, climate innovation, and social innovation. In addition, the QBDS and QCMP were reviewed to determine the ways in which the Standards could be updated. The landscaping research and data collected from a student survey were used to develop an evaluation matrix from which five potential sites that had been identified on campus were evaluated. From this, the site best suited for redesign was selected. A map of Queen's campus showing the investigated sites can be found in Figure 1.

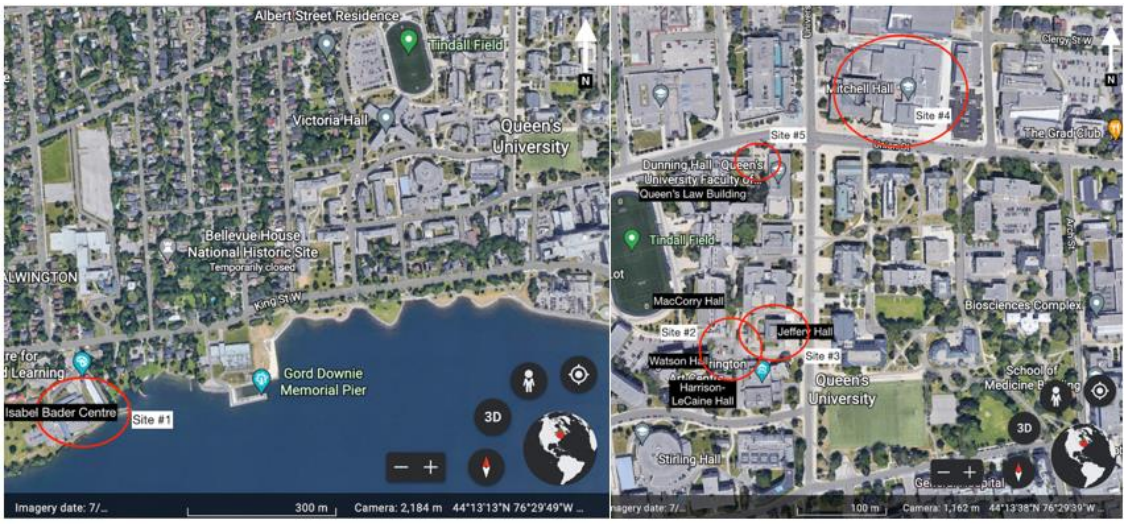

Figure 1: A map of the locations of the sites considered for naturalization design relative to Queen's University (Modified from Google 2022).

During the Winter Term, a final proof-of-concept design was created for the selected site to demonstrate how the updates to the QBDS might be implemented on campus. Three preliminary site designs were considered, each focusing on one of the identified key design components (Stormwater Management, Naturalized Green Spaces, and Human Need). A final proof-of-concept site design was produced using an evaluation matrix that was developed based on the vision described in the QCMP, feedback from the Facilities Department, and social response through another student survey. Each design was analyzed using the evaluation

matrix, and a final design was produced incorporating all three design elements based on evaluation matrix scores and the Team's engineering judgment.

Additionally, recommended updates to the QBDS, specifically Division 32 – Exterior Improvements, were developed and included in this report. Recommendations include investigating alternative retaining walls, re-evaluating the use of bollards on campus, specifying the recommended planting types, and adding an additional section dedicated to the management of stormwater runoff around campus. These updates would ultimately work to ensure that the design of future sites on Queen's campus conform to the vision described in the QCMP by fostering sustainability.

An important constraint of this project was the need to comply to the standards currently described in the QBDS. Considerations also needed to be made to site accessibility, potential weather conditions, the location's Climate Zone, and the management of site maintenance and drainage.

The risks within this project were assessed in Section 11.0, and include the attraction of wildlife to Queen's campus, potential for students to experience allergies from new plants, and general worker injury in the construction and planting of the proposed design. Environmental factors that were considered in the project included whether the proposed project would contribute to carbon sequestration, manage stormwater runoff, and impact species on campus with the introduction of new plants. Societal factors that were considered in the project included how the naturalized area would affect the mental health of those who use the area as well as general useability.

This Final Report summarises the work completed during the 2022/2023 academic year and presents the recommended updates to the QBDS and the proof-of-concept site design. The report contains background information about the project and a project definition, including objectives, constraints, and stakeholders. A summary of the research collected for the project on topics including site investigations, erosion control, alternative retaining walls, coastal research, climate innovations, the QBDS, the QCMP are also included. The process used to evaluate potential locations for redesign and select a final design is described in detail in this report, including an explanation of the evaluation matrices criteria and weighting, along with the process and results of the student surveys. A schedule for completion of the project deliverables is also outlined in this report along with budgeting predictions, a risk assessment, and future recommendations.

2.0 Background Information

A project similar to the Sustainable Engineered Landscape Project has never been attempted at Queen's University. During the first meeting with Queen's Facilities Manager of Energy and Sustainability Nathan Splinter on September 14th, he described the process involved in designing new developments on campus (Appendix A). When a new building or structure is being planned for construction on campus, a design team is put together to develop a plan for

implementation. This plan is developed with a high degree of focus on operational success and often neglects to consider the environmental impacts of the design. Splinter also expressed dissatisfaction with the results of Queen's University's "Campus Beautification Project" completed in 2008 (Queen's University 2016). The Campus Beautification Project significantly reducing the amount of greenery on campus, specifically on University Avenue from Stuart Street to Union Street, by replacing it with concrete. The client intends to use the recommended updates to the QBDS and proof-of-concept to argue for greater consideration for the natural environment when designing new projects on campus. For example, standards regarding plant types are not currently discussed in the QBDS and would guarantee that plants located on campus are supporting the surrounding ecosystem and helping to reduce the impacts of climate change. There is currently no mention of drainage and stormwater runoff management in the QBDS. The proof-of-concept design works to demonstrate to Queen's University that these new standards are feasible and will benefit the University.

Along with the Beautification Project, other contributors to the decrease in naturalized areas around campus were the killing of numerous Ash trees by Emerald Ash Borers, and the toppling of many trees due to one specific ice storm in 1998. The notable storm was the Ice Storm of 1998, which forced the City of Kingston to declare a state of emergency for the first time in history (CBC News 1998). The impacts of the event are still felt on campus today, with clear indicators of where long-standing trees around campus have had to be replaced. The potential for an event like this to occur again needs to be considered when designing for the naturalization of landscapes around campus, especially with the unpredictable implications of climate change.

Another topic discussed during the initial client meeting was the visible impact of heavy rainfall and flooding felt at some areas of campus. The design of sustainable landscaping in these areas could increase drainage and drastically reduce these impacts. Buildings built into downward slopes such as Robert Sutherland Hall and MacArthur Hall typically had suffered from issues relating to water infiltration due to poor drainage, as mentioned by the client on September 14th in a client meeting (Appendix A). The management of site drainage was an important consideration for the development of the recommended updates to the QBDS and the proof-of-concept design of the selected site.

3.0 Project Definition

This project involved suggesting recommended updates to the QBDS to reflect the campus vision for an increase in naturalized landscapes described in the QCMP. A proof-of-concept design was developed for how those updates may be implemented on campus. A suitable location for naturalization was selected based on the location's current condition, geological characteristics, and social utility. The naturalization redesign aimed to cultivate the space into a habitat for local species and integrate the area with the surrounding natural environment.

The sections developed for the Progress Report described the process of selecting the site location using recommendations made by the client, information gathered during site

investigations, and the opinions of students gathered from a student survey. Research was completed on potential plantings and other materials that would promote carbon sequestration and improve campus biodiversity. This research was used to back up the recommendations for future project implementation. As such, the additions in this Final Report include the process that was used to iterate towards a final design and a section outlining the sample updates for the QBDS.

3.1 Objectives

It was the goal of the Sustainable Engineered Landscape Project to suggest recommendations for updates to the QBDS and develop a proof-of-concept landscaping design that would be ecologically beneficial to Queen's campus and well received by the campus community. The design had to be safe, feasible, aesthetically pleasing, and optimized for efficiency. All stakeholders had to be properly considered so that the design was not biased or overly targeted. A project goal was to think broadly and consider the application of the selected site's specific ideas with a transitionary lens. This would allow the design rationale for the updates to the QBDS to feel generalized naturally, rather than forced or niche.

3.2 Project Constraints

For this project, the client desired a proof-of-concept in which naturalization takes place on Queen's University campus. Since the location selected to naturalize was near campus facilities, there were several constraints on the project related to spatial integration and the standards described in the QBDS. These standards are outlined in Section 5.5 and Section 8.0 of this report. The locations investigated were all near infrastructure that must not be disturbed without proper reason and planning. The dimensions of any additions needed to be carefully considered, with important infrastructure, both above and below ground, needing to be protected. Any structural changes made, such as altering a retaining wall, had to be within both ultimate and serviceability limit state parameters to ensure safe and convenient use of the area.

The redesign was also constrained by the need to ensure no traffic would be blocked due to project implementation. Any loss of accessibility had to be mitigated by ensuring there was a substitute route or deviation that would work for everyone involved. The project was also restricted by both time and money since it had to take place within the deadlines of the 2022/2023 academic year and had to be financially feasible.

Time would also constrain the implementation of the site's redesign when relating to the plants that would be incorporated. This is because many plants must be planted at a certain time of the year to prevent them from dying before sufficient growth. Some plants are also invasive and damaging to certain ecosystems and therefore, ensuring that the plants used in the design synergized with the location was a constraint. Plants also have the potential to cause allergic reactions to people and so any plants identified as common allergens were restricted in this project. It is recognized that not all allergens can be prevented due to the variety of unique responses in different people, so a common allergen was defined using Canadian databases for

the purpose of this proof-of-concept. This definition could be further explored through later community surveys to create a more prevalent list of restricted plants, but during the project the priority was to restrict plants that presented the highest risk. To ensure the design adhered to these constraints, the topics were included in the individual plantings research in Section 5.1.

The climate and soil available at the chosen location was also a constraint on which plants could be successfully implemented in design since different plants require different levels of nutrients and humidity to thrive. Similarly, different plants are unable to grow at more shallow depths of soil, which made soil depth another important constraint when selecting plants for the design. The variation in climate across the globe is significant when determining which plants will thrive on a site, since some foreign plants were considered. An example of some of the preliminary research that was completed on climate zones is shown through the map of vegetative zones in Canada provided by the University of Waterloo and seen in Figure 2. Further identification of what plants are best in the project's climate not only now, but in the future, was completed using the sources found in Section 5.1.

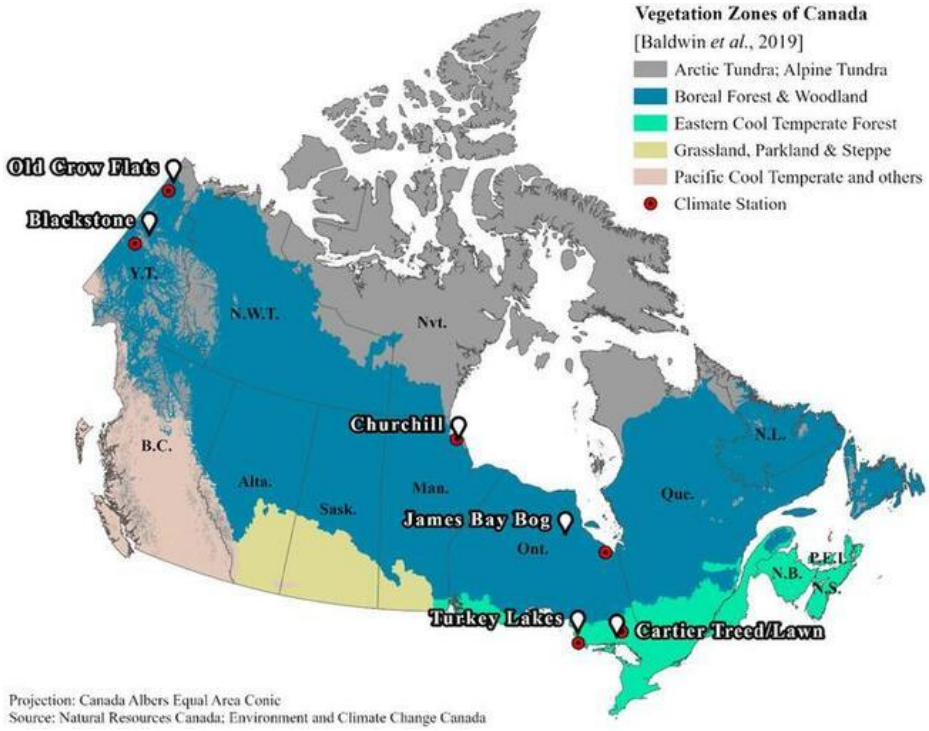

Figure 2: A map of vegetative zones in Canada (University of Waterloo Water Institute 2021).

The required maintenance of any plants involved was a constraint since the client expressed the desire for the site to be designed to require minimal maintenance (Meeting Date September 14th, 2022, Appendix A). However, the client did indicate that there would be some maintenance available if needed. Therefore, plants with potentially bothersome features and needs were avoided as a direct constraint, while the other aspects of maintenance were adapted into a criterion for the site design. For this reason, the project did not include any vegetation requiring specialist upkeep, such as a bonsai tree. Persuasive vegetation used to deter and guide pedestrians, such as thorny bushes, were also not included since more

intensive management would be required. This intensive management may not come from the upkeep of the persuasive vegetations, since many of them require little support to survive, but would be caused by the duty to manage the space around them. Examples of this would include preventing overgrowth or the degradation of other surrounding features that may result in greater risk of unintentional interaction with the persuasive vegetation. For the project to reach the goal of environmentally supportive design, the net environmental impact of all alterations must be positive. This constricted the design to certain options that needed to be creatively incorporated.

Another potential constraint was the weather conditions that the chosen location would face. Some structures or landscaped additions required consideration due to the Canadian cold, and the dangers that snow and ice could instigate. Not only can weather alter the forces acting on structures, but it can also lead to a larger drainage demand that this project had the potential to improve through added green spaces. Greenery or other researched features with sufficient filtration and drainage needed to be positioned to manage the surface run-off and prevent flooding. For this Final Report, infiltration technology, such as permeable pavement and rain barrels, have been researched and incorporated into a design criterion.

3.3 Stakeholders

The success of the Sustainable Engineered Landscape project will be important for not just the client but all parties that interact with the selected location. This section of the report outlines the general stakeholders that were identified before the selection of a location for naturalization design.

It is the Facilities Department's role to properly allocate resources for the benefit of an environmentally responsible Queen's University community. Recommended updates to the QBDS that reflect these efforts will be in the client's interest. The landscaping project designed acted as a learning experience to guide the rationale for these updates and, consequently, the client is invested in the project's timeline and quality. To help satisfy this stakeholder, the evaluation of the solution maintained their values on sustainability.

The students and staff that frequent Queen's University Campus will be in contact with the altered location most often. These stakeholders value travel efficiency and aesthetic quality, in addition to other personal preferences. These factors have a direct impact on the quality of life of these stakeholders since they make the campus more approachable and support an enhanced learning experience. The design of campus locations can also affect whether people feel safe, comfortable, and accepted while attending Queen's University. The recommended updates to the QBDS and selected site proposed could alter accessibility or dictate a passerby's motivation to utilize the spaces on campus. To help satisfy these stakeholders, the final suggested redesign aimed to create a space that integrates people instead of restricting them.

More than just people will be impacted by the suggested site redesign since the location will have its own ecosystem, including plants and wildlife. The project has the potential to displace or irritate this wildlife when performing construction. Not only is the process of landscaping

often loud but it can physically remove features of an area, such as food sources, that certain animals require for survival. The changes made to the ground can alter water quality and the height of the water table. By utilizing low emission concrete or other natural alternatives, the redesign has aimed to give the wildlife in the area a healthier lifestyle in the long-term. Increased greenery at the location also aims to create a net positive growth in green space, thus helping to improve not only habitat quality but the size of the space available for wildlife to form safe homes. More organized human activity can lower the risk of future habitat disturbances. The ecosystem may dictate spatial limitations of projects if certain areas are designated to be protected.

Those that oversee the Queen's campus will be invested in the project because it will act as a reflection of their capabilities. New students explore the campus every year and a well-designed area will provide a better impression of the administration's dedication to student welfare. The location is also nearby other campus locations that could be indirectly impacted by the changes. Mitigating any negative impacts on the surrounding areas will keep administration personnel pleased. Administration personnel must be convinced that the design presented through the new process is better than the current design process. The space had to be optimized to meet their needs, while also demonstrating a justifiable, positive impact on climate and student health. This stakeholder had many constraints outlined in the QBDS that needed to be upheld.

Just as Queen's administration could be overseeing spaces adjacent to the site, the City of Kingston could also be overseeing adjacent spaces. This would make them invested in the project because of the effects these sites will have interacting with each other. City by-laws also had to be followed or the proposal would be reprimanded and altered. Noise pollution is another big concern for cities and so minimizing complaints from the public will be pivotal. The Queen's Campus is an important institution in Kingston that helps to define the city's culture and identity. Ensuring that the campus is successful is of great importance for this stakeholder.

If there are any restaurants or other outlet stores around the chosen location, the design had the potential to be impactful. Changing an area can affect the inflow and outflow of people, animals, plants, or even water. Local businesses could receive a greater magnitude of business if changes to a site near there business provided outdoor seating but could also have to deal with costly natural damages, such as flooding or animal droppings. It was important for this stakeholder that the project considered the possible negatives to a naturalized landscape that is executed rashly.

The faculty helping to organize the project was another important stakeholder. The faculty has provided teaching assistants to guide the project as the result directly reflects the faculty's quality. The project's teaching assistant had to be kept up to date on the progress of the project to ensure the faculty could continue providing guidance.

Many of the changes that would be made to the landscape of the chosen location will require professional landscapers and construction workers to complete. The project will impact this

stakeholder by providing them with income and experience. A more complex solution would involve difficult procedures that would increase the risk of injury for those involved on the site. Ensuring the feasibility of a safe and practical solution is an interest of this stakeholder.

Those supplying materials for the proposed redesign could receive business and have the opportunity to advertise their involvement in an urban project. The scale of the project would increase both factors. The suppliers themselves will dictate what materials are available for the project and in what quantities.

4.0 Site Investigations

Various sites across Queen's University campus were investigated on September 28th, 2022. The five sites shown in Figure 1 were assessed at the same time as various other small sites and patches of grass around campus. These small grass patches served no obvious purpose and were often unable to grow due to excessive foot traffic. If these areas were to be naturalized, the fact that these areas have heavy foot traffic would need to be considered. It would be necessary to design around this fact and either make it obvious that the area is not to be walked on by making them difficult to walk through (i.e., planter boxes or raised ground) or redesigned to create naturalized walking paths. An example can be seen in Figure 3 showing the grass patch in front of Brant House.

The goals of the site investigations were to get an idea of what locations on campus could use naturalization, observe how different green areas are currently used, determine where there may be wasted space, and to get an idea of how much concrete is used on campus spaces that may have the potential to be naturalized. The outline of each of the five assessed sites are shown in Figure 4, Figure 5, Figure 6, Figure 7, and Figure 8. Notes were collected about the important characteristics of each site as displayed in Table 1. Images showing the described conditions at each site can be found in Appendix B.

Figure 3: Example of a small, green space on campus in front of Brant House

Figure 4: Outline of the area assessed for Site #1 (Modified from Google 2022).

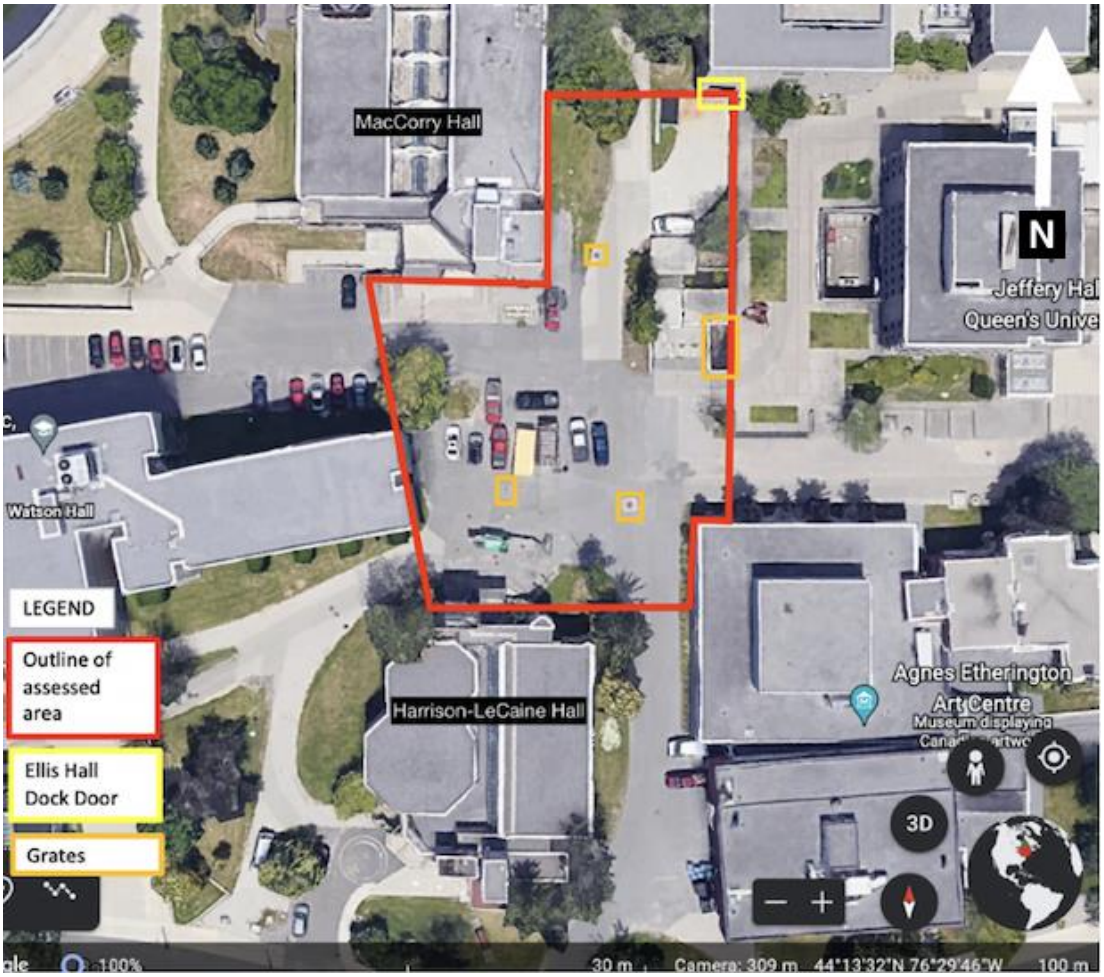

Figure 5: Outline of the area assessed for Site #2 (Modified from Google 2022).

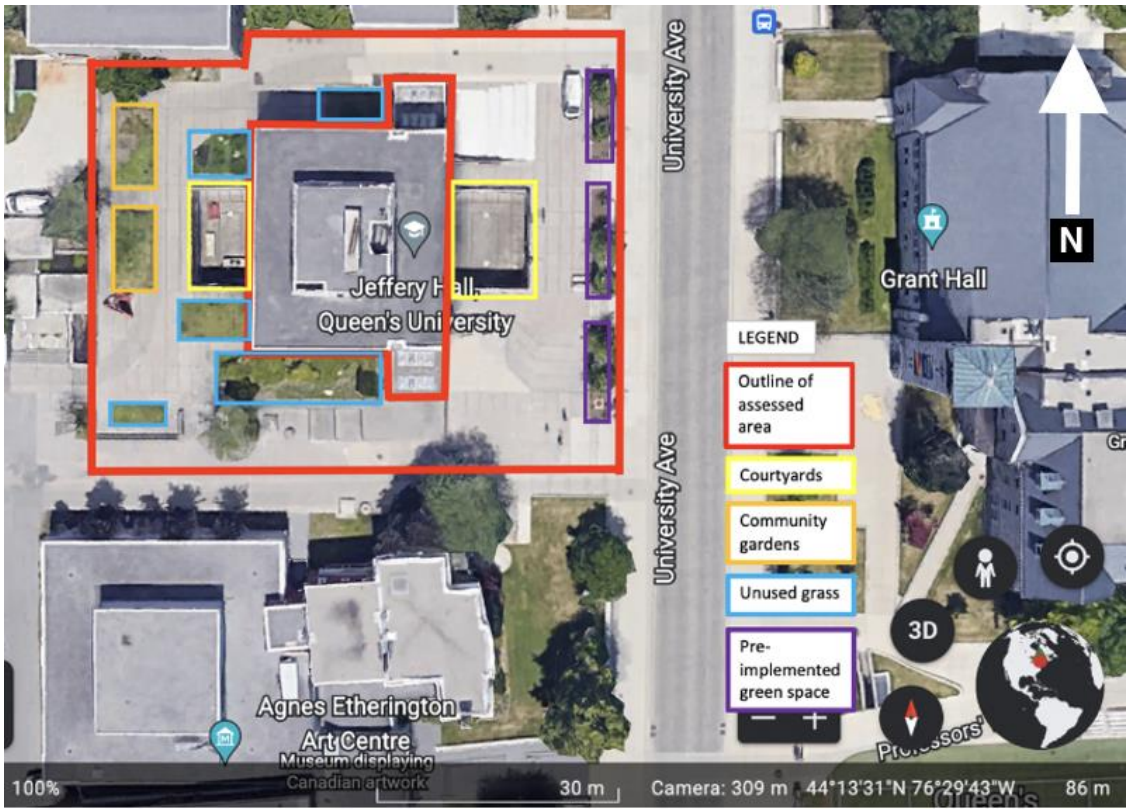

Figure 6:Outline of the area assessed for Site #3 (Modified from Google 2022).

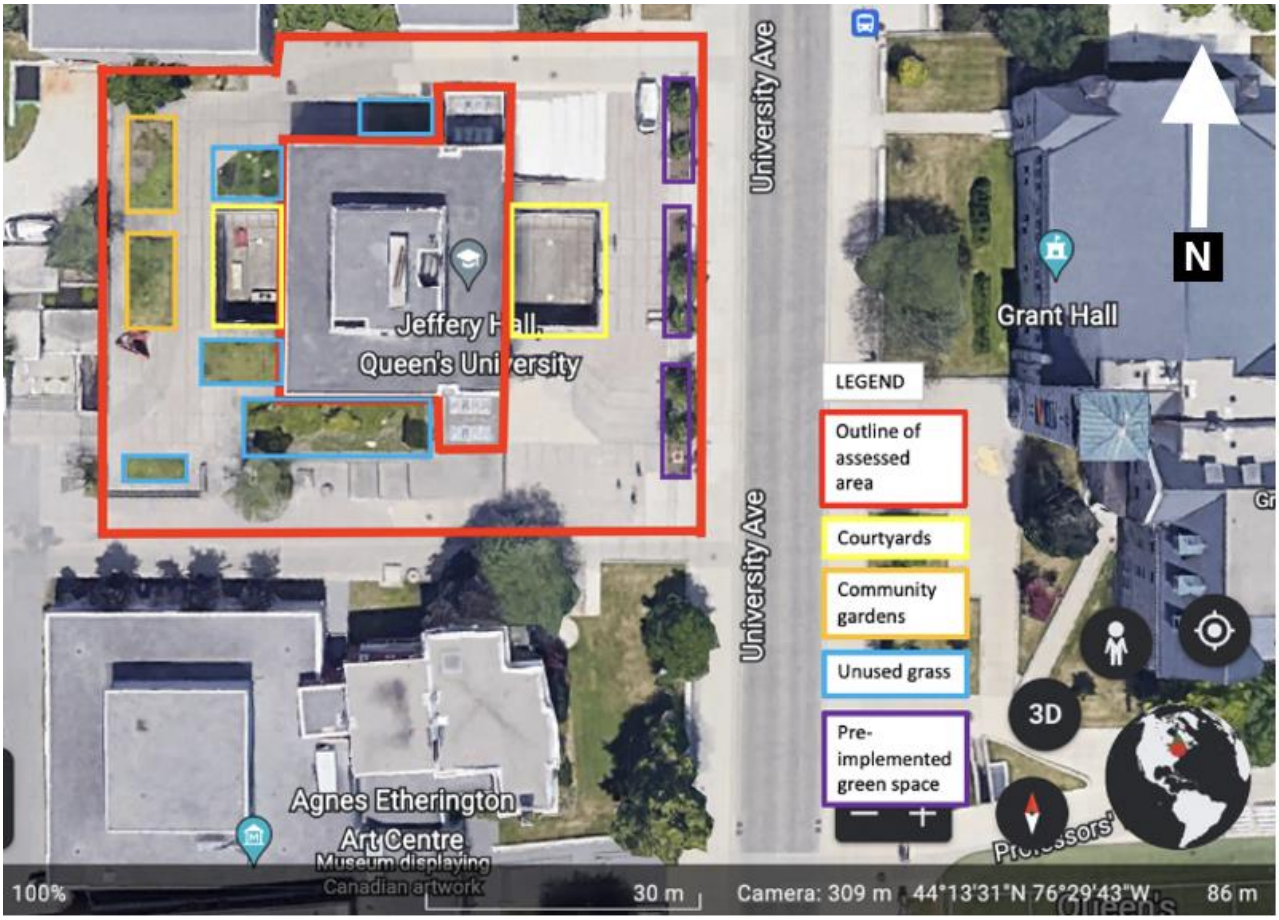

Figure 7: Outline of the area assessed for Site #4 (Modified from Google 2022).

Figure 8:Outline of the area assessed for Site #5 (Modified from Google 2022).

Table 1: Compiled notes on the site conditions of each of the five sites.

Site N.	Site Description	Site Investigation Notes
#1	The area between the South-East shoreline of Lake Ontario and the Isabel Bader Center.	1. The retaining wall concrete shows signs of major deterioration. 2. There are multiple rusting pipes extruding from the retaining wall. 3. The stones that make up the walking path are becoming loose due to vegetation growth in cracks. 4. The green area above the retaining wall is in good condition apart from the flattened grass where it is clear pedestrians have been walking.
#2	The area between Watson Hall, MacCorry Hall, Jeffery Hall and Harrison-LeCaine Hall.	1. Large open space with no vegetation or green space. 2. Vehicle traffic is prominent to certain buildings such as the Ellis Hall dock door. 3. Multiple grates in the area including in the middle. 4. Significant foot traffic.
#3	The area surrounding Jeffery Hall.	1. Minimal green space except for the small staff community garden on the West side of the building. 2. Two large courtyards sunken in the ground with no vegetation – all concrete, much of which is cracked. 3. Unwanted vegetation growing between cracks in concrete in entire area. 4. Apart from the community gardens, the entire surrounding area is concrete.
#4	The pathways between Mitchell Hall and the adjacent buildings.	1. Some vegetation in the form of narrow, concrete planting boxes surrounding Mitchell Hall. 2. Significant foot traffic on North and South sides of the building. 3. Entire area is covered in new concrete in good condition.
#5	The planter garden located between the Law Building and Dunning Hall.	1. Four planter boxes falling apart, made of stone and concrete. 2. The ground in the area is all concrete with multiple cracks and unwanted vegetation growing in the cracks. 3. Planter boxes filled with what is assumed to be weeds. 4. Substantial foot traffic.

Site investigations were also used to assess the drainage in different locations across campus, since a common topic amongst students on rainy days is the sub-par drainage throughout campus. Although drainage was considered during the site investigation, not every site was visited during rainstorms due to various constraints, including timing of rainstorms. To address the drainage problem, this topic was thoroughly discussed and integrated into the final design and recommended standards updates included in this report.

5.0 Design Research

Research was conducted on technical aspects of the project and impacts of the project on the surrounding environment. The research was used to make recommendations for updates to the QBDS and redesign the selected site to improve naturalization.

5.1 Planting

To create green spaces on campus that promote carbon sequestration, trees and shrubs must be planted. This is because their larger biomass allows them to be the most efficient carbon sinks. It is important to focus on planting native trees because they will be better suited to the climate and soil type, which will reduce maintenance, conserve water and soil, and benefit the wildlife and plants in the environment (Rideau 1000 Islands Master Gardeners 2022c). Different species of trees and shrubs have varying features that must be considered before planting. For example, the lifespan of a tree must be considered to plan for the future of the area it is planted in. Appendix C contains a list of possible native Ontario tree and shrub options, including details of each plant that would aid in decision making (Booth 2020; Credit Valley Conservation 2022a; Government of Ontario 2022; Muma 2019; Ontario Wildflower 2018).

There is currently a City of Kingston urban forest management plan that focuses on the long term benefits and costs of urban tree planting and the importance of maintaining tree cover. The plan emphasizes proper planting of trees to ensure preservation of the urban forest and promotion of fruit bearing trees to support the ecosystem (City of Kingston 2011). There are standards of tree maintenance in the City of Kingston by-laws and QBDS which state that trees must be properly pruned to prevent impact to infrastructure and to ensure public safety. Trees must also be removed if they become a hazard or an obstruction (Queen's University n.d.; City of Kingston 2017). This must be considered during planning so that trees will only be planted in areas where they will not become a hazard or obstruction in the future. This can be done by choosing a large area where it is unlikely that trees would become an issue or choosing a tree that will suit a more enclosed area.

All the potential sites for naturalization involved unused grass areas or small gardens lacking biodiversity. This means the gardens only contained a few species of plants with little variation in color, shape, or size. This can lead to an absence of ecological resilience as the garden will be more susceptible to pests and diseases. A lack of biodiversity also negatively impacts the overall health of the garden due to different species playing important roles in nutrient cycling, soil health, and pollination (Rideau 1000 Islands Master Gardeners 2022c). More biodiversity will

not only make a heathier garden, but also a more aesthetically pleasing garden. One solution is utilizing “meadowscape” landscaping design, a cluttered garden design that relies on its own ecological system (Rideau 1000 Islands Master Gardeners 2022b). An example of this design can be seen in Figure 9, where a large grass area incorporates many different plants to create a biodiverse patch that looks similar to a naturally growing meadow. The benefits of this landscaping design (Rideau 1000 Islands Master Gardeners 2022b) include:

- Offers habitat and forage for birds, pollinators, and beneficial insects.
- Native plants improve water infiltration and offer drought resistance.
- Eliminates mowing and greatly reduces maintenance.
- Eliminates the use of fertilizer, pesticides, and herbicides, which improves water quality due to reduced runoff.
- Higher carbon sequestration compared to traditional grass and gardens due to larger density of native plant roots.

Figure 9: Example of “meadowscape” landscaping design (NatureScot, 2018).

A variety of native grasses and flowers can be used to create these spaces. The selection can be based off sunlight or soil preference, tolerance of harsh conditions, and aesthetics. It is important to consider these factors during the selection of plants to ensure the new green spaces will survive as a healthy ecosystem. In Appendix C, tables can be found containing a selection of wildflowers tolerant to salt and harsh conditions, the sunlight and soil preferences of a selection of wildflowers, and a list of all native poisonous plants to avoid using. These plant selections will be a useful resource when designing greenspaces on campus, as details used to inform plant selection will be available.

There is also a similar landscaping design called “sedgescaping”. Sedges are a large family of graminoid (grass-like) flowering plants with 5,500 known species. There are approximately 200 sedges native to Ontario that vary in characteristics to fit in any ecosystem and design (Rideau 1000 Islands Master Gardeners 2022b). An example of a sedgescaping design can be seen in Figure 10.

Figure 10: Example of “sedgescape” landscaping design (Rideau 1000 Islands Master Gardeners 2022b).

Underplanting trees with sedges instead of mulching is an important part of maintaining a healthy landscape ecosystem. The dense sedge root systems hold water to help keep trees hydrated, improving the moisture capacity of the soil. This helps with the issue of having too many trees in an area drying out the soil, which can cause invasive tree roots to search for moisture in surrounding areas (Rideau 1000 Islands Master Gardeners 2022b). Other benefits of using sedgescaping design (Rideau 1000 Islands Master Gardeners 2022b) include:

- Native plants improve water infiltration and offer drought resistance.
- Provides nesting sites for small wildlife.
- Larval host for pollinator species.
- Seeds are source of food for small wildlife.
- Some species are evergreen, adding colour in the winter.
- Deer do not eat them.
- Eliminates the use of fertilizer, pesticides, and herbicides, which improves water quality due to reduced runoff.
- Higher carbon sequestration compared to traditional grass and gardens due to larger density of native plant roots.

An important aspect of the green space design was to not drastically increase the amount of maintenance on campus. Using the sedgescape and meadowscape landscaping techniques

reduce the need for maintenance as the landscapes are created to grow and thrive in their own ecosystem. There should also be proper lining on the edges of each landscape to avoid overgrowth onto pathways. The only maintenance to the new landscapes will include occasional trimming to avoid overgrowth, and the pruning of trees and shrubs when the branches begin to effect public safety. Apart from occasional trimming, the discussed landscapes are self-sustaining without the need for watering or mowing.

5.2 Erosion Control

Natural Fibre Erosion Control Blankets were researched as a method of controlling erosion in naturalized areas on campus. This method had the potential to benefit the chosen site, in terms of controlling erosion. This method promotes the establishment of vegetation, contributes to slope protection, and is biodegradable, therefore having minimal impact on the existing soil (Terrafibre 2022). An example of a Natural Fibre Erosion Control Blanket in use can be seen in Figure 11.

Figure 11: Example of a Natural Fiber Erosion Control Blanket in use (Devtron Sale Ltd 2022).

Coconut Fibre (Coir) logs were researched as a natural coastal retaining structure. They are effective in providing a natural method of soil stabilization and support along various erosion-prone areas (One Clarion 2022). They offer a high level of strength and reinforcement and are all natural and biodegradable. An example of Coconut Fiber logs in use can be seen in Figure 12.

Figure 12: Example of Coconut Fiber logs in use (D2 Land & Water Resource 2022).

Synthetic geotextiles are another option for erosion control that had potential for implementation in the project. Woven geotextiles are created by weaving together fibres, whereas non-woven geotextiles are made by bonding fibres together. There are a variety of both woven and non-woven geotextile types with varying pore spaces. These geotextiles consist of synthetic materials such as polypropylene, polyester, polyethylene, nylon, polyvinyl chloride, glass, and various mixtures of these materials (United States Environmental Protection Agency 2021). An example of a synthetic geotextile being used in an erosion control method is provided in Figure 13.

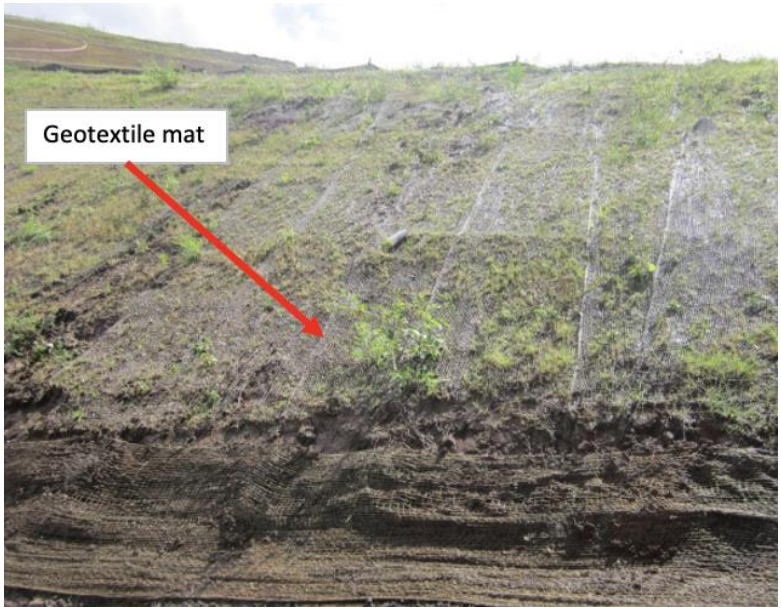

Figure 13: Geotextile mat used to control erosion on a steep slope (United States Environmental Protection Agency 2021).

5.3 Alternative Retaining Walls and Coastal Design

Preliminary research was completed on various types of natural alternatives for retaining walls, such as vegetative walls, crib walls, gabion walls, and rammed earth walls.

Vegetative retaining walls are an option where plants can grow out of the bags that make up the overall structure of the wall. This is an appealing option because it provides ample space and flexibility for greenery. This option is mostly used in inland settings and so testing would need to be done to validate the stability in a coastal setting. An example of a vegetative retaining wall can be seen in Figure 14.

Figure 14: Example of a vegetative retaining wall (Flex MSE 2007).

Crib Retaining walls include interlocking planks, which can be made of natural materials and provide pockets for natural growth in between planks. Some centrifugal testing has been done to validate the strength of these walls (Sudan Acharya 2010) making them a promising option. The concerns relating to crib retaining walls are the potential for weakening of the structure if there is rot in the wood under wet conditions or pests eating away sections. An example of a crib retaining wall can be seen in Figure 15.

Figure 15: Example of a crib retaining wall (Norwegian Geotechnical Institute 2016).

The gabion retaining wall is another alternative where interlocking wire baskets full of stone make up the structure, which provides good hydraulic conductivity and substantial strength (Odom 2019). These characteristics make the baskets an excellent option for managing the forces present in most campus settings, but may not be ideal for dealing with the waves at Site #1. When ice forms in the gabion baskets, forces can work to pull apart the wiring and degrade rock. Even so, advances in galvanized steel and spray on mitigation have nearly eliminated the threat of rusting in the baskets and so further creativity may help to eliminate the issue of ice in this alternative as well. This option also has flexible arrangements that can increase the room for plantings and improve aesthetics, such as the example shown below in Figure 16.

Figure 16: Example of a gabion retaining wall (Soraya, n.d.).

Retaining wall research was also conducted on the Rammed Earth Wall which uses local aggregates, rebar, and small amounts of Portland cement to stabilize walls (Innovative Earth 2022). As an ancient method to construct sturdy walls, now typically used for homes and building designs, it has potential to be implemented as an aesthetically pleasing retaining wall on campus. An example of this type of retaining wall can be seen in Figure 17. Note that this type of retaining wall could be used on campus, however not near the water for coastal applications.

Figure 17: Example of a Rammed Earth Wall (First in Architecture 2019).

5.4 Alternative Coastal Design

Geotextile breakwater tubes were researched as another method to control erosion along a shoreline. Although this may not be relevant to the chosen site, it was necessary as preliminary research for Site #1. These breakwater tubes act as a first line of defense against tidal action and waves and help retain sand and shorelines, working to achieve coastal erosion control (Erosion Control Products 2022). An example can be seen in Figure 18.

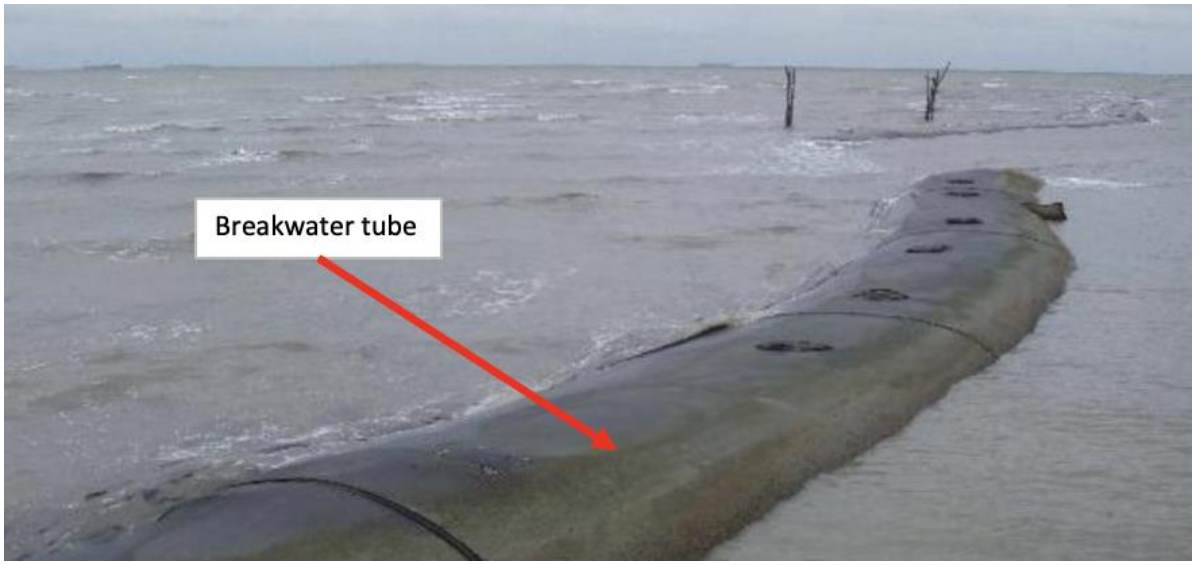

Figure 18: Example of a geotextile breakwater tube (Malaysian Ministry of Environment and Water 2017).

5.5 Climate Innovation

A large part of the project goal was to produce more sustainable and biodiverse areas on campus through the development of innovated climate technologies. One area of innovation is in the science of carbon sequestration. Carbon sequestration is a process where the carbon dioxide in the atmosphere is captured through biological, chemical, or physical methods. Climate change is directly related to increased carbon dioxide in the atmosphere which increases global temperatures. This is the greenhouse effect and has caused the global temperature average to increase by approximately 2 degrees Fahrenheit over the last century, with the rate increasing each year (Lindsay 2022). To help lower the rising global temperature, increasing the magnitude of carbon sequestration in communities is an innovative step for the future. The new planting and landscape methods in Section 5.1 will significantly increase carbon absorption. One mature tree can absorb approximately 48 pounds of carbon dioxide in one year, and the density of the root systems in the meadowscape and sedgescape designs absorb more carbon dioxide than traditional gardens (NatureScot 2018). New carbon sequestering green spaces on campus can feasibly influence other communities to create similar spaces, making a larger impact in the fight against climate change.

Another key area of innovation that has been utilized in this project is in stormwater runoff management. Low Impact Development (LID) Technologies are the newest form of stormwater runoff groundwater management practices, which aim to manage runoff by increasing infiltration of water into the soil (Toronto and Region Conservation Authority 2019).

Permeable pavement is a type of paving that is designed to allow for rainfall to infiltrate into the underlying soil and remove contaminates from the storm water (Capital Region District 2013). Increased infiltration to the soil is achieved using pathing designs that include small gaps between areas of concrete as shown in Figure 19 below. Permeable paving does require more maintenance than typical paving due to the collecting of debris in the infiltration gaps. Clogging of these gaps can reduce the effectiveness of permeable paving.

Figure 19: An example of the permeable pathing design used to improve infiltration (Sustainable Technologies 2019)

Infiltration trenches are another LID that can be used at the sides and ends of pathways to improve infiltration. Trenches are dug around the perimeter of pathways and filled with small rocks and gravel (Sustainable Technologies 2023). Water is better able to infiltrate into these trenches where they are in contact with the soil layer beneath the pathway.

Vegetative swales and rain gardens are two types of green space development that can be used to increase infiltration and manage storm water. Vegetative swales are open shallow channels that slow runoff and promote infiltration into the ground (Un 2017). Swales can also be designed with earth weirs that further slow the runoff. Rain gardens are plant areas developed with especially permeable soils and graded to capture water (Jarrett 2022). Some rain gardens also place a layer of rock or gravel at the bottom of the permeable soil to increase permeability.

Rain barrels are one of the most popular and well known LIDs due to there relatively low cost and high accessibility. Rain barrels are a form of rainwater harvesting where water is collected and stored in barrels above ground (Sustainable Technologies 2023). Rain barrels are typically placed beside rooves so that water collected in eavestroughs can be sent to the rain barrel. Water collected in rain barrels are typically used during the dryer months in the summer for irrigation to save water and costs.

5.6 Social Innovation

The evidence of the positive effects on mental health from being in nature includes studies on psychological conditions such as depression, anxiety, and other mood disorders. Access to nature has been found to improve sleep, reduce stress, increase happiness, promote positive social interactions, and help generate a sense of meaning to life (Beyer et al. 2014). Being in green environments also boosts various aspects of thinking, including attention, memory, and creativity, in people both with and without depression (Kingsley 2022).

A study took 38 healthy participants out of urban environments and into a nature experience and took brain scans to see how their prefrontal cortex changed. Before the nature experience the participants showed elevated levels of rumination, which is usually studied in the context of clinical depression. After the nature experience the participants showed lowered levels of rumination and a decrease in the stress hormone cortisol (Bratman et al. 2015). This study proved that even a short period of time in nature can increase the mental health of people effected by the stresses of urban living, especially students.

Poor mental health is rising in university students, with 46% of Ontario students in 2016 stating they are too depressed to fully function and 65% stating they suffer from overwhelming anxiety, these percentages both being approximately 7% higher than in 2013 (Ontario’s Universities 2017). Creating larger and more frequent green spaces on campus can produce social innovation by helping students and staff maintain better mental health.

5.7 Queen's Building Design Standards

The Queen's Building Design Standards (QBDS) are a set of documents that outlines specific design standards for Queen's University. The documents are intended to be used in conjunction with applicable codes and regulations put in place by the City of Kingston and other regulating bodies. The latest complete version of the QBDS was published in 2017. Divisions are currently being updated and added for the newest version of the report. The QBDS has a total of 32 Divisions, each outlining the standards of specific design aspects.

The QBDS can be found on the *Facilities at Queen's University* section of the Queen's University website. A document for each of the Divisions of the QBDS can be found on the webpage, along with documents on some other general standards and additional policies. The Divisions of the Standards most applicable to the Sustainable Engineered Landscape Project are explained in further detail in Table 2.

Table 2: A list of the Divisions in the Queen's Building Standard of particular interest and their respective design concerns [Adapted from Queen's University n.d.].

Queen's Building Design Standards Division	Design Aspects of Concern
Division 01 – General Requirements	• General Notes • Summary of work • Work Restrictions • Price and Payment Procedure • Contract Modification Procedures • Payment Procedures • Project Meetings • Construction progress Documentation • Special Procedures • LEED Requirements • Quality Requirements • Sustainable Requirements: Concept Design • Construction Facilities • Temporary Barrier and Enclosures • Temporary controls • Cleaning & Waste Management • Facility Performance Requirements • General Commissioning Requirements
Division 22 - Plumbing	• Common Work results for plumbing • Plumbing Piping • Facility Water Distribution • Facility Sanitary Sewerage • Electric Domestic Water Heaters Commercial Plumbing Fixtures

Queen's Building Design Standards Division	Design Aspects of Concern
Division 31 - Earthwork	• Common work results for earthwork • Clearing and grubbing
Division 32 – Exterior Improvements	• Operations and Maintenance of Exterior Improvements • Common Work Results for Exterior Improvements • Unit Paving • Concrete Walks and Curbs • Sidewalks • Wood, fences, and gates • Retaining Walls • Metal and Chain link Fences and Gates • Site Furnishings • Manufactured Site Specialties • Planting Preparations • Turf and Grasses • Plants • Planting Accessories

These divisions are of particular interest when considering the ways that projects like the Sustainable Engineered Landscape Project are currently regulated by Queen's University and how they may be improved to support naturalization of areas on campus.

Division 01 – General Requirements includes many of the administrative aspects of the design project such as payment, project management, contract procedures, and key aspects relating to sustainability. This includes information on LEED Certification Requirements, Queen's University's own Sustainability Requirements, and Cleaning and Waste Management standards.

Division 22 – Plumbing includes information and standards relating to plumbing in and around sites on campus. It should be considered when designing a naturalized site that includes any drainage system, like planting or the construction of retaining walls. Besides that, sites need to be designed as to not interfere with the current plumbing installed in the area.

Division 31 – Earthwork includes standards relating to the removal of soil and trees on campus. Projects involving the naturalization of sites on campus will likely require the removal or movement of soil and dirt on the site. Sites will also require a level of maintenance that may involve the pruning or removal of a tree.

Division 32 – Exterior Improvements is especially important when designing naturalized sites. This division covers standards relating to a wide range of exterior design elements including

sidewalks, fences, retaining walls, and plants. These standards will guide many of the finer details of the design of a naturalized site on campus.

It was important that these standards we followed during the project as much as possible to improve the ability of Queen's Facilities to use work done on this project for potential future designs.

5.8 Queen's Campus Master Plan

The Queen's Campus Master Plan (QCMP) is a document establishing a framework for guiding how Queen's University will physically change over the next 10 to 15 years. The framework aims to accommodate the evolution of programs and activities at Queen's and enhance the student experience. The QCMP explains the process that Queen's University underwent to complete the study of sites on campus and ways they could be improved. Some particular space needs and conditions are also highlighted. The Campus Vision is outlined in the QCMP with six guiding principles (Queen's University 2021):

1. Support Queen's academic mission.
2. Enhance the campus experience.
3. Promote good facilities management.
4. Foster a more sustainable campus.
5. Integrate the campus with its settings.
6. Create a campus that supports health and wellness.

The QCMP also discusses plans and initiatives for integrating Queen's University with the City of Kingston, including the cycling networks, housing, and public transport. There is also more in-depth discussion of the Master Plans for Main and West Campus. These focus on current and future land use, social infrastructure, heritage, movement networks, and utilities. The QCMP also briefly outlines plans for implementation of the Master Plan with building design guidelines and precinct plans.

6.0 Site Selection

An evaluation matrix was developed including chosen criteria and weightings that were then used to select a final location for the proof-of-concept design.

6.1 Site Evaluation Matrix & Rubric Outline

The evaluation matrix developed to analyze the potential sites for redesign is seen in Table 3.

Table 3: Blank evaluation matrix used to analyze the potential sites for redesign.

Criteria	Weight	Site #1	Site #2	Site #3	Site #4	Site #5
Importance to Students	15%					
Impact on Environment	25%					
Current Adherence to Master Plan	25%					
Current Condition	20%					
Availability of Funding	15%					
Total	100%					

To ensure that scoring was consistent for each criterion, an evaluation rubric (Table 4) was created to define the scores in each criterion.

Table 4: Evaluation rubric that defines the meaning of the scores in each criterion of site evaluation.

Criteria	**Low (1)**	**Medium (2)**	**High (3)**
Social Opinion	Site received a Social Score less than 3.	Site received a Social Score between 3 and 3.3.	Site received a Social Score greater than 3.3.
Environmental Impact	Area has little to no room for planting plants/ trees.	Area has some room for planting	Area has lots of room for planting
Adherence to Master Plan	Current site adheres to 5 or more of the guiding principles	Current site adheres to 3-4 of the guiding principles	Current site adheres to 2 or fewer of the guiding principles
Current Condition	Site is in ideal visual and structural condition (i.e., minimal to no cracking or degradation), site is completely useable to its full extent.	Site has poor visual OR structural conditions but is more or less still useable.	Site is in poor visual and structural condition (i.e., multiple areas of cracking or degradation), site is nearly not or not useable to its full extent.
Available Funding	Little to no funding available from any source	Funding available from either the City of Kingston OR Queen's University (not both)	Funding available from both the university and from the City of Kingston.

The categories described below produced the quantifiable criteria seen in Table 3. The following paragraphs explain the reason each category was chosen as a criterion while providing rationales that explain the reason for each rubric range and matrix score.

Social Opinion:
The sites were evaluated for how important the naturalization of the site is to the surveyed Queen's students, considering the evaluation rubric in Table 3. The social scores from the survey were evaluated relative to each other and so the ranges that were used in this criterion of the rubric tried to distribute and distinguish the best and worst sites. The lowest score was approximately a 2.6 for Site #1 and the highest score was approximately a 4.0 for Site #3, so it was decided that anything scoring more than half-way between these two scores, a 3.3 or higher, should be given full points of 3 on Table 3. This was because even if they did not score the highest, they were still areas receiving a strong public desire for improvements. The lower bound of the 2-point range was set to a social score of 3 because anything below this likely saw a very low score in one of the two questions that pulled down the overall score. A score of 3 would be the median of possible responses and so a lower score would suggest a social perception leaning towards disagreement.

Impact on Surrounding Environment:
The sites were evaluated for how impactful changes could be for the location's environment, considering the amount of area each site has for planting plants and trees. Sites that have lots of unallocated space and are surrounded by other heavily paved areas will have a larger impact on the environment than a site that is near other very well naturalized sites. A naturalized site's ability to stand out from the other surrounding areas will create a more positive experience for students in that area. A site with lots of undesignated space that would not be required to be paved was to be represented by a score of 3, a site with space to add plants, trees, and other greenery but also with large sections of space where this would not be possible were represented by a score of 2, and the sites with almost no room or only very small sections of space for environmental components were represented by a score of 1. Site #5 received a score of 1 because the space was very small to begin with and there would not be any space to make major changes. Site #3 and Site #4 were given scores of 2 because despite their size they are very linear and require large sections to remain paved for frequent pedestrian movement. Site #1 and Site #2 were considered sufficiently sized to provide major changes while not requiring paved walkways that would take up most of the space. Therefore, these two locations received a score of 3.

Current Adherence to Master Plan:
The campus vision described in the QCMP guides site design, but not all sites on the campus have been given attention during the duration of this document's lifespan. Thus, not all sites currently conform to the QCMP. This criterion is a measure of how much the current site design reflects the values established in the QCMP, since sites that achieve few to none of the goals established in the Master Plan should be more appealing investments for the University and be considered higher priority for proof-of-concept naturalization than those that already achieve many of the goals. These goals include promoting good facility management, fostering a

sustainable campus, and integrating the campus with the surroundings. Evaluation of each site's adherence to the QCMP was done by determining the extent to which each site follows the six guiding principles defined within the QCMP. Sites were rated inversely to the number of guiding principles they followed. A site that followed five or more of the guiding principles received a score of 1, a site that followed either three or four of the guiding principles received a score of 2, and a site that followed two or fewer of the guiding principles received a score of 3. Site #1 received a score of 1. Despite some issues with the site's current retaining wall, the current site design is pleasant and well-integrated with the environment, while effectively following most of the QCMP guiding principles, including Principles 1, 2, 4, 5, and 6. The site failed to meet Principle 3 due to the issues associated with the site's retaining wall. Site #2 and Site #3 were both given a score of 3, since these areas failed to meet most of the guiding principles in the QCMP including Principles 2, 3, 4, 5, and 6. These areas consist mostly of concrete and asphalt, with very little in the way of interesting design. The small section of green space currently in the area is in very poor condition in terms of both the concrete tiling and the current plantings. Site #4 also received a score of 3, since this site failed to achieve Principles 1, 2, 4, 5, and 6 of the QCMP due to its large amount of concrete and lack of noticeable design elements. Site #5 received a score of 2, with the site achieving only Principles 2, 4, and 5 of the QCMP by being well integrated into the environment but failing other principles because it is poorly maintained.

Current Condition:

The sites were evaluated on their current condition, since sites that have visible damage to pathways and infrastructure could be greatly improved if given the attention that would come with site naturalization. Sites in poor condition reflect badly on the University while lessening the quality of the student experience on campus and sites that are in very good condition are significantly less likely to be worth the investment by the University to demolish or change existing infrastructure. The current condition of each site was rated based on the visual and structural conditions with a score of 1 given to sites that were visually and structurally complete. Good structural conditions were defined as a site having negligible cracked or chipped materials and no displaced components. Good visual conditions were defined as a site not being neglected, with overgrown or discoloured features that do not synergize with the surrounding landscape. Site #4 was given a score of 1 because the location was recently developed, and the site investigation identified no visible wear or mess. Site #2 and Site #3 were given scores of 2 because despite visible wear the locations were structurally adequate and used on a regular basis. Site #1 and Site #5 were given a score of 3 because they had visual and structural problems. The retaining wall at Site #1 was eroding, while the planter boxes and pathing at Site #5 had broken sections.

Availability of Funding:

This is a measure of the funding available for the naturalization of each site. Most of the sites under consideration will be located on Queen's main campus, so Queen's University is the primary investor in construction. However, some sites may be overseen in partnership between the University and the City of Kingston and so naturalization of these sites may be funded by both parties, allowing for far more options and higher quality designs to be considered

(Meeting Date September 14th, 2022, Appendix A) This does not guarantee additional funding, but it could be available if relevant stakeholders are convinced of the project's worth. It is the opportunity for better quality designs that makes the available funding an important criterion. The funding for each site was evaluated based on how many stakeholders would likely be contributing. A score of 1 was given to any site with no known funding possibilities since it would be more difficult to start a project there, if only 1 of the stakeholders were believed to be potential funders the site was given a score of 2, and a score of 3 was reserved for any site that could receive funding from both stakeholders. The only site to receive a score of 3 was Site #1, since this project bordered the lake which is under Kingston's jurisdiction and so it was reasonable to hope for funding from both stakeholders. The remaining sites had no known funding opportunities since the areas that had been selected on campus were not confirmed to be areas within the University's list of interests, so these 4 alternatives were given a score of 1 but an asterisk was used to indicate the possibility of upgrading this criterion's score in the future.

All the criteria identified for the project were important and valued but some of the categories were discussed at greater length with the client and made sense to prioritize. The opportunity when selecting a location to create environmental improvements and elevate an area to better adhere to the current and desired goals of the QCMP were the categories most in line with the project's scope. These criteria were given weights of 25% each accordingly.
The current conditions of each alternative received a weight of 20% since the applicability of any changes would be dependent on feasibility and practicality. For example, an area that had recently been developed would be more difficult to justify improving again since the conditions, despite not upholding the new environmental standard, would be already refined.

The funding was not emphasized by the client during meetings, but it was stated that the Bader Centre project was likely to receive funding from the city if chosen and this category sought to add value to this factor. The social response in developing each location was important but it was believed that any chosen location had the potential to obtain a positive response if design elements were done well, so it was justified to give this criterion a lower weighting. These criteria were weighted as 15% each.

6.2 Site Selection Survey Results

To help validate the need for the project, a survey was made in Google Forms to engage with the students that use the Queen's Campus through photos of the five sites and corresponding questions. This survey was administered to Queen's engineering students with the help of the Queen's Facility of Engineering and Applied Science staff and administered to Queen's students from a wider range of disciplines using Facebook group connections.

This survey was an important project step because the people using the space are important stakeholders and needed to be involved for the project to be socially successful. Improving a site that students believe would benefit them and their surroundings helps to promote social interest in campus development, whereas a very well naturalized site that students rarely see may not be worth the time and money required. Thus, the students were asked to rate the

need for improvements in each image and how often they passed through each site on a scale from 1 to 5. A 1 indicated a response of not a lot and a 5 indicated a lot. The results of the survey gave distributions that have helped to guide the site evaluations. The survey results for Site #1 are shown as examples in Figure 20 and Figure 21.

Figure 20: The distribution of Need results for Site #1 collected from the site survey.

Figure 21: The distribution of the Use results for Site #1 collected from the site survey.

The distribution of survey scores for each question were averaged and then the two questions for each site were also averaged to give a Social Score for each site that would accurately characterize the data. The overview of the social score results can be seen in Figure 22.

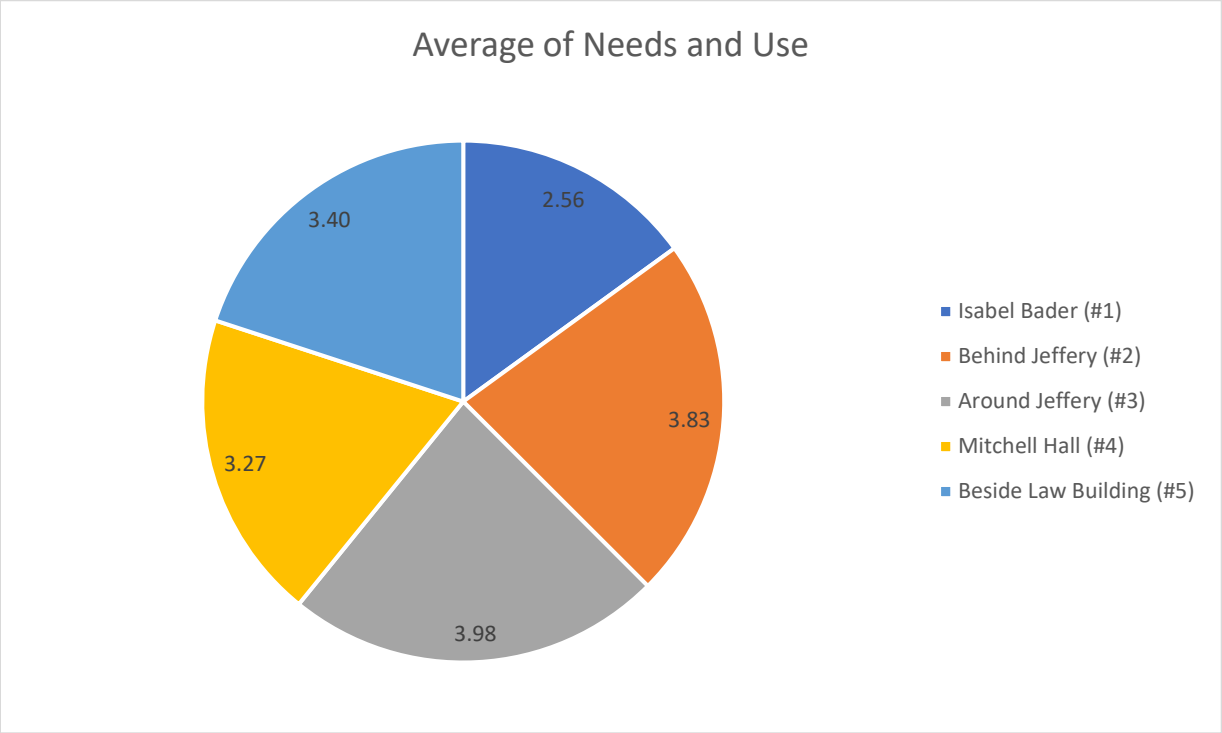

Figure 22: Visual of the averaged Social Scores calculated from the results of the site survey.

The calculation for the Social Score for site #1 can be seen below as an example. The terms N_1 and U_1 represent the averaged Need and Use score for Site #1 respectively and S_1 represents the calculated Social Score for Site #1.

$$N_1 = (1 * 0.085) + (2 * 0.155) + (3 * 0.211) + (4 * 0.38) + (5 * 0.169) = 3.393$$

$$U_1 = (1 * 0.451) + (2 * 0.408) + (3 * 0.113) + (4 * 0.028) + (5 * 0) = 1.718$$

$$S_1 = \frac{N_1 + U_1}{2} = \frac{3.393 + 1.718}{2} = 2.5555$$

These survey results are only a preliminary example of what is being planned as an addition to the QBDS. For this example, the sample size was small, with only 71 students out of the thousands attending Queen's University having participated. Most were engineering students from the CIVL 460 class with a similar interactive experience with the areas around campus. The goal is that a future survey would be much more representative by providing access to all Queen's students and the surrounding community that walks through the campus.

The results showed that Site #1 received a score of 1, since the social score was less than 3. Site #4 received a score of 2 since the social score was less than the boundary of 3.3. The remaining sites all received scores of 3 for this criterion.

6.3 Potential Site Evaluation

The evaluation rubric shown in Table 4 was used as a guide to score each potential site and complete the evaluation matrix as seen in Table 5.

Table 5: Completed analysis of potential sites using the evaluation matrix and evaluation rubric.

Criteria	Weight	Site #1	Site #2	Site #3	Site #4	Site #5
Importance to Students	15%	1	3	3	2	3
Impact on Environment	25%	3	3	2	2	1
Current Adherence to Master Plan	25%	1	3	3	3	2
Current Condition	20%	3	2	2	1	3
Availability of Funding	15%	3	1*	1*	1*	1*
Total	100%	2.2	**2.5**	2.25	1.9	1.95

Note: Asterisks (*) indicates potential change in score based on scoring rationale explained in Section 6.1.

The site that received the highest score from the evaluation matrix was Site #2, the area between Watson Hall, MacCorry Hall, Jeffery Hall and Harrison-LeCaine Hall. This location had no known funding but otherwise almost perfectly represented the type of area desired for change. Site #3 also scored quite high and could be considered as a valid option if funding was provided for this site and not Site #2.

7.0 Proof-of-Concept Site Design

An evaluation matrix was developed including chosen criteria and weightings that were then used to develop a final design for the proof-of-concept at Site #2.

7.1 Preliminary Site Design

Aid in the development of the final design, three preliminary designs were created, each focusing on a different aspect of importance. Through evaluating these designs, insight was gained into what elements to pursue in the final design. It was decided that some elements would be used across all redesigns, including the planned permeable pavement on the shared pathways. It was only by iterating upon all three of these base options for site design that a final solution could be proposed. Option A was based around Stormwater Management to maximize drainage at the chosen site. The chosen site currently has particularly bad drainage

and is prone to flooding during rainfall events. Various LIDs were chosen to mitigate these issues in this area while still maintaining landscape naturalization by increasing biodiversity. A visual model can be found in Figure 23.

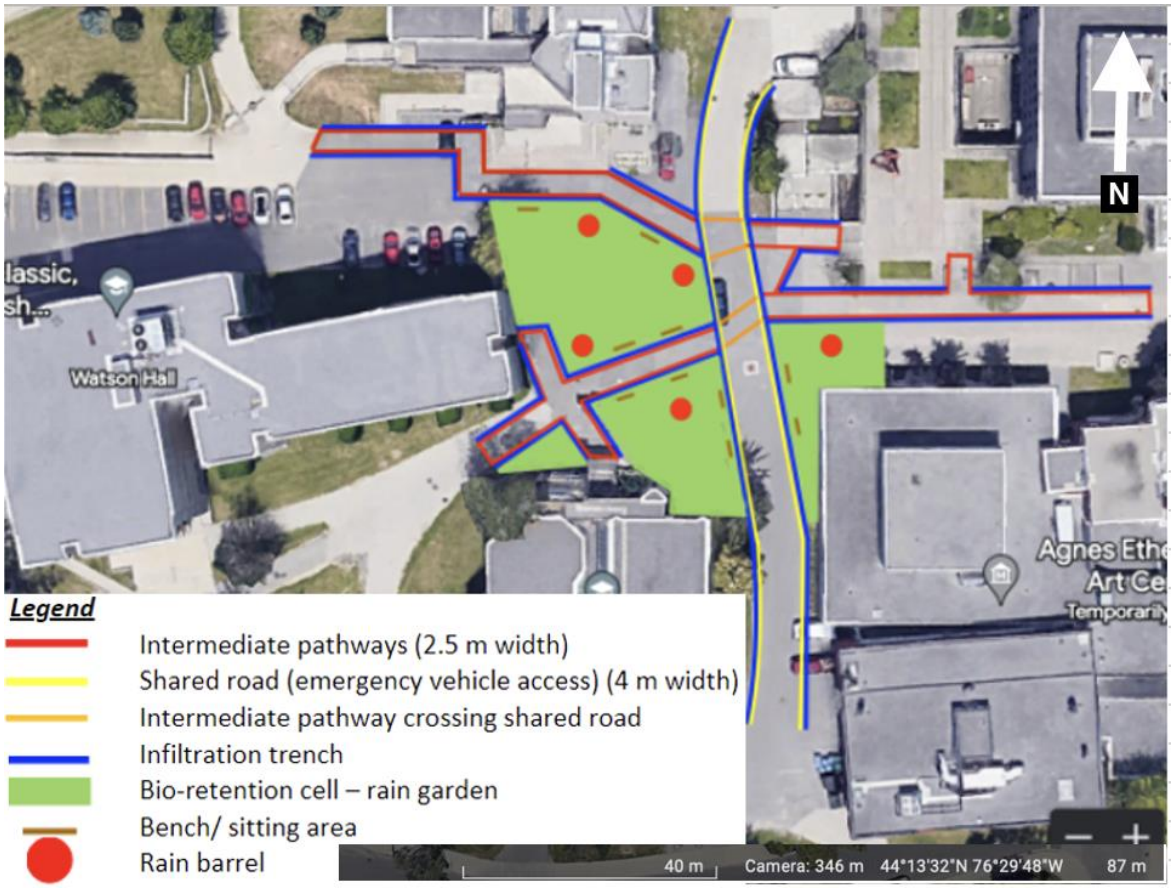

Figure 23: Visual model of Preliminary Design Option A - Stormwater Management.

Infiltration trenches were added next to each pathway to deal with water runoff directly on the pathways. These narrow ditches would be filled with gravel and retain necessary water storage volumes to capture runoff and infiltrate to the native soil below.

Several large bio-retention cells in the form of rain gardens were placed throughout the site. On the surface, these cells would be garden area and below the surface, depressions of permeable engineering soil mixture will be placed above a gravel drainage bed. These cells provide storage, infiltration, and evaporation of both direct rainfall and runoff captured from surrounding areas. As well, the surface will look like a regular garden with lots of opportunities for variation and to increase biodiversity in the area.

Rain barrels were placed around the site to collect rainwater during the spring, summer, and fall months. Collected water can be used to water plants directly on site or at nearby locations on campus. The rain barrels will not be used in the winter months as the water will turn to ice, expand, and break the rain barrels. Finally, several benches have been placed around the site for pedestrian enjoyment and useability.

Option B was the design based around Naturalized Green Space. The site is currently covered in mostly pavement. Different types of green spaces have been chosen and integrated as shown in Figure 24.

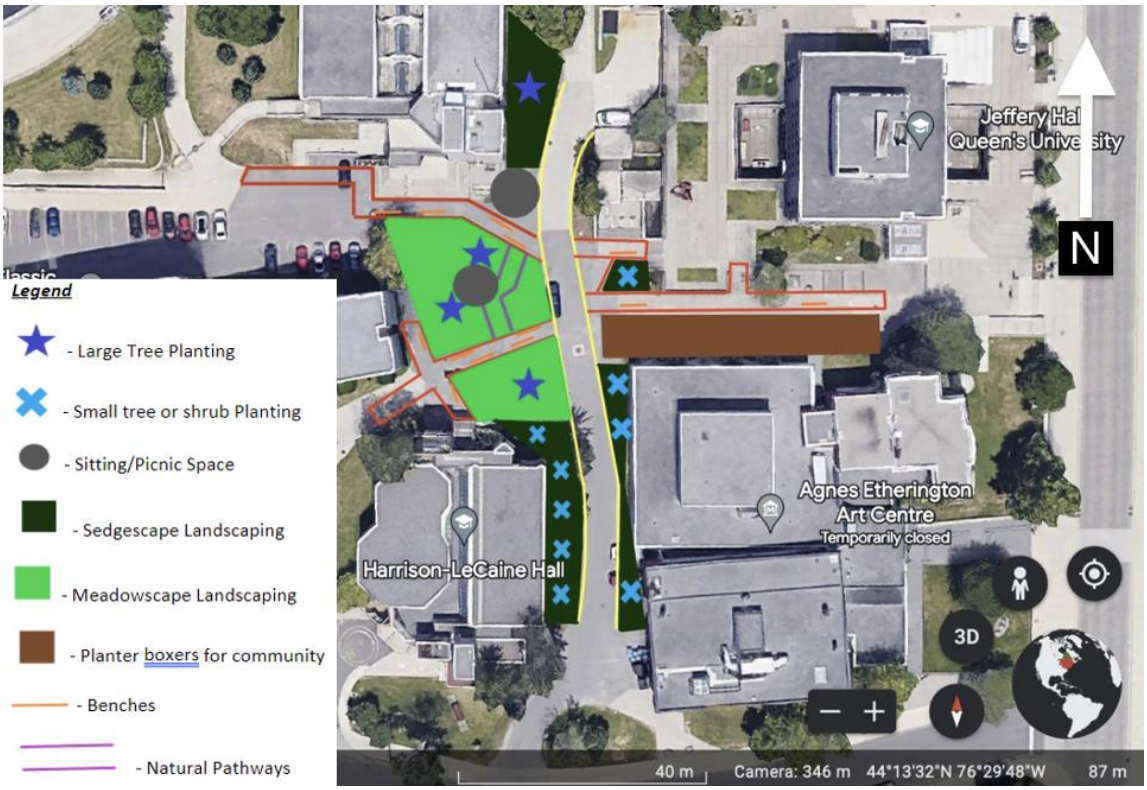

Figure 24: Visual model of Preliminary Design Option B - Naturalized Green Space.

A mixture of large and small trees has been added to the area, a stark contrast to the paved space seen previously. The design includes both meadowscape and sedgescape to diversify the area and lower the need for maintenance. Both of these types of green space are discussed in more detail in the Section 5.1. A large community planter box is included to encourage green habits and provide an activity that can be good for the wellbeing of staff and students. Other community features are also added including standard benches and an area designed as a sitting space.

Option C was the design based around Human Need and making the space more desirable for active community use. The site is currently used for mostly maintenance parking and student walking. The redesign includes the removal of large amounts of pavement and replacement grass planting to make the area feel more welcoming as seen in Figure 25.

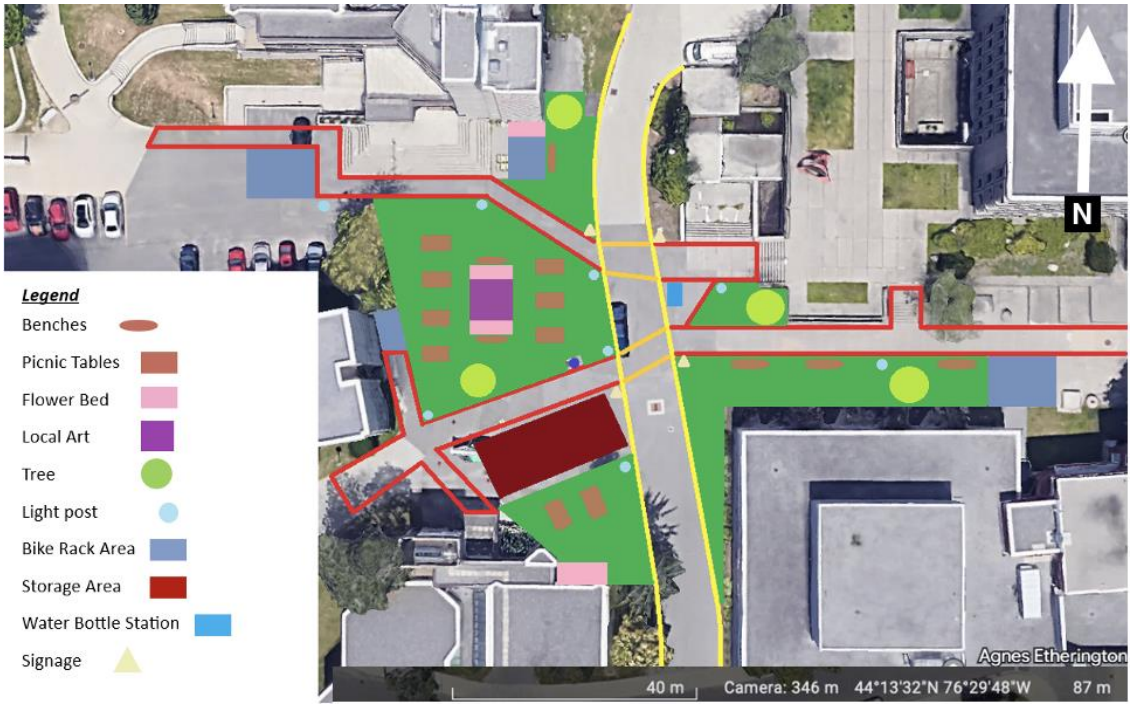

Figure 25: Visual model of Preliminary Design Option C - Human Need.

A large space was included that would provide a central, local art piece surrounded by flower beds. Standard benches would be present, but there are also larger picnic style benches that would encourage group gatherings and hopefully provide access to outlet or internet accommodations. There are designated spaces for bike racks and a storage area including a shelter that would protect from the elements. Finally, the design also included a water bottle station for refills that would be operational in the warmer months.

7.2 Design Evaluation Matrix & Rubric Outline

The evaluation matrix developed to analyze the preliminary site designs is seen in Table 6. To ensure that scoring was consistent for each criterion, an evaluation rubric (Table 7) was created to define the scores in each criterion.

Table 6: Blank evaluation matrix used to analyze the preliminary site redesigns.

Criteria	Weight	Option A	Option B	Option C
Pedestrian Health & Safety	20%			
Pedestrian Accommodations	10%			
Aesthetics	20%			
Green Zone Magnitude	15%			
Maintenance	15%			
Groundwater Management	20%			
Total	100%			

Table 7: Evaluation rubric that defines the meaning of the scores in each criterion of preliminary design evaluation.

Criteria	**1**	**2**	**3**
Pedestrian Health & Safety	The design meets one or none of the three factors of lighting, protection from the elements, and vehicle protection.	The design meets two of three factors of lighting, protection from the elements, and vehicle protection.	The design meets all three factors of lighting, protection from the elements, and vehicle protection.
Pedestrian Accommodation	Only 1 or no accommodating features are included.	Between 2 and 4 different types of accommodating features are included.	5 or more different types of accommodating features are included.
Aesthetics	Survey results indicated aesthetic acceptance of less than 50%.	Survey results indicated aesthetic acceptance of between 50% and 75%.	Survey results indicated aesthetic acceptance of 75% or higher.
Green Zone Magnitude	Less than 50% of the workable space has been allocated as green zones.	Between 50% & 90% of the workable space has been allocated as green zones.	90% or more of the workable space has been allocated as green zones.
Maintenance	Some Features could create more need for maintenance than a standard area.	Maintenance is expected to be standard.	Maintenance is made convenient though innovative planting features.
Groundwater Management	Only 1 or no mechanisms are in place to effectively deal with drainage.	2 types of mechanisms are in place to effectively deal with drainage.	3 types of mechanisms are in place to effectively deal with drainage.

The categorization described below produced the quantifiable criteria seen in Table 7. The following paragraphs explain the reason each category was chosen as a criterion while providing rationales that explain the reason for each rubric range and matrix score.

Pedestrian Health & Safety:
The design for the area behind Jeffery Hall has the potential to impact student health and safety, since it is an often-used campus space. The students that will use the area are major stakeholders and it is engineering code to uphold the welfare of the people. Thus, the sites will be evaluated on their potential to improve or neglect this welfare. The current site design has some features that promote safety, such as a few light posts and a Queen's blue light phone, but improvements have been considered necessary especially when looking at the three key areas. The three areas of health and safety that have been identified as targets include better lighting, protection from weather or temperature (the elements), and protective division between cars and pedestrians. Option A and Option B have been given a score of 1 because at least two of the three factors have been deemed insufficient. Option A provided infiltration trenches along the sides of the paths, thus providing a certain level of separation between the two modes of transport, and dissuading pedestrians from standing too close to the emergency road. However, this option does nothing to remedy the lack of protection from weather or improve the reach of lighting. Option B provided no improvement to any of the three factors. Option C was given a score of 3 because all three factors where met. The design included additional lighting, strategically places signage to inform pedestrians of the potential vehicle activity, and protection from weather in the form of bench umbrellas and the storage building.

Pedestrian Accommodations:
It was desired that the final design would have pedestrian accommodations on the site, to ensure the location had greater purpose and take advantage of the opportunity in redeveloping the space. It was decided that this criterion would be another way to evaluate the preliminary designs and ensure a complete final product. To quantify this criterion, the decision was made to base the evaluation on the number of accommodation types present in the design, since judging based on individual quantity would have neglected the benefits of a diverse spread of options for the campus. For this project, a pedestrian accommodation has been defined as any type of object specifically in the design for direct interaction with the Queen's community. Thus, an art piece meant to be looked at by students would be a pedestrian accommodation, but a rain barrel, although there to benefit them, would not be included for general interaction. The current design had no accommodations since the area was just a passage for getting around campus. Option A received a score of 1 for this criterion because the only addition was several benches. Option B received a score of 2 because it had benches, designated student sitting areas, and a community planter box. Option C received a score of 3 because of its many additions including benches, flower beds, bike racks, an art piece, a rentable storage area, and a water bottle station.

Aesthetics:
Aesthetics and social acceptance were considered an important part of the designs because those who use the campus would not enjoy having to tolerate an unpleasant area. Since having

the area be actively used after redevelopment is the goal, creating a space that would be neglected is not sound design. Additionally, it is generally accepted that redevelopment efforts will invest into aesthetic integration and so failing this criterion would reflect negatively on the institution. To score this criterion another survey was created to gauge the public opinion, this time in respect to the design of the site. It was decided that any design averaging a social score of less than 5 out of 10 would be thought of negatively by the majority and deserve a score of 1 for the criterion. To differentiate between a score of 2 and 3 for the criterion, a boundary halfway between score 1 and perfection was then utilized, being 7.5 out of 10.

Green Zone Magnitude:

To ensure the project was indeed an environmental landscaping project, as desired by the client, the designs were evaluated based on the magnitude of green space added. This factor would only consider the areas of the site that were flexible as some areas had strict pathing restrictions laid out in advance to the design component brainstorming. Of this workable space the thresholds for scoring were decided to be 50 percent and 90 percent, as this provided adequate distinction between targeted greenspace and general implementation of grass over pavement. The exact nature of the plantings and greenery being considered for each space were up for alteration and are discussed in greater detail in the Recommendations section of the report. Option A and Option C received a score of 2 because although they replaced paved areas with grass, some areas were still paved. For example, Option C still retained the paved space designated for the storage area. Option B received a score of 3 because it did reach the threshold of approximately ninety percent workable green space.

Maintenance:

Any design proposed for the site behind Jeffery Hall would require a certain level of maintenance by the campus staff. A design that would lower this demand would be valuable for campus personnel, while one that would increase demand could be problematic and retract from the projects purpose as a proof-of-concept of the recommended Standards updates. Thus, the criterion was considered important for evaluating the designs. There was insufficient data to evaluate this criterion based on numbers. Instead, each design was evaluated with respect to standard operations expected for the components utilized. Option A received a score of 2 because maintenance required on the site was expected to be normal. The bioretention cells would not require much more maintenance than plain grass and the rain barrels would be actively used by gardeners without need for much campus regulation. Option B received a score of 3 because it was expected that maintenance would be lowered by the design. Unlike normal grass, the greenspaces proposed in this design seek to promote natural, more messy growth. It is expected that compared to grass these areas will not need to be trimmed as frequently to maintain their desired look. Option C received a score of 1 for this criterion because it is expected that certain design features may promote greater maintenance than expected from the average campus site. This increase is expected due to the redesign of the area into a significant amount of sitting space. The increased human activity and retention time on the site would likely increase litter.

Groundwater Management:
The final criterion decided for evaluation was the groundwater management on the site. Although successful groundwater management is a base desire for all campus sites, the method of evaluating these measures is lacking. Therefore, the designs will be evaluated in general on the number of features put in place to improve groundwater conditions. Considering the lack of proper management currently, three measures have been taken as a good start and thus given a value of 3. A site containing nearly no measures would alternatively receive a score of 1. Option B and Option C received scores of 1 for this criterion because only the LID emergency vehicle path was designed to improve groundwater conditions. This was also a measure that was generalized across all designs. Option A received a score of 3 due to the inclusion of rain barrels, infiltration trenches, and bioretention cell rain gardens.

Once again, the criteria chosen had to be weighted to create a more accurate evaluation. For example, it did not make sense to equate the value of accommodations to the value of human safety. It was decided that groundwater management and pedestrian safety were criterion that if done poorly would result in the greatest, most obvious negative impact for the campus. Therefore, these two criteria were given the greatest weight of 20%. Aesthetics was also put at a high level of importance of 20%, since it was the criteria most heavily influenced by stakeholders through the posted survey. Of the remaining three criteria, the category of pedestrian accommodations was weighted a bit lower at 10% due to the site's ability to still operate if done poorly, even if the value of operation would be reduced. Green Zone Magnitude and Maintenance were more directly related to the goals of the client and the site's ease of operation, and thus received a weighting of 15% each.

7.3 Preliminary Site Design Survey Results

The same surveying method of Google Forms that was used in site selection was once again used in evaluating the designs for the site. The survey was administered to Queen's engineering students with the help of the Queen' Facility of Engineering and Applied Science staff and administered to Queen's students from a wider range of disciplines using Facebook group connections. This time, the survey was able to be spread across a wider range of students in engineering that were not in CIVL 460 due to help from the year chair.

Each participant was given a visual of each preliminary design along with descriptions that explained the concepts. They would then be asked to score each design from 1 to 10 before providing any additional feedback at the end. It was explained that a score of 1 would indicate a negative interpretation of the design, while a score of 10 would indicate that they agreed the design would benefit the Queen's campus. The feedback at the end was also used both when finalizing the design and when suggesting further action in the Section 12.0 of the report.

Unlike the first survey that proposed two questions for each alternative, this survey only had one and thus only required the responses to be averaged normally to reach a final social score. This survey was once again a step in the right direction but not a conclusive evaluation of this criterion, due to the small percentage of students on campus that were able to respond to the survey in the available time (42 students). This surveying methodology could be expanded on in

the future when incorporated into the QBDS to allow for a better sample pool. Even so, the results of the microcosm were helpful in guiding a final design for the proof-of-concept. The survey results for Preliminary Design A are shown as example in Figure 26.

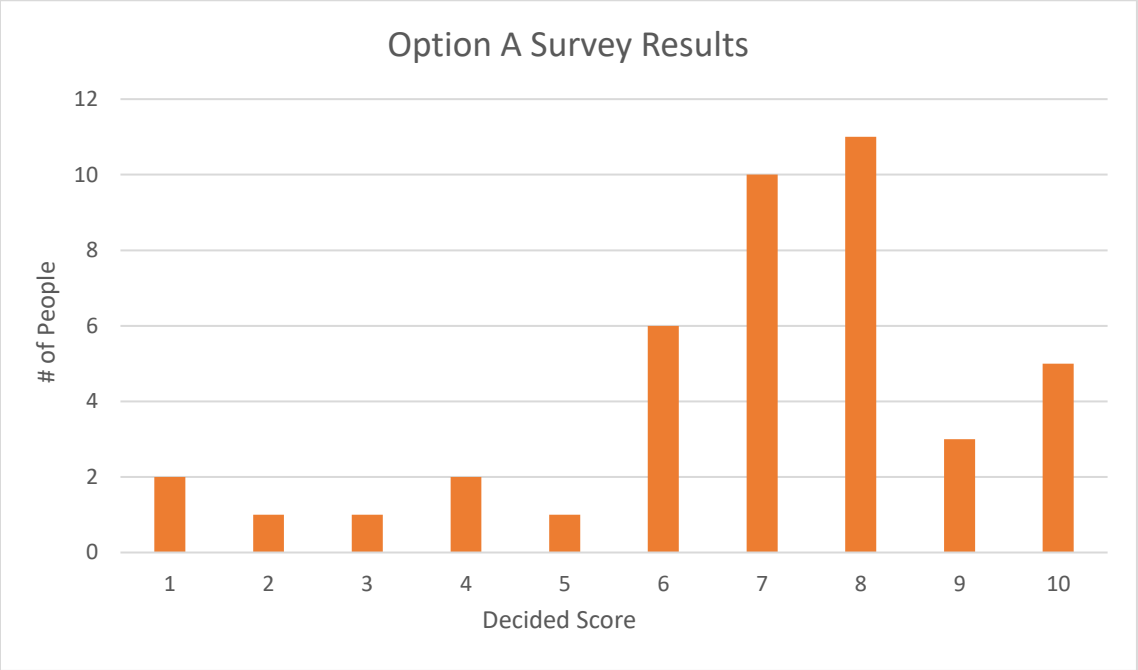

Figure 26: The distribution of the results for Preliminary Design A collected from the design survey.

Figure 27 shows the average social scores that were calculated for each preliminary design in respect to each other.

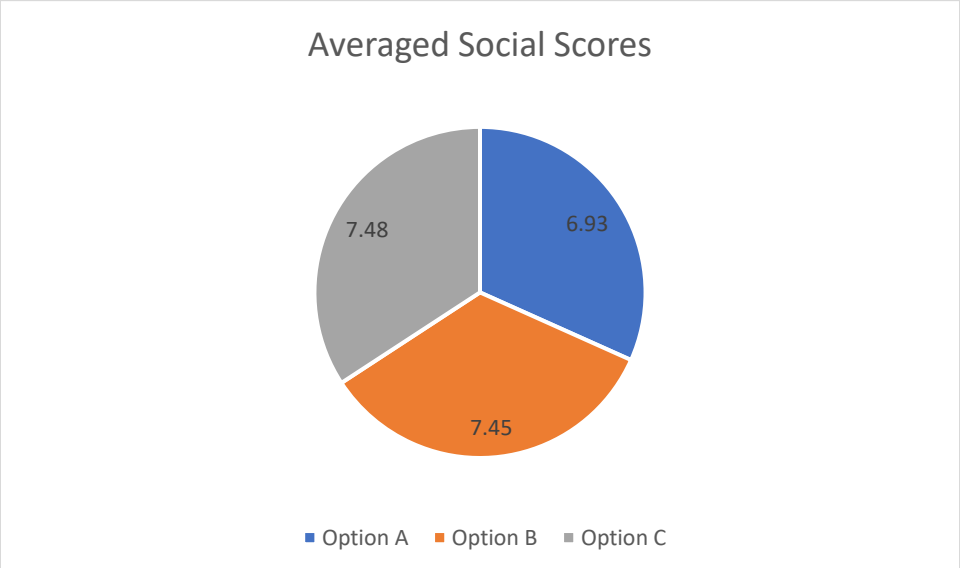

Figure 27: Visual of the Social Scores of each of the preliminary designs collected from the design survey. (A: Stormwater, B: Green Space, C: Human Need)

The collected data shows that Option C received the most positive feedback, but all the options were relatively the same. Even so, Option B and Option C round up to a 75% acceptance and thus received scores of 3. Option A is between 50% and 75% meaning it received a score of 2.

7.4 Preliminary Site Design Evaluation

The evaluation rubric shown in Table 7 was used as a guide to score each Preliminary Site Design and complete the evaluation matrix as seen in Table 8.

Table 8: Completed analysis of Preliminary Site Designs using the evaluation matrix and evaluation rubric.

Criteria	Weight	Option A	Option B	Option C
Pedestrian Health & Safety	20%	1	1	3
Pedestrian Accommodations	10%	1	2	3
Aesthetics	20%	2	3	3
Green Zone Magnitude	15%	2	3	2
Maintenance	15%	2	3	1
Groundwater Management	20%	3	1	1
Total	100%	1.9	2.1	**2.15**

It was observed that Option C scored best on the evaluation. Each design's features were still used in creating the final design, but moving forward into the iteration stage a greater emphasis was put on altering Option C to rationally incorporate some of the easier to transition features from the other two designs.

7.5 Final Site Design

The first iteration of the final design combined many of the pedestrian accommodations and safety features from Option C together with the green spaces from Option B. Additionally, the groundwater management features from Option A that could be incorporated into the other option's elements were included. A new feature that was added was the curbs at some edges of the design, meant to clearly define the separation of the site from the surrounding roads and parking lot (excluding the emergency route). The results of this first iteration can be seen in Figure 28 with the legend explaining the image provided in Figure 29.

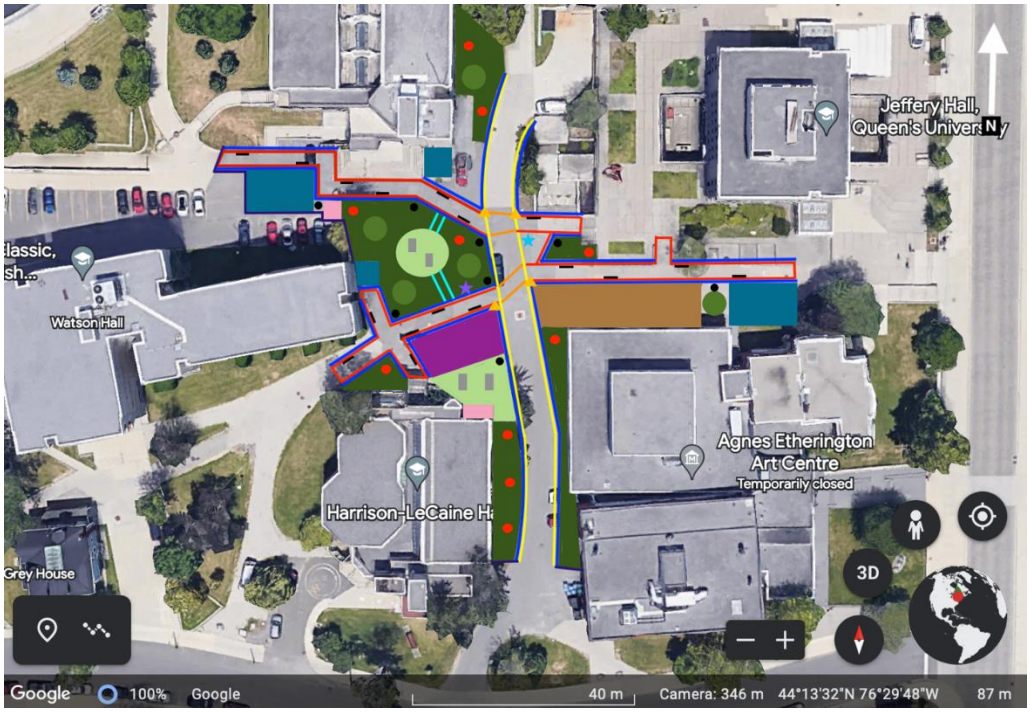

Figure 28: First iteration of the final design.

Legend

- Intermediate pathways (2.5 m width)
- Shared road (emergency vehicle access) (4 m width)
- Intermediate pathway crossing shared road
- Infiltration trench
- Natural pathway
- Curb (distinction between current roadway/ parking lots and naturalized areas)
- Tree
- Water bottle fill station
- Queen's blue light Outdoor Emergency Phone
- Streetlight
- Bike Rack Area
- Community garden planter box
- Flower planter box
- Storage Area
- Maintained grassy area
- Picnic table
- Sedgescape underlaid by bio-retention cell (rain garden)
- Pathway/ roadway signage
- Bench/ sitting area
- Rain barrel

Figure 29: Legend for the first iteration of the final design.

In this first iteration, the storage area, bike racks, water bottle station, picnic tables, and flower boxes were kept from Option C in the areas indicated. The safety features that remained included the signage near the emergency path, additional lighting, and the integration of the pre-existing Queen's blue light. The two areas that were altered to resemble Option B more closely were the central green space North of the storage shelter and the strip of land on the right of the site. The right strip was switched to include both the bike racks and a community garden, while the central green space was further naturalized to resemble the sitting area indicated in Option B. This decision was made to maximize green space and ease maintenance compared to what was in that area in Option C. The LIDs from Option A that were integrated were the rain barrels, infiltration trenches, and the bio-retention cells. These features were easily incorporated without restricting the ability to include elements from the other two options. In this design, the bio-retention cells were combined with the sedgescaping from Option B. Several large bio-retention cells in the form of sedgescape rain gardens have been placed throughout the site. On the surface, these cells will be sedgescape and below the surface, depressions of permeable engineering soil mixture will be placed above a gravel drainage bed just like in Option A. Another alteration that was made was that the benches in each design were moved onto the pathing to better resemble Option B. This was decided because many of the other benches across campus are also integrated onto pathing already, thus creating additional space.

Even though the first iteration was able to incorporate the successful element from each of the preliminary options, there were a few more small details that needed to be addressed. The design survey that was completed indicated the public's desire for another path connecting the site along the side of Watson Hall, as well as, the desire for the pathing to be a bit more curvy. These final changes were implemented into the design and a visual was then produced on AutoCAD as seen in Figure 30 using the same legend as provided in Figure 29.

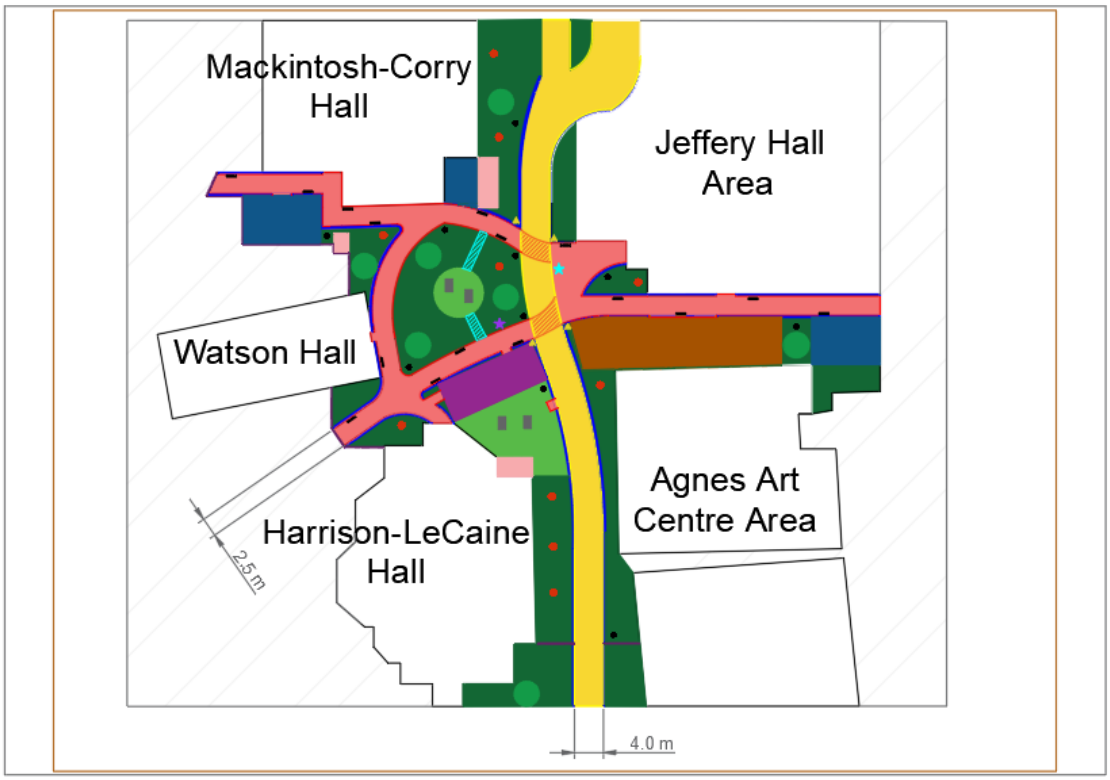

Figure 30: Final iteration of the Final Site Design.

7.6 Final Site Design Evaluation

To prove that the final site design was an optimal combination of the other options, the site evaluation matrix was again utilized to score the Final Design. The Final Design scoring can be seen in Table 9.

Table 9: Analysis of Preliminary Site Designs and Final Site Design using the evaluation matrix and evaluation rubric.

Criteria	Weight	Option A	Option B	Option C	Final Design
Pedestrian Health & Safety	20%	1	1	3	3
Pedestrian Accommodations	10%	1	2	3	3
Aesthetics	20%	2	3	3	1+
Green Zone Magnitude	15%	2	3	2	2
Maintenance	15%	2	3	1	2
Groundwater Management	20%	3	1	1	3
Total	100%	1.9	2.1	2.15	**2.3+**

The final design scored 3 on pedestrian health & safety because it kept the features of lighting, shelter, and transportation separation seen in Option C, as outlined in Section 7.1. The final design also kept the storage area, bike racks, water bottle station, picnic tables, and flower boxes meaning that at least five accommodations were available. Thus, the score for pedestrian accommodations was a 3. Unlike Option B, the final design had some workable spaces that were chosen to be kept as concrete such as the foundation of the storage area and the bike rack spaces. The score for this criterion of green zone magnitude was a 2. The maintenance will be eased by the meadowscaping as in Option B, but also made more difficult due to the picnic benches kept from Option C. This balanced out to approximately standard levels of maintenance and thus scored a 2. The rain barrels, bio-retention cells, and infiltration trenches that were kept in the final design allowed for a score of 3 on groundwater management. This resulted in a final score on the matrix between 2.3 and 2.7 depending on the results of public feedback that could not be collected in time for this report's submission. However, the score is still higher than the other options even if the lowest outcome was taken and thus proving that the design has been enhanced.

8.0 Queen's Building Design Standards Recommended Updates

The goal of the recommended updates to the QBDS is to reflect the vision of campus described by the QCMP. The recommended updates to the Standards work to ensure that the design of future sites on Queen's campus foster sustainability while integrating with the surrounding natural settings to enhance the campus experience. Designs also need to promote good facilities management and support Queen's academic mission. The current version of the QBDS has some mention of sustainability but fails to address the "beautification" trend of using large volumes of concrete in building designs on campus as explained in Section 2.0. The recommended updates focus on improving Division 32 – Exterior Improvements, including making changes to some of the existing sections of the division and developing a new section that discusses acceptable mechanisms for stormwater management. The updates to Division 32 would increase the amount of consideration given to the sustainability and naturalization of any new projects on Queen's campus.

Section 16 of Division 32, currently entitled Concrete Walks and Curbs, describes the process of designing and installing concrete walks and curbs (Queen's University n.d.). The section also describes specifications of curbs and walkways on campus to ensure consistency in design. It is recommended that the section be updated to include specifications of shared streets that are intended to function at multimodal routes for use by pedestrians, and vehicles. Shared streets should be designed such that pedestrian use is clearly prioritized. The widths of road and pathways should be redefined using the specifications indicated in the *Queen's University Enhanced Pathway Standard & Recommendations* Report (Bates et al. 2022). The specifications for curbs should also be updated to encourage the use of deliberately designed curbs. In some areas of campus, it is currently unclear whether it's a vehicle accessible area or not (Meeting on February 3rd, 2023, Appendix A). Deliberately designed curbing can be used to separate areas designed for use by vehicles from those that are not.

It is recommended that Section 32 of Division 32, entitled Retaining Walls, be updated to include information on the use of alternative retaining walls such as the vegetative, crib, and gabion retaining walls discussed in the Design Research section of this report. The standards should encourage the investigation into the feasibility of alternative retaining walls and discuss the potential benefits of their utilization of campus.

Sub-Section 13 of Section 39 of Division 32, entitled Bollards, describes the specifications, and intended uses of bollards on campus (Queen's University n.d.). Bollards prevent traffic in certain pedestrian areas and are typically made of concrete. They are a design feature that has been identified as not matching the aesthetic goals of environmental integration on campus. It is recommended that this sub-section be updated to encourage alternative methods of preventing vehicle access that better utilize the space before selecting bollards as a final option.

Section 93 of Division 32, entitled Planting, describes the specifications of tree planters and planting mixtures for use on campus (Queen's University n.d.). It is recommended that this section be updated to encourage the use of bio-diverse and naturalized landscaping such as meadowscape and sedgescape designs in addition to trees. The updated section should describe the benefits of these designs as they relate to environmental integration and planting management.

It is recommended that an additional section be added to Division 32, Section 94, entitled Stormwater Management. This section should encourage the use of Low Impact Development Technologies (LIDs) at sites on campus to increase infiltration and control stormwater runoff. The section should include specifications for where specific LIDs are appropriate as well as describe the management needs of specific LIDs. Another aspect of the section could include a standard for the allowable rate of runoff production at a given site on campus. There are currently not such standards in-place and no widespread data on the runoff production at different sites on campus. Further investigation into runoff production and the addition of maximum allowable runoff production is mentioned in the Next Steps Section of this report. An updated version of Division 32 has been produced as an example of how these updates may be applied to the current standards. This updated version can be found in Appendix D, with the recommended changed underlined.

9.0 Project Schedule

The project schedule was developed to manage the completion of key deliverables during the project. A detailed breakdown of the tasks required to complete these deliverables has been presented, with an outline of the team members responsible for each task. The project timeline also included regular meetings with the team, the group manager, and the client.

9.1 Key Deliverables

The majority of the key deliverables for the project were determined by course instructor, Professor Sean Watt. These included the Work Plan approved by the client (Appendix E), the Progress Report, the Poster Presentation, and the Final Report. The client also requested that a short, 5-minute Client Presentation be given to Queen's Facilities at the end of the Fall Term. A breakdown of these deliverables and their due dates can be found in Table 10. Table 10 has been updated to include the date of the Poster Presentation. The client also mentioned a 10-minute Client Presentation to be given to Queen's Facilities at the end of the Winter Term. This presentation was included in the prevision version of Table 10. This presentation has not been mentioned by the client since the Progress Report and has been removed.

Table 10: List of key deliverables and respective due dates.

Deliverable	Components	Date Provided
Work Plan	• Project requirements and scope • Schedule for project completion • Preliminary research • Preliminary cost estimation • Team qualifications	September 30, 2022
Fall Client Presentation	• Outline of project scope • Impact on Queen's University • Summary of completed work	November 23, 2022
Progress Report	• Project requirements and scope • Summary of site investigations • Summary of research • Social impacts • Evaluation of potential sites • Preliminary analysis of selected site • Schedule for project completion • Cost estimation • Assignment of duties	November 25, 2022
Poster Presentation	• Visual demonstration of completed work • Visual of selected site • Visuals of potential design considerations • Visual of potential design elements	January 16, 2023
Final Report	• Project requirements and scope • Site design iteration • Evaluation of potential site designs • Completed site design • Calculations and cost estimation for design • Finalized schedule of project completion • Description of next steps and group dynamics	March 24, 2023 (Draft) April 21, 2023 (Final)

Deliverable	Components	Date Provided
Oral Presentation	• Outline of project requirements and scope • Impact on Queen's University • Description of project completion process • Presentation of final site design and recommended standards updates • Suggested project next steps	March 27, 2023

9.2 Major Tasks

The major tasks that have been completed during the project have been outlined in a Work Breakdown Structure (WBS). These major tasks were requirements for the completion of the key deliverables that have been outlined in Section 9.1. These tasks included the completion of work that have been presented in key deliverables as well as the writing or presenting of these deliverables. The WBS has been updated to reflex the changes made to the task plan during the Winter Term. The WBS can be found in Appendix F. Each of the tasks in the WBS was assigned to one or more members of the team. Many of the tasks were assigned to all members of the group but were mostly completed separately before the work was brought together for group consideration. A Responsibility Assignment Matrix (RAM) can be found in Appendix G. The assignment of duties for the completion of all aspects of the Sustainable Engineered Landscapes Project is explained in detail in Section 13.0.

9.3 Project Timeline

The project timeline was tracked and updated using a Gantt Chart developed by the team. The deliverables and tasks within the Gantt Chart have been colour coded to indicate the type of task. The colour corresponding to each task type can be found in Table 11. The Gantt Chart has been updated to improve its readability by removing the connecting lines between tasks. There have also been additional tasks added to reflect the updates made to the list of key deliverables and the WBS. The Gantt Chart can be found in Appendix H.

Table 11: List of task colours in the Gantt Chart and the type of task indicated.

Colour	Type of Task
Orange	Writing or Presentation of Deliverables
Green	Research
Blue	Design and Evaluation

10.0 Cost Estimation

The largest potential cost for this project is the removal of concrete from the site. Removing concrete can cost up to $10 per square foot, including all demolition and cleanup cost (Lawn Starter 2022). The amount of concrete that could potentially be removed from the site is a maximum of 3,150 square feet. This would relate to a concrete removal cost of potentially $31,500. The next cost in creating the green space is soil preparation. Soil preparation involves testing and altering the current soil, and potentially replacing the soil depending on the quality. Testing can cost between $20 to $200 depending on the amount of lab tests and type of lab tests required (OMAFRA 2016). New soil can cost up to approximately $50 per yard, which means the total cost will depend on how much new soil is needed. If 50% of the 3,150 square foot site is made into green space, then the new soil cost would be approximately $8,750 if new soil was needed for all of the landscaping.

The cost of plantings will depend on the type of plants chosen, such as small trees costing $200 each or large trees each costing at least $1000, and the total number of plants needed to fill the green space (City of Ottawa 2021). The green space design is planned out to accommodate approximately 4 large new trees and 10 new small trees or shrubs. This would total to a potential $6,000 for tree selection. The plants to be incorporated into the sedgescape and meadowscape gardens can range in cost from $5 to 50$ per plant (City of Toronto 2021). Including the plant selection and the cost of installation, the cost can reach to $50,000 or greater (Lawn Starter 2022).

The green space design incorporates new pedestrian accommodations such as hardscaped walkways, benches, and lighting fixtures. The new accommodations can vary in cost depending on quality of material but average at $500 per item (Houzz 2022). The green space design plans for a possible 20 pedestrian accommodation items, resulting in a cost estimate of $10,000. The installation and materials to create the hardscaped walkways can cost between $15 to $40 per square foot (TrustedPros 2023). Approximately 50% of the greenspace design will be hardscaped, which results in an estimated hardscape cost of $23,625.

There will be a large upfront cost to create the new green spaces with a variety of new plants and trees, however, maintenance cost will be reduced. The new green space design is planned to be low maintenance with no need for mowing, constant trimming, or heavy use of pesticides. As referred to in Section 5.1, the meadowscape and sedgescape designs nearly eliminate the need for maintenance. Queen's University has an operating budget of $712.1 million, using $18.1 million for facilities management, in the 2021-2022 year (Queen's University 2022). Reduced landscape maintenance can allow more of the budget to be used to enhance other aspects of the campus.

The removal of concrete also has a large environmental cost, that can not be put in numbers. The production of concrete already releases 0.93 pounds of carbon dioxide per pound of concrete created if considering current production standards (Portland Cement Association 2019). The concrete at the older sites on campus likely released a greater amount of carbon

dioxide due to being produced according to older methods and standards. Therefore, it is important that the least amount of concrete is removed to create the greenspaces, and all removed concrete is properly recycled. The machinery used for concrete removal also causes environmental concern. Depending on the type of engines and fuels being used the overall emissions can be reduced but are still significant enough to consider (Lawn Starter 2022).

Table 12 displays the cost estimation for the largest upfront costs of the creation of the new green space design.

Table 12: Cost estimation for largest upfront project costs.

Description	**Cost Estimate (CAD $)**
Concrete Removal	31,500
Soil Preparation	1,000
Plant Selection and Installation	50,000
Pedestrian Accommodations and Hardscaping	33,625
Total	**116,125**

11.0 Risk Assessment

To identify and evaluate the risks and hazards associated with the implementation of a new green space on campus, each anticipated risk is categorized based on likelihood and consequence (Monday 2022). Table 13 displays how the risk categories are created based on likelihood and consequence. Table 14 lists all the anticipated risks and their correlating risk category.

Table 13: Categorization of risk based on likelihood and consequence.

Likelihood	**Consequence**				
	Insignificant (1)	**Minor**	**Moderate**	**Major**	**Catastrophic (5)**
Certain (5)	High	High	Extreme	Extreme	Extreme
Likely	Moderate	High	High	Extreme	Extreme
Moderate	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Rare (1)	Low	Low	Moderate	High	High

Table 14: Assessment of anticipated risks.

Anticipated Risk(s)	Likelihood	Consequence	Risk Category
Soil Contamination	2	4	High
Low Water Supply	2	4	High
Falling Branches/Trees	3	5	Extreme
Allergies	5	3	Extreme
Attracted Wildlife	3	3	High
Construction Risk	2	3	Moderate
Underground Infrastructure Damage	1	4	High

The first anticipated risk in Table 14 is the possibility of soil contamination that can affect the health of trees and gardens. Due to the green space being created in an area previously used for different purposes, and the site being in a busy urban area, the soil could be at risk of contamination. Unhealthy soil can reduce health and potentially destroy plants if left untreated. Contamination is considered unlikely as other trees in the area appear to be healthy and soil tests can be conducted to assess the soil health. The major consequence compared to unlikelihood of occurring gives the risk of soil contamination high risk category.

Low water supply can occur if the area experiences drought or if there is improper drainage system that does not support water flow to plant roots. Without water the new plantings will die, which is considered a major consequence. The risk is unlikely as the area is not prone to drought and the green spaces can be designed to ensure proper drainage and water flow to plant roots. This risk is put in the high risk category due to unlikelihood of occurring and major consequence.

As trees mature, they increase their risk of loosing branches or even falling over entirely. Falling branches or entire trees have the potential to fatally injure people or damage property, giving this risk a consequence level of catastrophic. Due to weather factors such as the high wind speeds in Kingston the likelihood of falling branches is increased. This risk can be mitigated with proper maintenance and observation to ensure no possible branches or trees will fall, giving this risk a moderate likelihood. The likelihood compared to the consequence puts this risk in the extreme risk category.

The main risk of creating new biodiverse green spaces on campus is how nature can affect people and the surrounding infrastructure. Introducing a broad variety of plants to campus can lead to allergic reactions from people. Plants that people commonly have allergies to can not be planted, however, it is impossible to ensure that no one will have allergic reaction when creating greenspaces. This risk is determined to have a certain likelihood due to the various types of possible allergies that anyone on campus could have. Utilizing sedgescape designs more frequently than meadowscape designs can help this issue as most allergies come from

flowering plants found in meadowscape design. Meadowscape design should not be eliminated entirely as an important part of the environmental impact of the greenspaces is to increase the number of flowering plants that benefit endangered pollinator animals such as bees. Most common allergies from plants are manageable which is why this risk is only has moderate consequence but still put in the risk category of extreme due to the likelihood.

The biodiverse green spaces introduce the possibility of attracting wildlife to the area with the potential of them making their own habitats. This can increase the possibly of wildlife encounters on campus, however, this can be limited to small animals by using plants that larger wildlife, such as deer, do not have interest in eating. There is also the risk of small animals intruding into campus buildings and possibly damaging property. The right precautions would have to be taken to seal off buildings from animal intruders. These risks are all unavoidable parts of nature that should be expected if wanting to improve and nurture the environment.

There are also construction risks that include the risk of worker injury and underground infrastructure damage when demolishing concrete. These are risks that the construction company and Queen's University will consider during any construction project on campus. Underground infrastructure could also be at risk of being damaged by the roots of newly planted trees. If trees are not receiving enough moisture, then their roots can invade nearby pipes and buildings searching for moisture. This can be avoided by considering the surrounding infrastructure when planting trees and monitoring the moisture of soil (Rideau 1000 Islands Master Gardeners 2022c).

12.0 Recommendations

Multiple considerations should be made in the further implementations of this project. Surveys should be completed on the pedestrian and vehicle traffic that passes through the selected design area to ensure that enough pathway will be available to accommodate this traffic. Surveys will also be needed to be completed to thoroughly understand the drainage in the area and the volumes of runoff water that typically accumulate. Calculations should be completed to understand the maximum allowable runoff production in the area as well as generally on Queen's campus. This should be added to the recommended additional section of the QBDS Division 32. Standard signage should be created to clearly indicate share road areas so that both pedestrians and vehicle drivers are aware of where to share the road and to watch out for others. Complete and accurate budgeting must be completed for the final design to be implemented on campus. Approval will need to given by Queen's University for the final design and updates to the QBDS to be implemented. This will be up to the Queen's University Facilities department to follow up on.

A designated area in the final design should be assigned for snow gathering in the winter months. Further specific and technical considerations must be implemented to ensure proper management and function of the final design and all of its components. This may include the management of grass around sitting areas, collection of garbage, function of water bottle fill station, and technical aspects of rain barrel water collections. One must also consider the

underground network below the pavement of this area which was out of the scope of this project in terms of specifics. As well, thought should be put into how to stop pedestrians from cutting off of paths and walking through garden areas. This may be through signage, higher curbs, or barriers.

It should be noted that the team was made aware part way through the project of future plans for renovating the Agnes Etherington Center and Jeffery Hall. These projects will begin in late 2023 and early 2024, and the project leads showed interest in collaboration on these projects. As the team members of this project will no longer be students at Queen's University at these future times, this report will be provided to them as an aim in design since the final design of this project incorporates both part of the Agnes Etherington Center and Jeffery Hall.

13.0 Group Dynamics

The team works with the motivation that an equal amount of work will be completed by each team member throughout each deliverable. The following roles have been maintained throughout the 2022/2023 academic year:

The Team Lead, Neil, was responsible for management of group responsibilities and dynamics. He has overseen final editing and revision of all team documents and presentations. He ensured that Queen's Building Standards were upheld throughout the project and developed the recommended Standards updates for transitioning future campus areas.

The Communications Advisor, Brooke, was responsible for recording meeting minutes and booking meeting rooms. She was the key point of contact between the team, the client, and the group manager.

The Technical Advisor, Brenden, identified potential locations and scope for landscaping projects. He conducted research on potential plants, materials, and methods for naturalized landscapes as well as research methods of promoting carbon sequestration.

The Societal Coordinator, Nathan, guided the aesthetics of the design and investigated public perception/interaction with each investigated site. He was responsible for the production and management of student surveys and producing the visual of the proof-of-concept design.

To promote an effective team environment and reduce the chance of conflict, all members acted with proper etiquette and respect. Team members showed up to planned meetings on time, and if a member was late or had to miss a meeting, the rest of the team was updated via direct messages. It was expected that planned meetings would be considered a priority and important reasoning was required for absence. Team members who missed any meeting were responsible for keeping up to date on Meeting Minutes shared with the team and ensured they were clear on actions items for which they were responsible in preparation for the next

meeting. During meetings, members were expected to focus on the project and refrain from completing non-relevant work or using their phones for non-project related activities.

Team members were expected to treat each other with politeness, courtesy, and kindness. Discrimination or cruel intent towards other team members would not have been tolerated. Each member's contribution was valued by listening when speaking and considering all new ideas and opinions.

Team members were expected to complete work by agreed upon deadlines and did so throughout the 2022/2023 academic year. No conflicts arose between team members during the project. As expressed in Section 9.0 of this report, the Gantt Chart was updated frequently to include further details on the list of components for each deliverable. Additional due dates were also added to the Gantt Chart and WBS. A detailed breakdown of Fall and Winter Term contributions can be found respectably in Table 15 and Table 16. Hour logs from each team member can be found in Appendix I.

Table 15: Fall Term contributions from each team member.

Team Member	Fall Term Contributions
Nathan	**Societal Coordinator:** Problem definition with a focus on stakeholders' needs and the creation of the student survey, ensuring smooth transition from single site example to QBDS recommended updates Rationale. **Group Charter:** Conflict Resolution. **SOQ/Resume:** Paragraph about individual qualifications, individual resume + congruent editing of all resumes. Individual slide for SOQ presentation to Client and Project Manager. **Work Plan:** Problem Definition (Scope, Objectives, Constraints, Stakeholders), Plan for Completion of Work. **Research:** Natural Retaining Walls (Vegetative, Crib, Gabion), Site Underground Utilities. **Progress Report:** Project Definition (Objectives, Constraints, Stakeholders), Alternative Retaining Wall Research (Vegetative, Crib, Gabion), Social Response, Design Alternatives & Evaluation, Logo Design. **End of semester presentation for Clients:** Student Survey
Brooke	**Communications Lead:** Regular communication between team and client and Project Manager, booking of meeting rooms for all meetings + creation of Team's meeting invites. Meeting minutes for all meetings. **Group Charter:** Responsibilities of each Team member, Communications Plan. **SOQ/Resume:** Paragraph about individual qualifications, individual resume + congruent editing of all resumes. Individual slide for SOQ presentation to Client and Project Manager. **Work Plan:** Introduction, Background Information, Team Members and Qualifications, Conclusions, References, Appendix B, Appendix C. **Research:** Natural Retaining Walls (Natural Fibre Erosion Control Blankets, Geotextile breakwater tubes, coconut fibre logs, synthetic geotextiles, Rammed Earth Walls, Pros and Cons of Planter Boxes) **Progress Report:** Introduction, Background Information, Site Investigations, Erosion Control Research, Alternative Retaining Wall Research (Rammed Earth Walls, Breakwater tubes), Group Dynamics, Conclusions, Next Steps, References, Appendix B, Appendix C, Appendix D. **End of semester presentation for Clients:** Site Investigation, Next Steps
Neil	**Team Lead:** Responsible for managing group dynamics and responsibilities **Group Charter:** Timing of project **SOQ/Resume:** Paragraph about individual qualifications, individual resume + congruent editing of all resumes. Individual slide for SOQ presentation to Client and Project Manager. **Work Plan:** Letter of transmittal, Plan for completion of work, schedule documents, final edits, revisions, and formatting **Research:** QBDS, Campus Master Plan **Progress Report:** Letter of transmittal, research on QBDS and Campus Master Plan, Adherence to Master Plan Rating in evaluation matrix, project schedule Final edits, and formatting. **End of semester presentation for Clients:** Progress and Results

Team Member	Fall Term Contributions
Brenden	**Technical Advisor: I**dentify potential locations and scope for landscaping projects. He will conduct research into potential plants, materials, and methods for naturalized landscapes as well as research methods of promoting carbon sequestration. **Group Charter:** Etiquette and Respect **SOQ/Resume:** Paragraph about individual qualifications, individual resume + congruent editing of all resumes. Individual slide for SOQ presentation to Client and Project Manager. **Work Plan:** Preliminary Research, Preliminary Cost Estimate **Research:** Site Investigations, Planting research, Landscaping Research, Mental Health Research, Climate Innovation Research, project cost research **Progress Report:** Planting Research, Climate & Social Innovation, Cost, Risk Assessment, References, Appendix A **End of semester presentation for Clients:** Project Scope

Table 16: Winter Term contributions from each team member.

Team Member	Winter Semester Contributions
Nathan	**Societal Coordinator:** Problem definition with a focus on stakeholders' needs and the creation of the student survey, ensuring smooth transition from single site example to QBDS recommended updates Rationale. **Poster Presentation:** societal affects and stakeholders, contribute to design of poster. **Final Report:** Project Definition, Objectives, Project Constraints, Stakeholders, Site Selection (Evaluation Matrix, Student Importance Survey Results, Site Evaluation), Preliminary Site Design writeup and model, Final Design Evaluation Matrix, Preliminary Site Design Survey Results and Evaluation, Final Site Design description. **Final Presentations:** Stakeholders, and societal effects of design including surveys.
Brooke	**Communications Lead:** regular communication between team members, client, and Project Manager, booking of meeting rooms for all meetings + creation of Team's meeting invites. Meeting minutes for all meetings and ensuring team members are aware of updates. **Poster Presentation:** Project Scope, Site Investigations, and Next Steps, contribute to design of poster. **Final Report:** Introduction, Background Information, Site Investigations, Design Research (Alternative Retaining Walls, Coastal Design), Final Design model, Preliminary Site Design writeup and model, Recommendations, Group Dynamics, team contribution of tasks, Conclusions, References, Appendices A, B, G. **Final Presentations:** Project scope and requirements, Final design, next steps.
Neil	**Team Lead:** Responsible for managing group dynamics and responsibilities. **Research:** QBDS, Campus Master Plan **Poster Presentation:** Current progress and details about chosen site, contribute to design of poster. **Final Report:** Letter of transmittal, Executive Summary, Design Research edits, Climate Innovation research, QBDS research, Campus Master Plan research, research on QBDS and Campus Master Plan, QBDS Recommended Updates, Project Schedule, Key Deliverables, Major Tasks, Project Timeline, Appendices D, E, F, H, final edits, formatting, and document submission. **Final Presentations:** Final deliverable's compliance to the Queen's Master Plan, how this is feasible for the QBDS.
Brenden	**Technical Advisor:** Identify potential locations and scope for landscaping projects. Conduct research into potential plants, materials, and methods for naturalized landscapes as well as research methods of promoting carbon sequestration. **Poster Presentation:** Plants and Landscaping research, cost estimates, risks and contribute to design of poster. **Final Report:** Research (Planting, Erosion Control, Alternative Retaining Walls, Social Innovation), Preliminary design model, Cost Estimations, Risk Assessment, Appendix C. **Final Presentations:** Plant and landscape research/chosen plants and landscapes and why they were chosen.

14.0 Conclusions

The goal of the Sustainable Engineered Landscape Project was to recommend updates to the Queen's Building Design Standards that promotes the campus vision for naturalized landscapes described in the QCMP and develop a proof-of-concept to demonstrate how these recommended updates could be applied to an actual site on Queen's campus.

In the Fall Term, the team identified and selected a section of campus with appropriate conditions to support the naturalization of the landscaping, considering factors such as ground conditions, drainage, and existing underground infrastructure. Research was collected on topics related to the naturalization of landscaping on campus including planting, erosion control, retaining walls, and climate impacts. Research was also completed on the QCMP and QBDS to determine the ways in which the Standards could be updated. The landscaping research and data collected from a social survey were used to develop an evaluation matrix from which five identified sites on campus were evaluated. From this, the best site suited for the redesign was selected.

During the Winter Term, a final proof-of-concept design was created for the selected site to demonstrate how the updates to the QBDS might be implemented across campus. Three preliminary site designs were considered, and a final proof-of-concept site design was produced using an evaluation matrix that was developed based on the vision described in the QCMP, feedback from the Facilities Department, and social response through a survey.

Additionally, recommended updates to the QBDS, specifically Division 32 – Exterior Improvements were discussed. Recommendations included investigating alternative retaining walls, re-evaluating the use of bollards on campus, specifying the types of plants used around campus, and adding an additional section dedicated to the management of stormwater and runoff around campus. Next steps were included to ensure the proper and complete implementation of both the final design and the updates to the QBDS.

Team Xpect Green hopes that the Queen's Facilities Department can use this report to show Queen's University that updates to the current QBDS are feasible and will be beneficial to both Queen's University as a company and for all of its students and staff.

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Appendix A – Logbook of Meeting Minutes

Fall Term

Sept. 9th, 2022, Team Meeting
Team's Call, 6:00pm – 7:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Roles and responsibilities for each team member
• Presentation attire
• Initial ideas and questions about proposed project

Key Notes:
• The project being bid for is E2 - Sustainable Landscaping

Action Items:
• Format resumes to look similar
• Prepare for presentation including slides and what individuals will say
• Present presentation on 09/08/2022

Sept. 14th, 2022, Team + Client Meeting
ILC Meeting Room + Team's Call, 3:00pm – 3:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Nathan Splinter, Llynwen Osborne, Marlow Sara Benson
Topics Discussed:
The team met to discuss the proposed job of Sustainable Landscapes at Queen's University. This is a project that has never been done before at Queen's and aims to add new "rules" to the Queen's Building Standard. Within this Standard, there are several requirements, and the goal of this project is to hopefully show that there should be certain environmental requirements implemented for each building on campus. The client gave an example of the newer building, Mitchell Hall, and all the concrete that surrounds it. Typically, when a new building or structure is being planned for campus, a design team is put together and they develop a plan with a higher focus on operations rather than the environment. The client is hopeful that through this job, the team can convey that both the built and natural environment should be considered. With rationale, there is potential to get the Queen's Building Standard changed or updated. There are no current rules about what you can and cannot plant on campus so this would be something interesting to potentially add to the Standard as well.
Some examples of areas on campus that could be modified to have sustainable landscapes were discussed to be Mitchell Hall and the ARC, the area between Mackintosh-Corry Hall, John Watson Hall and Jeffery Hall, as well as Richardson Stadium. These areas all have a large amount of concrete. The client also spoke about how the Isabel Bader Center does not have a lot of naturalization and that the erosion on the waterfront nearby has been increasing. This was suggested to be a great area to focus on as it will include sustainable landscaping as well as water erosion from increasingly high-water levels at the shoreline. A project to control erosion at this lakeshore setting is already being planned by the University in partnership with the City of Kingston. This project would have funding associated with it and by focusing on this area of campus, it would be possible to actually implement what the team comes up with in the near future.

Another topic discussed during the meeting was heavy rainfall flooding and some areas on campus that could be improved upon through sustainable landscaping to increase drainage. It was discussed that any buildings with sloped ramps leading to lower levels typically have poor drainage. Some examples given were Robert Sutherland Hall, the New Medical building and the basement of MacArthur Hall.
Overall, the University has greatly reduced its natural and sustainable landscaped areas in the past few decades in promotion of "Beautification". Photos can be found online of what Queen's campus used to look like and how it was covered in trees. Other than these manmade changes, the campus trees have gone through several ice storms, notably one in 1997, which increase each year, as well as the Emerald Ash Borers killing off many Ash trees. It would be great to figure out smart ways to incorporate trees back through campus.
Next steps for the team to get going on this project were discussed. A bi-weekly meeting will be scheduled with the team and the clients to check in on status and bounce around questions and ideas. The client has requested a 5-minute presentation be presented to the team at the end of the Fall semester to update stakeholders on what the team will be doing for this project and how this will be a benefit to Queen's University. It was noted that this should be a high-level presentation. Next steps for the team are to come up with a list of questions and documents we might need from Queen's University and potentially to connect with the other six CIVL 460 groups that will be completing similar work with Queen's University for their projects. It was noted to avoid scope creep and use the other teams to check in but focus on the task at hand.
A final note was made that the goal of this project will be to figure out how people, plants and animals can enjoy the space that will be sustainably landscaped rather than just focusing on humans alone. Overall, the team and the client all seem to be excited about this opportunity and are looking forward to getting started.

Key Notes:
• The Isabel Bader Center is a preferred location of the Client for this project

Action Items:
• Compile a list of resources required from the Client and send to them

Sept. 15th, 2022, Team Meeting
ILC Meeting Room, 11:30am – 1:00pm
Attendance: Brooke Sampson, Neil Trainor
Topics Discussed:
• Task delegation for Group Charter deliverable
• General timeline for project
• Talked about documents we may need from the Client
• Talked about when would be a good time to have weekly meetings with the Group Manager

Key Notes:
• The documents we are requesting are any maps showing coastal data near the Isabel Bader Center, a topographical map of Queen's campus, a map of Queen's underground infrastructure

Action Items:
• Everyone to compile a general weekly calendar for Neil to combine and figure out when we all have time for meetings

• Group Charter parts should all be done by 3pm on 09/16/2022 so that a final review can be completed
• Submit Group Charter by 4:30pm on 09/16/2022
• Meet early next week to complete site investigations around campus
• Brooke to email Client with request for documents

Sept. 21st, 2022, Team Meeting
ILC Meeting Room, 2:00pm – 3:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Task delegation for Work Plan deliverable
• Discussion of which areas we want to visit and how they will be assessed
• Planning for site visits

Key Notes:
• Individuals parts for the Work Plan deliverable will be due Wednesday, September 28th by midnight.

Action Items:
• Individual parts of Work Plan
• Next team meeting will be spent visiting the Isabel Bader Center and potentially some other areas around campus

Sept. 22nd, 2022, Team Meeting + Group Manager
ILC Meeting Room, 5:30pm – 6:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Each team member's experience and how it will be beneficial for this project
• Determining the key deliverables and goals of this project
• 2018 is too little and 2019 is too much in terms of WBS examples. Preliminary research should not be extensive and should ultimately define the scope.

Key Notes:
• It may be too busy to meet with Juliana once a week as well as a group separately - could still meet as a group and make it working time.
• Break down 4-5 potential areas around campus to compare - not too many and don't need too much detail
• if Juliana is going to review our work before submissions, she needs at least 2 days to go over and return the work.

Action Items:
• Gantt Chart should have more details especially for the beginning term
• Need to add surveying into Gantt Chart

• Should add photos of each site visited to report

Sept. 28th, 2022, Team Meeting
Walking Around Campus, 2:00pm – 4:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Spatial feasibility – above and underground.
• Are there already barriers present in the area that could be naturalized (i.e., putting in a tree won't be making a new barrier/ obstacle
• Pathways/ student traffic
• Amount of light that the area gets
• Why is the MacCorry/ Stirling area all concrete? Is there anything underneath there?
• Comparison area: MacCorry to Law Building – concrete + trees, grass area by Kingston Hall/ Clark Hall

Key Notes:
• Team visited various locations on campus to complete initial site assessments
• Areas visited were Isabel Bader Center, MacCorry/ Stirling concrete area, Stirling Hall courtyards, Mitchell Hall, Douglas Library, Victoria Hall, grass areas around campus residences, area between ARC and Mitchell Hall, Clark Hall/ Campus Bookstore

Action Items:
• Look into the parking structures under Tindell and Nixon field
• Look into if there is anything under the MacCorry/ Stirling concrete area
• Look at slopes, retaining walls, runoff-potential areas
• Look at different areas of campus when a big rainfall comes – hardscaped areas
• Look at old photos of University Avenue from when campus was more naturalized
• Look at documents sent over by client
• Edit and submit Work Plan
• Set up another meeting with the client to review site investigations

Oct. 5th, 2022, Team + Client Meeting
ILC Meeting Room + Team's Call, 3:00pm – 4:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Nathan Splinter, Llynwen Osborne, Marlow Sara Benson, Alexandra Rae Peet
Topics Discussed:
• Research - why is the beneficial to the University? Will it be more work/upkeep/maintenance?
• Retaining Walls (examples are fabric bags with plants grown directly inside, want to avoid concrete. Concrete is not great, bricks are better, something else that is naturalized is the best - need a vegetative or non-concrete retaining wall for Isabel Bader Center)
• It is important to take multiple photos of each site/ include them in reports.
• Consider remediation - how far will you go down, what will you replace the excavation waste with (i.e., what will be the best soil)

• Bi-weekly meetings with Client will begin October 26th - Teams meeting invitations will be sent out by Llynwen (can be used to discuss deliverables and bounce ideas off the client)

Key Notes:
• Qualitative and quantitative research will be needed
• The Queen's Master Plan should be very useful - if this project aligns with the Campus Master Plan, the University will be more inclined to put money towards it (their goal is to get everything in line with the Master Plan)
• The grassy areas with grass not growing properly can be because of foot traffic as well as salt - an alternative would be to put up Timber boxes and fill them with vegetation

Action Items:
Research:
• Cost/other benefits of naturalization
• Operations and maintenance reductions
• Look into external standards, best practices, case studies (LEED Green has Sustainable sites
• Look into the Queen's Master Plan
• Show the picture of Mitchell Hall (all that concrete) next to a photo of the somewhat green area behind Ellis Hall between MacCorry

Oct. 6th, 2022, Team Meeting + Group Manager
ILC Meeting Room, 5:30pm – 6:00pm
Attendance: Brenden Underwood, Brooke Sampson, Neil Trainor, Juliana Reinert
Topics Discussed:
• Reviewed how the client meeting went on Oct 5th
• Freeze-thawing could have been a likely reason for the retaining wall at Isabel Bader Center to corrode like it did
• Reviewed how the site visits went on Sept 28th
• Discussed plan for Reading Week and next steps for project
• Discussed importance of having something that can be used to visualize size when taking site photos

Key Notes:
• When taking photos of sites, it is important to have something in the frame that allows the viewer to see the size of what they are looking at (i.e., notebook, water bottle, person, orange, etc.)
• The final poster and the progress report should have multiple "good" photos included in them - use best photos for matrix evaluation
Action Items:
• Start researching listed research areas over the Reading Break and discuss as a group when we return

Oct. 19th, 2022, Team Meeting
ILC Meeting Room, 3:00pm – 4:00pm

Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Reviewed research conducted by each team member during the reading break
• Discussed what will be presented to clients in next week's meeting (research and criteria)
• Looked at photos of different types of natural retaining walls and discussed their pros and cons

Key Notes:
• Likely will not need a meeting with Group Manager this week - multiple other assignments and midterms this week to focus on

Action Items:
• Compile key research and criteria ideas by Monday, Oct 24th so that Neil can combine them into a slideshow to present to the Clients next meeting (Oct 26th)

Oct. 26th, 2022, Team Meeting
ILC Meeting Room, 2:00pm – 3:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Reviewed key research conducted by each team member since last week's meeting
• Discussed what to highlight to the client in upcoming client meeting
• Divided up who will do what for the progress report (Due Nov. 25th) + questions about the report for Juliana
• Reviewed comments from Juliana from Work Plan

Key Notes:
Multiple questions for Group Manager on Progress Report requirements:
• Do we need a preliminary solution or just a plan? (From rubric: "Process of final solution was very effectively communicated") - one of the parts of the Progress Report is to have a "Conceptual Design"
• Do we need to include all parts from Work Plan in the Progress Report or scrap the sections that are not outlined in the requirements for the Progress Report
• How can the Work Plan be in the appendices? This is in the outline.
• Do you really want us to add all of our hours and meeting minutes to the end of the progress report?

Action Items:
• Each team member must review their sections of the progress reports before tomorrow's Group Manager meeting to be prepared to discuss what can be improved for the Progress Report.
• Each team member must get familiar with what they will be completing for the Progress Report
• Each team member to prepare a summary of what they have completed for this project in the past 2 weeks + what their plan is going forward (due for tomorrow's Group Manager meeting)

Oct. 26th, 2022, Team + Client Meeting
ILC Meeting Room + Team's Call, 3:00pm – 4:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Nathan Splinter, Llynwen Osborne, Marlow Sara Benson
Topics Discussed:
• Presented research topics to clients
• Client mentioned there is significant flooding near Robert Sutherland Hall.
• Important to capture specific ideal states for plants (i.e., ideal distance between trees/ bushes) - Little Forest Group would be a great resource (they put together planting kits of trees that grow well together)
• Armour Stone could be a good alternative to concrete in a retaining wall (not concrete, very heavy, large stones stacked on top of each other)
• Don't write off the initial idea of vegetative walls - they have a benefit from rooting systems (ex. Mangrove trees), as long as the correct biomass/ bush/ tree type is chosen.
• There is a community garden behind Jefferey Hall, and 2 others with AMS and West Campus - good examples for box gardens
• The School of Urban Design is currently running a project (ending early December 2022) that looks at pathways on campus and potential to de-pave and re-design. This could be an opportunity to reach out and implement one of the areas that they identify as the focus of this capstone project
• They are creating a new Standard for campus pathways - size depends on flow rate of traffic, type of material used depends on type traffic using the path most often.

Key Notes:
• Ensure that the identified area + solution if a final deliverable but ALSO a standard for future use. (Create a new Standard that is a singular section and fits into the Queen's Building Standard + is aligned with the Queen's Master Plan)
• Ensure that the positive effects of naturalization around campus on mental health are included in final deliverable (Most people will say they would rather walk around the older parts of campus, where there is more naturalization, rather than the newer parts that are full of concrete)

Action Items:
• Determine a date for a short 5 and 5 (5 minutes presenting, 5 minutes for questions) presentation to clients for end of November - email clients with a date that works for the team
• Reach out to Joyce Hostyn to get information on native plants from the 1000 Islands Master Gardeners (Little Forest Group)
• Research into Amour Stone
• Reach out to Queen's School of Urban Design - Madelen Fellows - about their project with pathways and potential synergy.
• Reach out to some individuals that are specialists in specific species that have strong root systems ideal for vegetative walls

Oct. 27th, 2022, Team Meeting + Group Manager
Team's Call, 5:30pm – 6:15pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Juliana Reinert
Topics Discussed:
• Key feedback from Group Manager and Professor on Work Plan (See Key Notes section)
• Who will be doing what for Progress Report
• What was discussed with Clients in yesterday's meeting
• Questions about Progress Report for Juliana were answered/ acknowledged for follow-up

Key Notes:
• See "CIVL 460 Work Plan Feedback from Group Manager Meeting" Document in Teams Group files.

Action Items:
• Work on editing sections from Work Plan with use of feedback
• Work on criteria for picking a site for this project
• Juliana to follow up with Prof. Watt on:
    1. The definition of "alternatives" and what he will classify as this,
    2. If the Work Plan in its entirety will be required as an Appendix for the Progress Report or if just the Gantt Chart is required.
• Nathan to email Juliana to get more information on Stakeholders as discussed in the meeting.
• Neil to follow up with Juliana on how to clearly add the "left part" of the Gantt Chart and present clearly in the Progress Report

Nov. 3rd, 2022, Team Meeting + Group Manager
Team's Call, 5:30pm – 5:45pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Juliana Reinert
Topics Discussed:
• Specific feedback from Prof. Watt
• How to include effects of climate change (20 years impact) on the project (how it will affect the chosen plants and drainage systems (Watt is a "Hydraulics guy", so this is important to him))

Key Notes:
• Juliana discussed Progress Report with Prof. Watt and it was determined that a final "Conceptual Design" will not be required for the group for the Progress Report. Instead, in depth research and a decision matrix will be needed
• Prof. Watt is insistent that a climate assessment is included in the Progress Report (and have climate zone maps to back up the decisions for plants) - this should be a section of the Progress Report
• Look into how climate change
• Prof Watt will be discussing Progress Report requirements this upcoming Monday lecture

Action Items:

• All team members to work on sections for Progress Report + focus on decision of site
• Team to send Progress Report (whatever is done) to Juliana before Nov. 10th team meeting to get feedback on layout and what is written so far
• Focus heavily on plants research for upcoming Progress Report (need lots of reasoning)

Nov. 9th, 2022, Team Meeting
ILC Meeting Room + Team's Call, 2:30pm – 2:45pm
Attendance: Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Internal group due dates for decision matrix, final report and when to send to Juliana for review
• Topics to be discussed during next meeting with client and as a team (decide on a site)
• Is an online survey sent out to students allowed at Queen's for this project - discuss with Juliana

Key Notes:
• Meet from 1:30pm - 3:00pm on Wednesday Nov. 16th as a team before Client meeting (3pm - 4pm) in person to review decision matrix and decide on a site
• Meet with Juliana on Thursday, Nov. 17th to discuss any last questions
• Send initial "final" draft of Progress Report evening of Friday, Nov. 18th to allow Juliana to review.
• Integrate feedback from Juliana into final draft over Monday, Nov 21st - Wednesday, Nov. 23rd
• Nov. 24th - Thoroughly edit Progress Report individually and submit in the evening.
• Nov. 25th - backup date if more time is needed (note: Brooke will be unavailable after 12pm on Nov. 25th)

Action Items:
• Neil to finish decision matrix by evening of Nov. 11th
• Nathan to talk to Juliana about online surveying
• All - work on individual sections of Progress Report

Nov. 10th, 2022, Team Meeting + Group Manager
ILC Meeting Room, 5:30pm – 6:15pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• What should we talk about in the "Assignment of Duties" section? - TA confirmed it can be used for future assignment of duties as we already have a section dedicated to who has done what for the Progress Report. Still need at least 1 small paragraph to talk about who did what in the Progress Report.
• Reminders of what should be included or improved upon for Progress Report.
• Which specific sites should be looked at in terms of the Decision matrix?

• Chosen sites to analyze will be
- Bader Center
- Jefferey in the pits and not past the pavilion (look at Team's document)
- Mitchell Hall/ ARC
- Big open concrete/asphalt area behind Ellis on way to Vic Hall + ramp by Tindell
• Backup sites will be:
- Destroyed elevated potting areas beside Law Building
- Grassy plots can be a problem area and be addressed in the Code (present solutions)

Key Notes:
• Criteria could be more qualitative as it is not so far. However, this project is not very qualitative to begin with
• Include drainage in the matrix as affects on surrounding environment - important to include for Prof
• Prof marks every single report which is good, but what he wants and what the client wants seems to be quite different - need to synergize
• Prof understands that for the Progress Report we will not have a final design - research and justification is most important
• Site investigation is very important - good figures must be included in the report (not all shoved in the appendix)
• Ensure to mention Climate Change impacts but the assessment can fully be done in the Winter semester
• Climate Change affects should be part of the criteria decision matrix
• If help is needed for the structure of how we will evaluate each site and the set up, ask Juliana It's important to highlight all the aspects of each site

Action Items:
• Brooke to email 1000 Islands plant expert contact to get an idea of what they can help us with, Brenden to come up with specific questions to ask
• Brooke to send what we have of the Progress Report to Juliana tomorrow (Friday) night to review
• Nathan to create a Google Form for the student survey and send to Juliana to be posted on OnQ (send by Tuesday, Nov. 15th)
• Team to review photos of each site and decide which ones need to be re-taken with an object for scale.
• Divide up who will take photos of which sites

Nov. 16th, 2022, Team Meeting
ILC Meeting Room + Team's Call, 1:30pm – 3:15pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Final notes and last-minute assignment of new duties for the Progress Report
• Discussed decision matrix criteria, chose a site location
• Decided on Team logo

• Discussed topics and compiled questions for Client meeting

Key Notes:
• Need to get better photos of each site to include in the Progress Report
• Decided on location for the project as the area around Jeffery Hall
• Logo chosen was #8

Action Items:
• Brooke to write about the drainage and the site investigation stage
• Better photos of each location, especially the chosen location, to be taken with an item for scale
• Add team logo to each page in the Progress Report
• Neil to add a section (likely in Section 8) about the new Standard we want to create + Brooke to comment on it in the Next Steps Section
• Talk to Client about the preferred date for 10-minute update presentation
• Reminder for each team member to have their rough parts completed for the Progress Report by TIME, on Friday, Nov. 18th, 2022, so that Brooke can send to Juliana for feedback
• Continue to edit report over the weekend

Nov. 16th, 2022, Team + Client Meeting
ILC Meeting Room + Team's Call, 3:15pm – 3:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Nathan Splinter, Llynwen Osborne, Marlow Sara Benson
Topics Discussed:
• Location, date, and time for 10-minute presentation
• Discussed results of the decision matrix evaluations + 2 top-ranking sites (area around Jeffery Hall and area behind Jeffery Hall)

Key Notes:
• Jeffery Hall is going to be going through a renovation in the near future, so it is a good location to choose (and also scored the highest in the decision matrix)
• 10-minute presentations will take place on Wednesday, November 23rd from 2pm-3pm at the Queen's Facilities Office on King Street

Action Items:
• Nathan Splinter to send meeting invite with specific date and time for 10-minute presentations
• Nathan Splinter to send contact information to Brooke for the Project Manager of the Jeffery Hall renovations

Nov. 17th, 2022, Team Meeting + Group Manager
ILC Meeting Room, 5:30pm – 6:15pm
Attendance: Brenden Underwood, Brooke Sampson, Juliana Reinert
Topics Discussed:

• Multiple questions about report formatting, content, and citations

Key Notes:
• This is the final meeting with the Group Manager for the Fall semester
• Make sure that it is obvious in the Scope section what will be in the Progress Report and what will be in the Final Report

Answers to Questions:
1. When referring to a standard, if it has a specific name, use "Standard", if it just in general, use "standard".
2. No need to include the updated Work Plan as an Appendix as it will not add much value to this specific report/ will be repetitive
3. All appendices should be mentioned by name in the body of the report. Any Figures/ Tables in the appendices do not have to be mentioned by name but should be acknowledged (e.g., see more images in Appendix A)
4. Meeting Minutes and Team Member Hours can be mentioned in the Group Dynamic Section of the report
5. Disclaimer can be included on Cover Page of the report (Juliana to check during rough draft review if this looks correct and give feedback)
6. Innovation should be its own small section - point out changing the Queen's Building Standards, climate impact, carbon footprint. Talk about what it is and where in the report you can find it
7. Risk Assessment should be included but only must be 1 or 2 paragraphs. Include Environmental and Societal risks
8. Costs section can be in terms of environmental and societal costs, doesn't have to be monetary (mental health can be included!)
9. Assignment of Duties section should be for the entire semester of who has done what
10. Figure captions/ numbers are not necessary for the Acknowledgement email from the Client or the Team Hours section - can include as full pdfs and attached at the end in a pdf combiner
11. If no date of publication is given, can use date accessed in ASCE references
12. A video found on a website can be cited as a website for ASCE
13. For description of site investigations, present tense can be used

Action Items:
• Send rough draft of Progress Report to Juliana before Saturday, November 19th at 8am
• Juliana to show Brooke how to cite a magazine in ASCE
• Brooke to show team members how to add ASCE in Zotero as a citation method
• Brooke to include a paragraph that explains how to Queen's Building Design Standards is a website where you can find all the Standards rather than a Code itself

Nov. 22nd, 2022, Team Meeting
Team's Call, 7:00pm - 7:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:

• Topics to discuss in tomorrow's client presentation + who will discuss what
• What to wear for client presentation
• Timing of getting to Facilities Department building
• Final notes on Progress Report editing and questions

Key Notes:
• Brooke to meet other team members at ILC at 2:15pm and drive team to Facilities Department building at 355 King St. W.
• All content to be completed by Wednesday, Nov. 23rd night so that team can edit together in Thursday's meeting
• For presentation: Neil – Introduction, Progress + Site Results, Brenden – Project Scope, Nathan – Social Survey discussion, Brooke – Site Investigations and Next Steps
• Team to dress in Business Casual for client presentation

Action Items:
• Editing of Progress Report to take place in ILC meeting room as a team on Thursday, Nov. 24th from 12:00pm – 2:30pm
• Each team member responsible for adding content to presentation slides + talking about individual parts in the presentation

Nov. 23rd, 2022, Client Presentation
Queen's Facilities Department building (355 King St. West, Kingston) Board Room, 2:45pm – 3:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Nathan Splinter, Llynwen Osborne, Marlow Sara Benson, eight other Facilities Department employees
Topics Discussed:
• Presented about project scope, site investigations, social survey results, progress through Fall semester, chosen site (Site #2), next steps.

Key Notes:
• Reminder from Nathan Splinter that Jeffery Hall is in the Design Phase for completing a full green roof project – could be beneficial to expand Site #2 to include the area just between the West side of Jeffery Hall and the beginning of the defined Site #2
• The Agnes Etherington Art Centre (South of Site #2) will soon be going through an external renovation – something to consider as it will affect Site #2 naturalization
• It will be critical for the team to ask lots of questions to the Facilities Department about these other two projects so that we can work with them
• Potential to work with the CIVL 460 group focusing on permeable concrete as an alternative to regular concrete in the scope of this project

Action Items:
• Send Progress report to client once it has been submitted to the CIVL 460 drop box and the "okay" has been given from the teaching team to email to client

Winter Term

Jan. 1st, 2023, Group Meeting
ILC Meeting Room, 3:30pm – 4:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Layout of poster, reviewed examples and created document
• Weekly team and client meeting times
(Team meetings will be on Tuesdays in the ILC from 4:40pm to 6:30pm, client meetings will be biweekly starting on January 20th on Fridays online from 10:30am to 11:30am)

Key Notes:
For poster:
• Brenden - Innovation
• Nathan - Choosing of Location
• Neil - Abstract
• Brooke - Site Investigation + Next Steps

Action Items:
• Finish poster draft by Wednesday, January 11th at 4:30pm to send to Julianna for feedback

Jan. 17th, 2023, Group Meeting + Group Manager
ILC Meeting Room, 11:00am – 11:30am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Progress Report Feedback + discrepancies between Juliana and Prof. Watts comments
• Presented Poster presentation
• Who will oversee what going forward
• Gantt Chart review with Juliana
• Things to keep in mind for Final Report
• Discussed how clients said Jeffery is already having a naturalization project and how we can tack on to that and expand our scope/ they could just implement our recommendations into their project that's already happening
• Dr. Fillion and LIDs - could talk to him about technical implementation for this project to reduce runoff/ help with drainage

Key Notes:
Presentation Feedback:
• Neil - very good
• Brooke - Show on the map where each site is
• Nathan - what is relevance of number of answers we got vs the number of students who use the campus (significance - it is a good idea and still significant! Could be preliminary data)

• Brenden - more importance to mental health aspect of this! Can be a key selling point for adding to the Standard (will make the university happy)

Notes on Progress Report:

• Could have been improved with more time
Deeper research into plants and the survey results
• Watts suggestion - disagrees with Juliana in 2-3 spots (we should go with what we think is best)
• Lost marks in cohesive writing, minor grammar mistakes (we are a bit over average yay! Our report was GOOD)
• Urban planning was missed in the report (could be added as justification)

Suggestions for Final Report:

• Most important to know how to justify our decisions
• How much concrete will we remove, pathways, sitting areas - justify with working hours and cost
• Could develop design criteria with clients
• If Juliana didn't say anything in comments, she agrees with Watts, if she says something then she says she doesn't agree
• No feedback given after final report is submitted - should be sending to Juliana regularly to get feedback
• Needs a better description of each site
• Watts wants suggestions for each other site as well (if we have time…) Design criteria should be enough for that really (according to Juliana)
• If we are too busy one week - don't have to have meeting and can just email our updates

Action Items:

• Start working on the Final Report document now and add to it over the semester to give ample time for editing in the final 2-3 weeks
• Read feedback on Progress Report once it is returned to us

Jan. 8th, 2023, Group Meeting

ILC Meeting Room, 3:30pm – 4:30pm

Attendance: Brenden Underwood, Brooke Sampson, Neil Trainor

Topics Discussed:

• Move weekly Tuesday meetings to 4pm instead of 3:30 to accommodate Neil's training sessions
• Plan for the design criteria
• Questions to ask the clients
• Reminder that Alex sent us an example on how to write Design Standard

Key Notes:

• First step is design criteria - consider cost, maintenance, time, what to do with the waste (avoid sending to landfill - recycle if we can)
• Plantings: different types of wildlife that may be attached (wanted/ unwanted)
• Get an idea of the plan for around Jeffery Hall - work with their vision

• Complete another site investigation - determine how much space we must work with
• Figure out what MUST stay as is (in terms of paths/ roads for vehicle and pedestrian traffic and access) - this doesn't have to be ALL concrete - there can be greenery!
• Need to determine realistic criteria that can be implemented anywhere on campus - could be generalized as "green landscape" - may be beneficial to do percentage of greenery rather than x number of plants
• Design Standard seems vague now - may not be appropriate to have percentages. It should be more of a guide/ suggestion.
• Looking back - another criterion we could have looked at in terms of choosing a site would be how much of the area NEEDS to be concrete/ transportation such as roads.

Action Items:
• Brooke to reach out to get in touch with Facilities team who is working on pre-planned Jeffery renovations
• Brenden to contact Queen's maintenance to get an idea of how they work

Questions for Clients:
• How specific should the guidelines be
• How much space HAS to be available for vehicles - can we make one laneway and a potential turnaround for vehicles to and from Ellis + a singular pathway for students to walk on (once we know this - talk to Queen's pathways team)
• Do you have any questions about our progress report - open to feedback and questions.
-•Ask that they please read the report before the meeting
• Do you have any ideas for evaluation design criteria - what specifically do you care about or want to see
• Do you have a contact for someone who has written the Standards - would like to talk about the framework and process with them?

Jan. 20th, 2023, Client Meeting
ILC Meeting Room, 10:30am – 11:00am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Llynwen Osborne, Marlow Sara Benson, Philip Wright, Alexandra Rae Peet
Topics Discussed:
• Questions for client + plan for the semester

Key Notes:
1. How specific should the guidelines for the proposed new Standard be?
• Put in very specific recommendations for garbage cans for example
• Some specs but not super specific
• Expectation but not product (3 stream garbage but no brand names) this is kind of the general rule

2. What types of vehicles are found driving around the site?

• They are working on permeable pavement and reducing lane ways (service only) and only 1 laneway - needs to be big enough for fire code (fire access). Behind Douglas and 5th field company lane
• Safety element and aesthetic
• Must determine what needs to go into Ellis loading dock (talk to Hal)
• There is an existing fire route plan already - needs to go all the way through, potential turnaround if we can't go all the way through
• Could look at honeycomb structure - plants can grow through but in an emergency, can support a vehicle load
• When they are revaluating the site/ pathway site - Tony (get contact from Facilities)

3. Do you have any questions about our progress report and what we are proposing?
• Philip questions: asked which site we selected - was it Site#2? Llynwen thought it was the Bader Centre (no), Philip thinks it's a great candidate.
• Only issue would be marrying this to the Master Plan - they want to make this a big open area it seems
• Could narrow roadways to service vehicles only
• 5th field company Lane area - beautification - look at report from Beautification project and see what they did - Llynwen to send this to us (or get from Tony)
• Lots of push towards native material/ plants - Philip is worried they won't be in a natural habitat and therefore will not thrive especially when surrounded by concrete
• May be better for non-native non-invasive plants (intention is there but not the ideal result)

4. Do you have any preference for evaluation design criteria - what specifically do you care about or want to see?
• Environmental considerations, Traffic, Safety, Aesthetics (Multiple interest points)
• Aesthetic must be functional (key point) - don't want to "put a band aid on it"

5. Do you have a contact for someone who has written part of the Design Standards? We would like to talk about the framework and process with them.
• Tony Gkotisis
Other:
• There is a large steam hole access point in the site area - need to have something that can accommodate the area with person-hole access - some plants will not work there because of the excessive steam
• Check out underground plans to see how much space we need
• Often need to access for repair
• The already planned pathways are supposed to be concrete bordered with something else (seems to be the campus standard going forward) - minimal in numbers but necessary
• Goal is to keep everything to an absolute minimum to maximize surrounding greenspace
• Lots of "Health and Wellness" as a selling point to the campus right now - consider and incorporate this
• Secure bike storage, bike racks, active learning area
• Investigate raised garden beds, merge what we do with the community garden

• Edible forest?
• Lack of storage on campus - space on campus is at a huge premium (little to no storage for any items - such as raised garden beds
• Proposed a storage area but not feasible for this area - bikes only but would be huge
• People have been asking for bike lockers - look at this - box with a key (don't have much secure bike storage) - there is one by Mac Cory and adding one at sterling
• School - different things to do at each space (be mindful here, etc.) - should run a survey to gauge what other students want
• Looking for consistency across campus - adapt to what the school wants to be in line with

Action Items:
• Llynwen to send contact for 5th Field Company Lane beautification project

Jan. 23rd, 2023, Poster Presentation
Ellis Hall 333, 6:30pm – 8:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Poster could be updated to be more presentable in print

Key Notes:
• Results from survey may be presented in a better way through a bar graph (both results for each site)
• Increase sizes of site numbers on lower left map to be seen better
• Shrink evaluation matrix (less white space in the boxes)
• Try to find clearer photos (they printed blurry)
• Increase size of map of the chosen site
• Potential to include Green Roofs in our scope or at least a mention of it (research into TMU green roofs and their vegetable/ bee garden)
• Look into Montreal green roofs
• Make sure all bullet points are the same format

Action Items:
• Update poster and send to Juliana to ensure the updated version is the printed copy

Jan. 31st, 2023, Group Meeting + Group Manager
Douglas Library Meeting Room + Team's call, 11:00am – 11:10am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Feedback from Progress Report
• Expect to show Juliana work from the past week in each upcoming meeting
• Ask if poster can be reprinted with an undated version

Key Notes:

• Time management was an issue for Progress Report - try hard to finish Final Report earlier so that there is enough time for review and catching mistakes before submission. This will also give more time for Juliana to review and provide feedback.
• It was difficult to know what the prof wanted out of the Progress Report as the rubric was vague - ensure to check detailed rubric (provided by Juliana) to check that everything the markers look for is addressed
• Now that we have feedback from Sean for the Progress Report, it will be easier to understand what he wants for the Final Report
• The Final Report will focus on checking Learning Outcomes

Action Items:
• Juliana to ask Sean if the poster can be re-printed with updates based on feedback from poster presentation for Ellis posting - Send poster by Sat. Feb. 4th at 12:00pm.
• For next week - send Juliana our work ahead of time to receive feedback and be prepared with questions/ talk about what we have worked on this week

Jan. 31st, 2023, Group Meeting
ILC Meeting Room + Team's call, 4:00pm – 5:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Questions for upcoming client meeting
• Neil talked to Dr. Fillion, and he is happy to meet with the group any time to talk about LIDs, etc. for drainage
• Discussed the criteria for site design proposals and determined an initial evaluation matrix

Key Notes:
• Art related + indigenous art and having an indigenous person creating it - figuring out how to incorporate and not using impermeable concrete/ ground (incorporation of artwork)
• Must think about space - 15 at most bike racks if we incorporate that, need to think about this
• Remember that the clients seemed ok with us only allowing maintenance and emergency vehicles in this space
• Need to make sure our project can be integrated with Jeffery project - are they doing anything with the East entrance to our "site" from South of Jeffery
• Set up a meeting with Permeable Pavement project team
• Think about evergreen vs not-evergreen plants and how they will look year-round. Evergreen looks best year-round.
• Make sure our pathways are the same as the new pathways suggested (Brooke to read the document they sent and set up a meeting for questions)
• Is there an alternative to putting salt down on the ground in green spaces in the winter (Brenden to look into this) - beat juice
• Worked on producing a decision matrix for the clients
• Animal factors - type of thing to help decide the expected life span of our plan
• Blue light posts included in the area for design (look at map - there already is one int eh area, make sure to watch out for it so that it stays)

• Make sure there are areas for garbage can(s)
• Survey for people ranking aesthetics and ideas for those - get this out earlier to get out to people
• Make 3 design alternatives, show them in survey, ask them specifically for each alternative how they would rate them aesthetically, take percent average - make quantitative criteria about how this is ranked for evaluation matrix

Action Items:
• Send clients questions + initial evaluation matrix for Friday's meeting (Brooke)
• In upcoming client meeting, talk to Tony about Standard writing

Feb. 3rd, 2023, Client Meeting
Team's call, 1:45pm – 2:15pm
Attendance: Brenden Underwood, Neil Trainor, Nathan Fitzpatrick, Tony Gkotsis, Marlow Sara Benson, Philip Wright, Alexandra Rae Peet
Topics Discussed:
• Summary of the project for Tony Gkotis who is newly invited to the weekly meetings
• Questions for client, update on progress and plan
• Nathan reviewed the evaluation matrix.

Key Notes:
1. Is the parking lot at the center of our site a "must keep"?
- City of Kingston Zoning by-law, no parking standard for the university, bicycle rack requirement based on classroom size

2. Confirm that we will be ok to just account for a 1 lane maintenance/ emergency vehicle road/ access route through the site.
- Restrict vehicle access to bare needs

3. Show clients where we don't think we need vehicle access at all (Neil to show clients)
- Agnes required for loading dock and garbage
- No design considerations for Agnes Centre, 1.5 year out from design

4. Do you have a contact for the Agnes Hall project we can reach out to?
- Agnes - western and Indigenous world views combines
- Indigenous outdoor space at path by Tindall

5. What type of salt does Queen's use around campus in the winter? (Answered in an email directly from Tony before the meeting)

6. Where is fire route required to be?
- Assume that need to maintain route north and south for only fire access

Other:

• Queen's has poor indication of where vehicles should and should not be which is why the chosen site looks like it's being used as a parking lot. We need to make sure we have clear elevation changes to ensure that people know not to drive in the area.
• The School of Urban Planning Final Pathways Report developed standards for pathway widths ranking low, medium, and high pathway use
• University Campus Master Plan regulations for open and green spaces
• Creating a transition from asphalt to multi-use will result in curb cuts
• Width and turning radius specs for fire trucks available
• Specs for how far a fire truck must go to require through lane
• Indigenous planting and design aspects

Action Items:
• Expand site to West of Mac-Corry and Watson Hall, everything East of Mac-Correy should not be parking lot

Feb. 7th, 2023, Group Meeting + Group Manager
Team's call, 11:00am – 11:30am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Reviewed evaluation matrix
• Reviewed and discussed next steps for the Final Report
• Brainstorming and how this happens (could use "Word Cloud" website)

Key Notes:
• First part of evolution matrix is easy to understand and clarify
• Pedestrian - over 2 connecting routes ("too thin" is objective - need to put numbers or at least something qualitative)
• "Sidewalks meeting minimum requirements" - what requirements - need to be more specific
• "3 factors of lining" - are the following the 3 factors? Be clear on this.
  - Take out 3 factors from inside of the matrix to be clear about what we are talking about
  - Clearly say what the factors are and present them ("Here are the facts 1, 2, 3")
• Pedestrian accommodations - what are the actual accommodations we are talking about specifically?
• Juliana likes that we are doing surveys
• Maintenance of plants - "may be difficult" and "convenient", need to describe the levels different
• Make sure to send her our writing - this will help with clarity and with content
• Present evaluation criteria before the matrix likely to make sure people are clear on what they are about to read before reading the matrix

Action Items:
• Brooke to send Queen's Building Standard to Juliana

• For next meeting - update Progress Report with all suggestions from grading (everyone to do their own parts), have brainstormed ideas ready to discuss with Juliana
• Next week have brainstorming ideas ready to show Juliana

Feb. 10th, 2023, Group Meeting
Team's call, 1:30pm – 2:30pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Brainstormed design ideas - pulled up photo of the site on the TV screen to get a good idea of what we're working with
• Trying to figure out if there is a real parking lot in southwest corner of Mac Cory – yes, it is based on Google Maps Street view

Key Notes:
• Seems there was a miscommunication from the client – Agnes updates will be happening in 2024 and include our selected site, and they want to collaborate but won't have anything ready to talk about until May – therefore whatever we design seems to not actually be followed through, however we can present our ideas to them and hope they take some of it into consideration.
• Drainage must be incorporated into every design
• Look at the "Brainstorming Ideas for Design Alternatives" file in Teams for all the important information

Action Items:
• Present brainstorm ideas to Juliana in Tuesday's meeting
• Put something about considerations on how to blend Tindell path to the rest of the design.
• Look at pathways report to make sure we know how much space we need for roads and pathways; from there we can section out the areas for different design ideas
• For end of Week 6 - client meeting - have set design of the site for where the pathways and roads will be
• For Week 7 meeting - have iterations for 3 designs + Neil to do the Design Standard work (Nathan - student focused design, Brenden - greenscape focused design, Brooke - LID focused design). Final design will be iterated from these.

Feb. 14th, 2023, Group Meeting + Group Manager
ILC Meeting Room, 11:00am – 11:30am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Juliana has been reading the building standards and admits they are very vague (our recommended changes would have a great impact)
• Juliana likes the way that we divide up tasks in a way that highlights our interests
• General discussion about plans and recommendations for the Final Report

• Discussed the Agnes Hall updates crossover with our project - Juliana will still be here in May so she will present/ push our ideas to that team

Key Notes:

Notes for the Final Report:

• Brainstorming document is in the Teams
• This week, plan is to define exact widths of pathways on our site - pedestrian and roadways
• 3 key design ideas to be combined (LID, Green-scape, Student Utility) - evaluate each on evaluation matrix
• We have started the evaluation matrix - still need to update with specific metrics (might take out the specific roadway/ pathway widths as they will be uniform for all designs)
• Worried we aren't writing yet; Brenden should be researching more about plants now rather than waiting
• Should start writing parts of the report now - over the break if we can
• Survey - send out right when we get back from the break with our designs attached (end of Week 7)
• Neil figuring out best way to discuss recommended future suggestions - figuring out if we need suggestions for the building code, or fully the standard itself (an initial idea/ draft?)
• Neil would like to get rid of everything in the Standard that pertains to biodiversity and put it all in its own section
• More of a structure and less of an exact standard
• Juliana suggests writing in the same wording but make it what you think it should be - send to Juliana as we go
• Deliver to client - this is what we wrote, and recommend and you can do with it what you want
• Important to provide a standard as a template or idea and they can do with it what they want
• In report - 1 paragraph of that you did to get there and provide standard in the appendix
• In report - lots of "this is to break researched more in the final stages" - its be done now so it is important to make sure we go through and edit the entire report to make sure its standardized and all updated before the submission
• New sections for final report: new site designs, evaluation for designs, final design, standards section, second survey,
• Make sure you show the second survey before the second evaluation matrix

Action Items:

• Send Juliana the updated evaluation matrix with design aspects
• Remind Juliana to remind Sean that it makes sense for the score to be presented, then the matrix with scores, then explanation of weighting (can't talk about weighing without seeing them) for final report

By Friday:

• Send Juliana the updated "Progress Report" with our edits for the Final Report and anything we have added rot the Final Report (Add new headings in our Tuesday meeting)

Updates for the Introduction Section:

• Keep bullet points

• Reword the first sentence to take out the “after the locations etc.” and make it show the information but not as “results”
For References:
• Author is Queen’s University, and the date would be last review which is just 2022 - base off the Queen’s University above that one, add date and “Queen’s University”

Feb. 14th, 2023, Group Meeting
ILC Meeting Room + Team’s call, 4:00pm – 4:30pm
Attendance: Brenden Underwood, Brooke Sampson, Neil Trainor
Topics Discussed:
• Chose the recommended pathway types for pedestrian and vehicles for the site
• Began planning what the site will look like in terms of pathway layout

Key Notes:
• Intermediate pathway: min width is 2m, max width is 2.5m + buffer (450mm) on either side (pg. 39)
• Shared streets (for main path) will be min 4m and max 4.5m with 750mm buffers
• Buffers could be good for LIDs
• Keep widths to minimums for recommendations
• Make sure to note that all pathways must be accessible and AODA compliant (read more into this report)

Action Items:
• Blueprint of the pathways - Brooke to draw an overlay on the map and send to group members to work on over the break
• Neil to look at brainstorming notes and figure out a rough draft of the building standard

Feb. 28th, 2023, Group Meeting + Group Manager
Team’s call, 11:00am – 11:30am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Reviewed Gantt Chart to check on progress
• Discussed plan for survey and send out date (this weekend)
• Discussed the Evaluation Matrix
• Showed Juliana the 3 preliminary designs
• Discussed drainage and having a baseline for each preliminary design + potential drainage calculations

Key Notes:
• Juliana did not understand why we had 3 designs that were so different - suggested that we at least make minimum drainage uniform across all 3 designs
• She is worried we won't be able to compare the 3 designs in an evaluation matrix, but we discussed this, and it was ok in the end

• Make sure to explain what is mandatory in each design (pathways locations/ widths, drainage aspects)
• We could present the LID design as a maximum drainage, but we still need a minimum drainage for every design
• Juliana wants us to have a simple runoff calculation for the site area (as an engineer, how much drainage do you need? We need numbers because we have a drainage problem in this area)
• Neil argued that any drainage added to this area is an improvement and it would be too time consuming to complete calculations at this point.

Action Items:
• Brooke to send Juliana the location in Teams of the Final Report
• Brooke to send Evaluation matrix to Juliana once it is updated
• Neil to look into if it is feasible to complete drainage calculations for the site

Feb. 28th, 2023, Group Meeting
Team's call, 6:00pm – 6:15pm
Attendance: Brooke Sampson, Nathan Fitzpatrick
Topics Discussed:
• Reviewed the updates Nathan made for the pathways design base layout on the site

Key Notes:
• Nathan updated the pathways on his preliminary design to better connect pathways to each building and to ensure the emergency vehicle road is not jagged and is smoother

Action Items:
• Meet as a full team tomorrow

Mar. 1st, 2023, Group Meeting
Team's call, 5:30pm – 7:00pm
Attendance: Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Reviewed and updated Evaluation matrix
• Discussed changes to the baseline pathways layout of the site
• Planned for updating the 3 preliminary site designs to be more professional/ tidy and on the new pathways baseline map
• Discussed who is doing what in the Final Report

Key Notes:
• Potential to add more criteria, however cost probably isn't necessary, Nathan Splinter wasn't too worried about this, and it would be very difficult to estimate
• Increase distance between boundaries of evaluation matrix to ensure we don't get a uniform result - need to change the matrix a bit

• Changes to the pedestrian accommodations and weighting - 3 as the highest was a small number to max out on considering Nathan's design
• Drainage calculations will not be feasible for this project for us, too much work and not enough time. Instead, make sure to describe why we aren't doing it and make the minimum be access road permeable pavement.
• Accessibility for permeable pavement could be an issue if it's for every pathway, instead we will make it a minimum for the access road to be permeable pavement as it is not used as much. Even though pedestrians will use it, it's not specifically for pedestrians.
• Make another paragraph to drive home the point of Integration of plants - could evaluate on area of flower beds and trees (trees need less maintenance than flower beds)
• Could include life span of plants - annual, biannual, and perennial.
• Or could distinguish between plants that "are just there" or need maintenance
• Get rid of integration of plantings and re-phrase maintenance criteria
• General maintenance - instead of giving it a number, talk about it to describe our decisions detailed explanations (Nathan's design will need to consider trash cans, social features that require maintenance (keeping lawn clean and cut around seating/ tables))
• For preliminary designs - 3 options - need descriptions for each do that people know what they're looking at.
• Try to make them look nice and legible - based off Nathan's pathways, add legend and description about the site and which is which.
• After background and research, split final report into 3 sections: 1. Site Evaluation + Social Response (subcategory) from the Fall, 2. Site design with subsection of site survey, 3. Building Standard section.

Action Items:
All: Continue to update individual parts of the Final Report and edit
Brooke:
• Email clients about Friday's meeting (don't have any questions but we plan to update them on our progress and plan for the rest of the semester)
• Email Juliana the updated Evaluation matrix
• Update pathways baseline pathways map and send to group
Nathan:
• Create and send out student survey for this weekend
• Add updated report parts to Final Report in Teams and integrate with updates Neil made in those sections with the prof's comments
Brenden and Brooke:
• Update preliminary design on updated pathways map - ensure it is tidy, somewhat professional, and legible - send to Nathan by Friday afternoon.
Nathan, Brenden, and Brooke:
• Write up a description of each component for assigned site design and overall description to ensure students looking at it know what it is and its benefits - send to Nathan by Friday afternoon

Mar. 7th, 2023, Group Meeting + Group Manager
Ellis Hall 217, 11:00am – 11:30am
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Reviewed Juliana's thoughts on Evaluation Matrix + progress on Final Report
• Looked at Student Survey and talked about plan for speeding it

Key Notes:
• Juliana thinks we might need to define "protection from the elements", however this was remediated as a translation misunderstanding
• Juliana is very impressed with the group's progress on the Final Report writing thinks we are on the right track
• Discussed the student survey and methods of spreading it
• Neil is working on a first draft of the Standard Section of the report this week to present to the team
• Juliana wanted to review the draft of our first survey in the Fall semester since she didn't know how we would put it together and present it, however now she trusts us and doesn't need to review in detail.
• New section for Final Report to be added (to the client version, no need to stress for the 460 version for marks) on feedback or suggestions from the survey responses
• It is time to start working on the final design now and can incorporate the survey responses in later

Action Items:
• Nathan to update Student Survey with a section for feedback + send to team and Juliana by end of day to distribute
• Brooke to post survey on social media (Queen's Facebook groups + Instagram)
• Juliana to post Survey to OnQ and send to Angela to distribute to Civil students

Mar. 7th, 2023, Group Meeting
Team's call, 4:00pm – 5:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Reviewed the Evaluation Matrix and edited the "Green Zone Magnitude" section
• Evaluated each of the 3 designs using the matrix, chose best parts of each to start on a final design
• Looked at all 3 design options and layer out a general idea of what the final design will look like using the results of the evaluation matrix
• Discussed Final Report writing and deadlines

Key Notes:
• Changed the 3rd level Green Zone Magnitude section of the Evaluation matrix from a percentage of 75%-100% to 90%-100%. Increased level 2 to 50%-90%

• We may need to compromise public spaces for final design to minimize maintenance (grass areas need to be mowed and social use attracts garbage)
• Could put benches on the pathways instead of other areas
• Keep some aspects of all areas - discussion resulted in a final design and what is to be kept and what is to be altered
• From current Queen's Standards - add curbs to define the barrier between parking lots and naturalized area, bike racks need to hold 2 sets of bikes perpendicular to each other
• Meadowscapes should also be LIDs (rain gardens)
• Necessary to include signage at crossing areas to protect pedestrians
• Need to include light posts and Queen's blue light in the area
Reasoning for evaluation choices:
• LID - some protection from vehicles due to drainage trenches beside paths
• Green - protection from elements due to trees, sitting areas and trees for social side of design
• Social - all 3 levels of protection, need for maintenance to keep picnic area/ benches grassy area under control, maintenance necessary for garbage.

Action Items:
• Everyone to keep writing sections - as new sections are completed, send to Juliana to review
• All sections to be finished by Monday, March 20th so that the entire week up until March 24th can be dedicated to editing and reviewing
• Brooke to email clients to cancel all client meetings until at least week of March 27th - no questions, just need to focus on the report

Mar. 14th, 2023, Group Meeting + Group Manager
ILC Meeting Room, 11:00am –11:30am
Attendance: Brooke Sampson, Nathan Fitzpatrick, Neil Trainor, Juliana Reinert
Topics Discussed:
• Reviewed Neil's updates to the Standards section of the report.
• Reviewed the updated section headings and report layout that Neil created for the group.
• Nathan updated the group on the results of survey (so far) and some comments made by students.
• Reviewed some important points for the Final Report.

Key Notes:
Updates to Section Headings:
• Split climate and social innovation for the Design Research area - Neil to add research on LIDs
• Split into Site Evaluation and Site Design
• Explain the evaluation matrix and all the parts of it
• Then later show the filled in evaluation matrix
• Show preliminary site designs, then show explanation and blank evaluation matrix, then show the final design and filled in evaluation matrix
• Expand a bit more on cost and risk assessments
• Update the previous parts

• Risk Assessment - it is very general right now, can talk about specifics aspects of risk, look at management plans
• Risk Assessment topics from social survey (must choose one controversial suggestion and the risk of choosing one over the other)
• Next Steps - surveying campus sites for types of drainage, not currently a standard for maximum drainage overflow
• Need to expand social research (site some papers on mental impacts of green spaces etc.), can also mention in Next Steps - conduct our own research into mental health on Queen's Campus
• Neil suggests having the opportunity for readers to look at evaluation matrix first and all the information so they can make their own decisions before seeing our decision
• This could be too long - may be more compact to merge and keep together

Survey Update:

• Much smaller turnout (42 compared to 72) to this survey than the last one (probably due to nearing end of semester
• Quite a few comments from surveyors
• Pointed out that we have 2 contradicting opinions (we have 1 who thinks we don't have enough bike racks and 1 who thinks we don't have enough - we could figure this out mathematically
• Lots of comments saying we need a path on the left side from Mac Cory to bottom left path (this may be in the next steps instead of final design. If it's an easy update, then we could add it) Need to make changes based on feedback.
• Multiple people think that there should be concrete there only and that what we have proposed won't be able to handle the pedestrian traffic in this area (we all disagree)
• Add this to Next Steps or Recommendations - we need a good understanding of pedestrian traffic in this area (visual surveying)
• Might want to leave some area for snow gathering/plowing/shovelling (may not be a design but needs to be mentioned)
• Make pathways curvier if we do 3D, if still on Google Maps we can just mention that ideally, they will be curvier in a more professional drawing

Other Notes:

• Final Design layout- Juliana says we can just keep it on Google Maps, don't need to make it professional looking but we can add this to Next Steps (Nathan could do the 3D model but is not necessary if we don't have enough time)
• Hours: we won't meet everything for this report, but we can make predictions for future hours for the rest of the semester
• Without Nathan, we don't think there will be a final client presentation. We should still send them the PowerPoint that we present for the class.
• Juliana showed us a table on how to evaluate risk (can use this for our risk assessment section) - in second table we can ignore the stakeholder part

<u>Action Items:</u>

• Brooke to send email to Juliana to remind her to review the Standards Section of the report
• Nathan to compile feedback in Team's so we can use while writing

• **All - send final written sections to Juliana to review as you have finished them!!**
• All - update Meeting Minutes and add prediction for the rest of the semester

Mar. 14th, 2023, Group Meeting
ILC Meeting Room, 11:30am – 12:00pm
Attendance: Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Reviewed the new section headings document and wrote down names for people accountable for the completion of each section
• Final plans for the Final Report including internal due dates and plan for editing next week

Key Notes:
• All written aspects of the final report are to be fully completed by midnight on Sunday, March 19th, 2023.
• All updated or new sections are to be sent to Juliana as they are completed. All completed on the Sunday internal due date will be sent to Juliana for final review on Monday, March 20th, 2023.
• Next Tuesday group meeting will be dedicated to editing the entire Final Report in person in a meeting room. More time may need to be allotted in the week as required.
• Nathan and Brooke to complete a more professional looking final design drawing during this time if time allows (using CAD or SketchUp)
• Neil will be responsible for compiling all Final Report writing into a final draft before the due date/ time responsible for report submission.

Action Items:
• All - write/ update assigned sections of final report by midnight **Sunday, March 19th, 2023.**
• All - update Meeting Minutes and add prediction for the rest of the semester

Mar. 21st, 2023, Group Meeting
ILC Meeting Room, 4:00pm – 6:00pm
Attendance: Brenden Underwood, Brooke Sampson, Nathan Fitzpatrick, Neil Trainor
Topics Discussed:
• Editing of the report
• Who is in charge of editing which sections
• When will all edits be completed by?

Key Notes:
• Neil to submit report, everyone to edit
• Meeting for poster presentation during client meeting time on Friday.

Action Items:
• All parts to be completed by midnight on Wednesday, March 22nd, 2023, for Neil to edit.

Appendix B – Site Investigation Photos

The images shown below were collected on September 28th, 2022 during site investigations completed by the Team.

Site #1

Figure 31: Photo of the deteriorating retaining wall with extruding pipes at Site #1.

Figure 32: Another photo of the degrading retaining wall at Site #1.

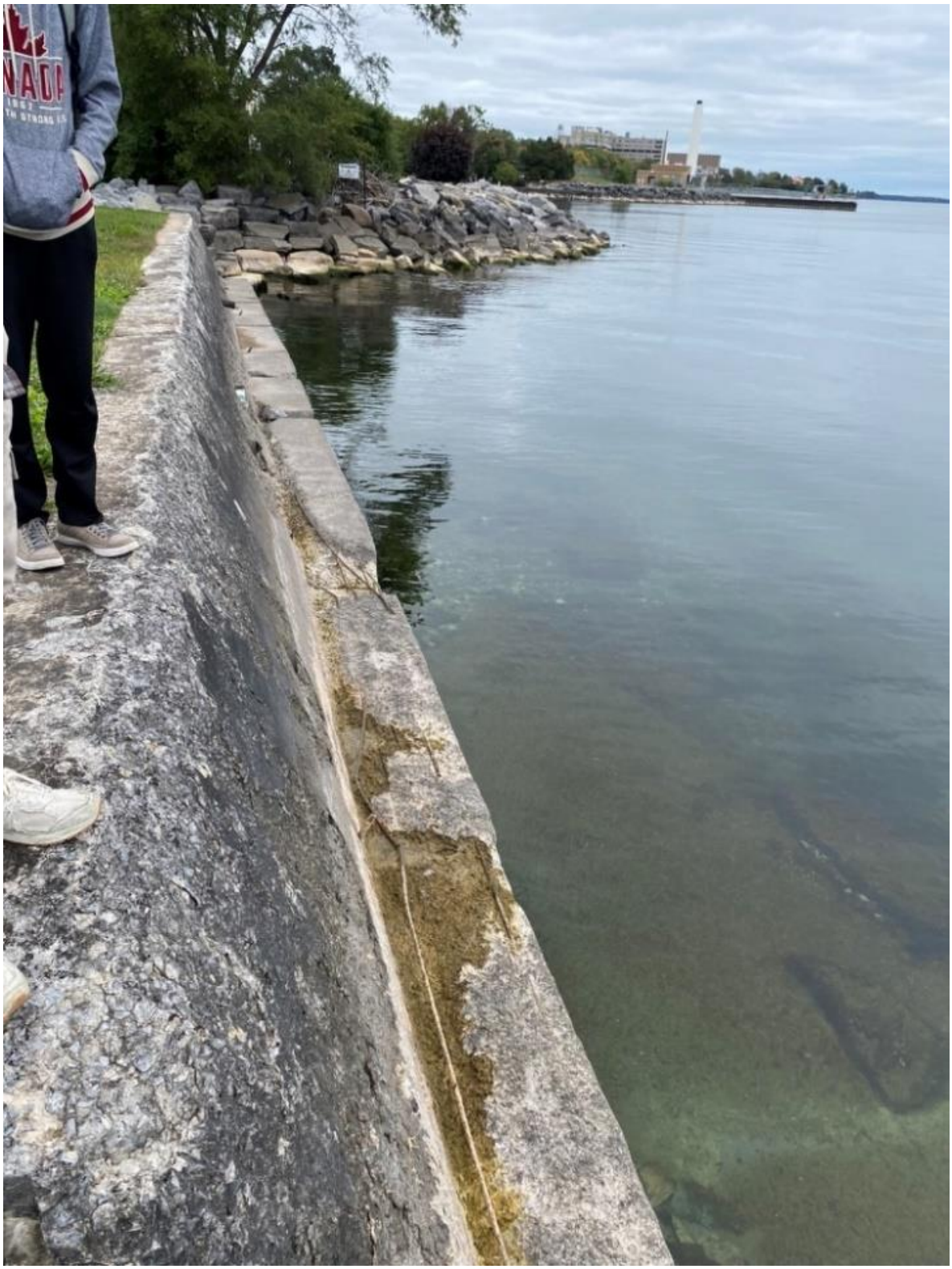


Figure 33: Photo of the rusted rebar visible on the degrading retaining wall at Site #1.

Figure 34: Close-up photo of the deterioration of the retaining wall concrete at water level at Site #1.

Figure 35: Photo of the eroding soil above the retaining wall at Site #1.

Figure 36: Photo of the overgrown vegetation in cracks of pathway at Site #1.

Site #2

Figure 37: Photo of the pathway leading into the West corner of Site #2.

Figure 38: Photo of the concrete area and ventilation great West of Jeffery Hall at Site #2.

Figure 39: Photo of the fenced off grates in the middle of Site #2.

Figure 40: Photo of an unused grass area East of Watson Hall at Site #2.

Figure 41: Photo of the North-East view of the unused grass area East of Watson Hall at Site #2.

Figure 42: Photo of the Ellis Hall Dock Door ramp at Site #2

Figure 43: Photo of the North-West view of the Jeffery Hall entrance at East side of Site #2.

Site #3

Figure 44: Photo of the sunken courtyard at the West side of Jeffery Hall (Site #3).

Figure 45: Phot of the sunken courtyard at East side of Jeffery Hall (Site #3).

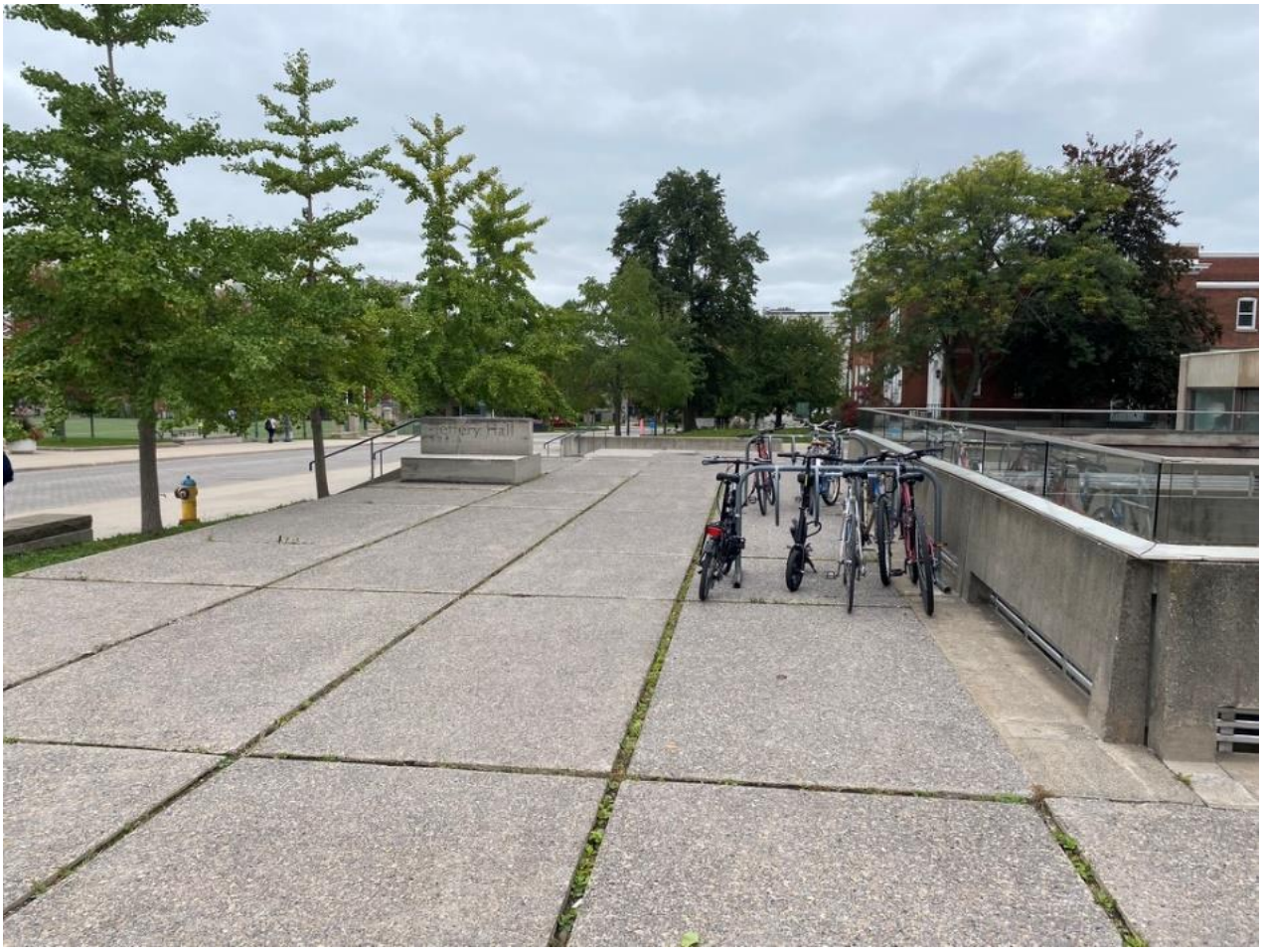


Figure 46: Photo of the East entrance area of Jeffery Hall (Site #3).

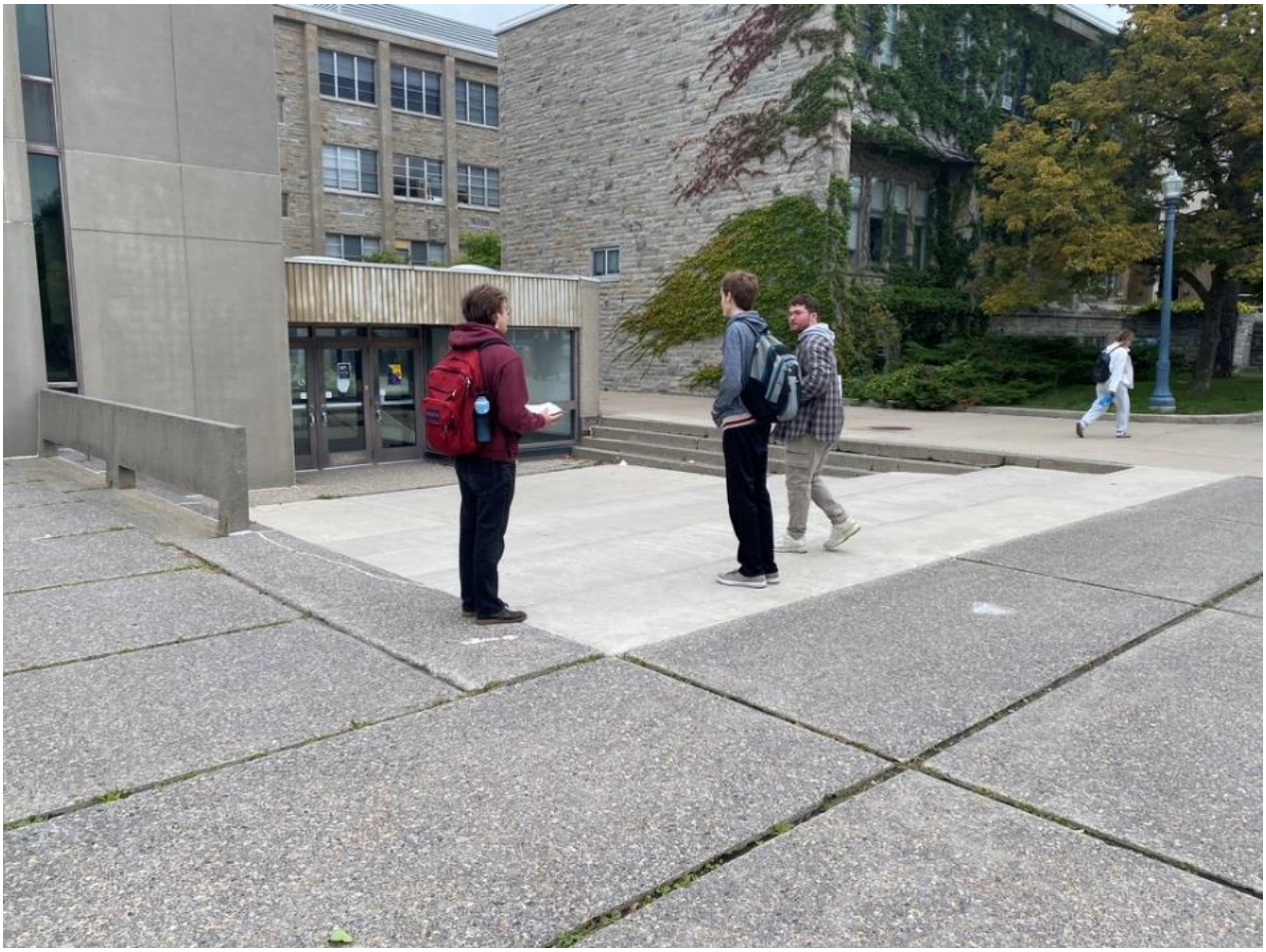


Figure 47: Photo of the large concrete steps at the East entrance of Jeffery Hall (Site #3).

Site #4

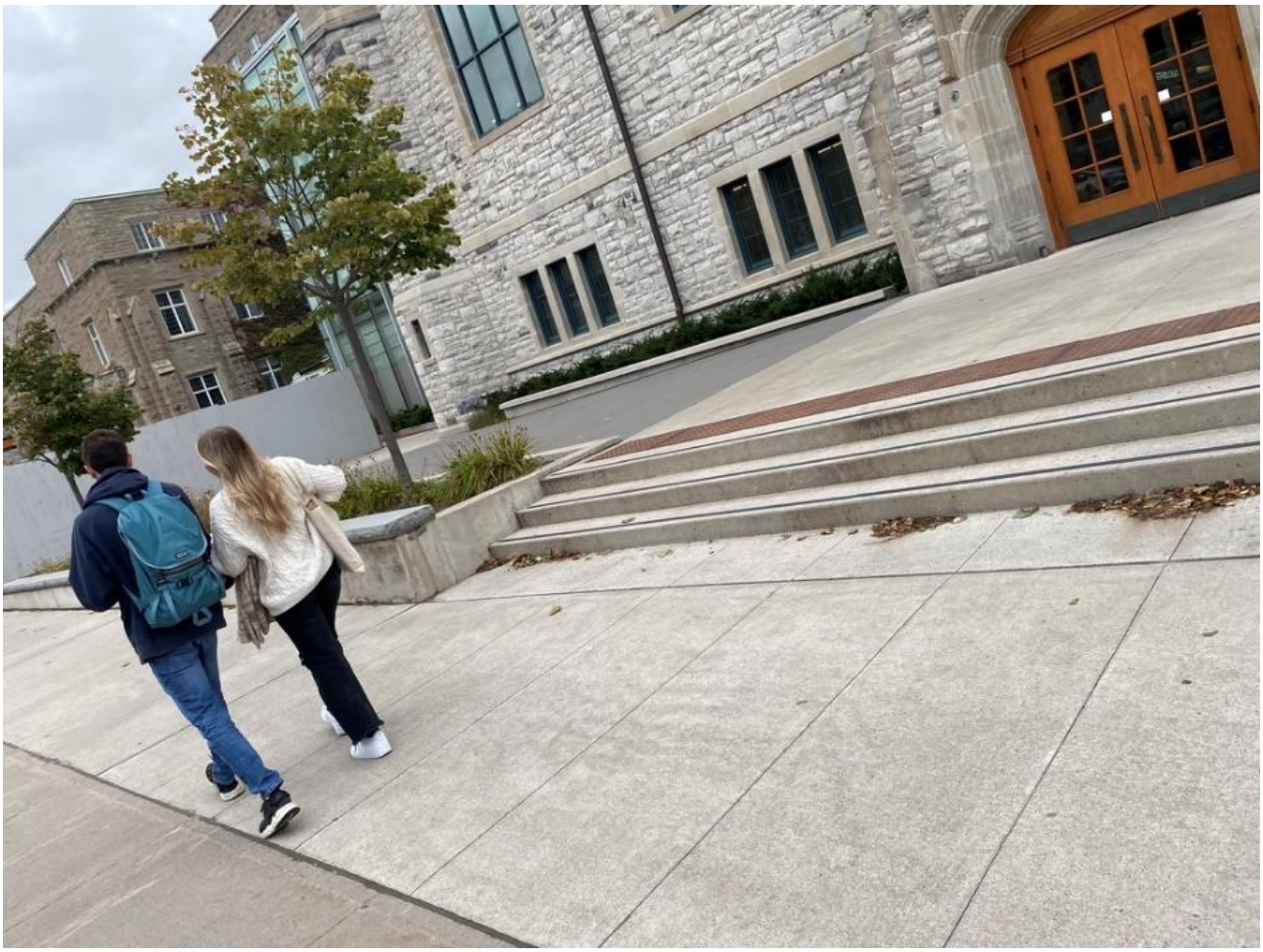


Figure 48: Photo of the South entrance of Mitchell Hall (Site #4).

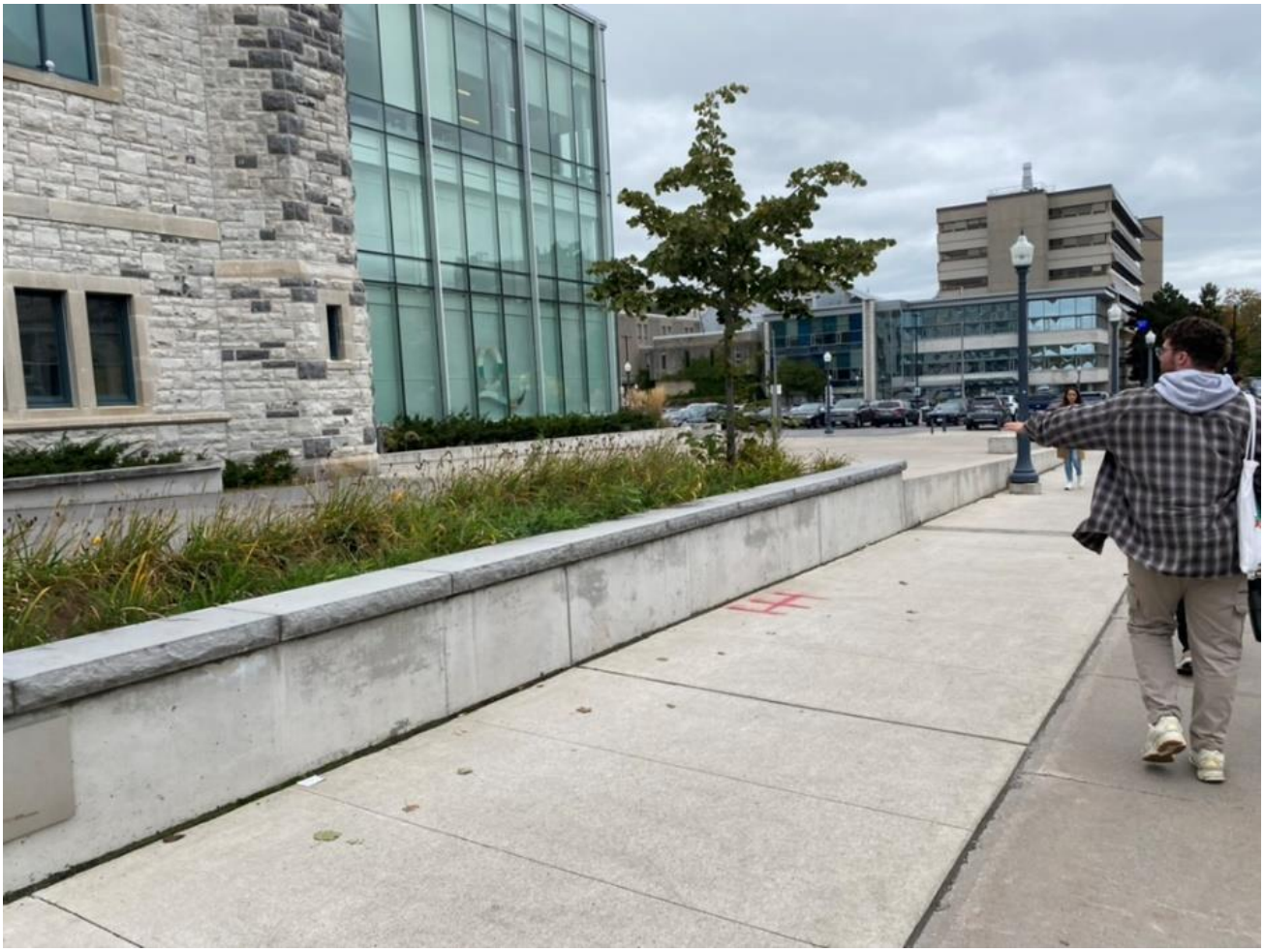


Figure 49: Photo of an alternate view of the South entrance of Mitchell Hall (Site #4).

Figure 50: Photo of the South-East corner of Mitchell Hall (Site #4).

Figure 51: Photo of the East walkway beside Mitchell Hall (Site #4).

Figure 52: Photo of the North walkway between Mitchell Hall and the ARC (Site #4).

Figure 53: Photo of the planter boxes on the side of the North walkway between Mitchell Hall and the ARC (Site #4).

Site #5

Figure 54: Photo of the planter boxes at the East side of the Queen's Law Building (Site #5).

Figure 55: Photo of one of the cracked planter boxes at Site #5.

Figure 56: Photo of the cracked concrete South of the planter boxes at Site #5.

Appendix C – Native Plants

Table 17: List of native trees (Credit Valley Conservation 2022a; Government of Ontario 2022; Muma 2019; Rideau 1000 Islands Master Gardeners 2022c).

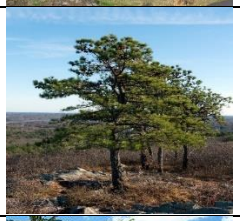
Native Tree	Details/Benefits	
Butternut (Juglans cinerea)	• Lifespan <75 years • Grows 20m-40m tall • Grows in well-drained soil • Nuts are eaten by wildlife	
Burr Oak (Quercus macrocarpa)	• Lifespan from 200-400 years • Grows 30m-50m tall • Acorns eaten by wildlife	
Honey Locust (Gleditsia triacanthos)	• Highly adaptable in different environments • Lifespan around 120 years • Grows 20m-30m tall • Fruit eaten by wildlife	
Pitch Pine (Pinus rigida)	• Lifespan around 200 years • Grows 6m-30m tall • Can survive in poor conditions • Provides food and nesting for wildlife	
Cucumber Tree (Magnolia acuminata)	• Endangered • Lifespan of 80-120 years • Grow 15m-30m tall • Grow best in deep, moist, well drained soil	
Tulip Tree (Liriodendron)	• Endangered • Lifespan up to 300 years • Grows 16m-18m tall • Grow in sun or part shade • Strive in deep and well drained soil • Flowers bloom to produce nectar for wildlife	
Rock Elm (Ulmus thomasii)	• Endangered • Lifespan up to 300 years • Grows 15m-30m • Shade tolerant • Grows well in various soil types	

Table 18: List of native shrubs (Credit Valley Conservation 2022a; Muma 2019).

Native Shrub	Details/Benefits	
Beaked Hazel (Corylus cornuta)	• Grows 4m-8m tall • Stays small in shade • Thrives in partial sun	
Silky Dogwood (Cornus amomum)	• Grows up to 5m tall • Thrive in wet areas • Prefers shade, can tolerate sun • Blooms spring flowers and produces fruit • Can provide wildlife habitat	
Golden Currant (Ribes aureum)	• Grows 2m-3m tall • Blooms spring flowers and produces fruit • Tolerate shade or full sun	
Jersey Tea (Ceanothus herbaceous)	• Grows 0.5m-1m tall • Drought Tolerant • Grows well in full sun and well drained soil • Blooms small flower shoots	
Bush Honeysuckle (Diervilla ionicera)	• Grows 1m-2m tall • Drought tolerant • Prefers dry locations • Grows well in sun and partial shade	

Table 19: List of salt/harsh condition tolerant native Ontario plants (Booth 2020).

Salt/ Harsh Condition Tolerant Native Ontario Wildflowers
Spotted Geranium (*Geranium maculatum*)
Canada Anemone (*Anemone canadensis*)
Canada Columbine (*Aquilegia canadensis*)
Canada Wild Rye (*Elymus canadensis*)
Purple Prairie Clover (Dalea purpur*ea*)
Lanceleaf Coreopsis (*Coreopsis lanceolata*)
Dotted Mint (*Monarda punctata*)
Bergamot (Monarda fistulosa)
Little bluestem (*Schizachyrium scoparium*)
New Jersey Tea (*Ceanothus americanus*)
Wild Strawberry (*Fragaria virginiana*)
Butterfly Milkweed (*Asclepias tuberosa*)
Pale Coneflower (*Echinacea pallida*)
Nodding Onion (*Allium cernuum*)
Zigzag Goldenrod (*Solidago flexicaulis*)
Black Eyed Susan (*Rudbeckia hirta*)
Pearly Everlasting (*Anaphalis margaritacea*)
Silverweed (*Potentilla anserina*)

Table 20: List of poisonous native Ontario plants (Ontario Wildflower 2018).

Poisonous Native Ontario Plants
Baneberry, Red (Actaea rubra)
Hemlock, Bulb-bearing Water (Cicuta bulbifera)
Hemlock, Poison (Conium maculatum)
Hemlock, Water (Cicuta maculata)
Iris, Blue Flag (Iris versicolor)
Ivy, Poison (Toxicodendron rydbergii)
Milkweed, Common (Asclepias syriaca)
Moonseed, Canada (Menispermum canadense)
Pokeweed (Phytolacca americana)

Table 21: List of native wildflowers with sun and soil preferences (Credit Valley Conservation 2022a).

	Common Name	Scientific Name	Sun	Soil	Height (cm)	Spread (m)
	Dry - Slightly Moist					
Wildflowers	**Anemone, Long-fruited***	*Anemone cylindrica*	☀◐	S L	10-60	N/A
	Aster, Calico Other name: Starved Aster	*Symphyotrichum lateriflorum* Former scientific name: *Aster lateriflorum*	☀◐	S L C	30-90	N/A
	Aster, Sky-blue*	*Symphyotrichum oolentangiense* Former scientific name: *Aster oolentangiense*	☀◐	S L	30-90	N/A
	Aster, White Heath	*Symphyotrichum ericoides var. ericoides* Former scientific name: *Aster ericoides*	☀	S L C	30-60	N/A
	Beardtongue, Foxglove*	*Penstemon digitalis*	☀◐	S L C	90-120	N/A
	Beardtongue, Hairy*	*Penstemon hirsutus*	☀◐	S L C	30-60	N/A
	Bergamot, Wild	*Monarda fistulosa var. fistulosa*	☀◐	S L C	60-120	N/A
	Black-eyed Susan	*Rudbeckia hirta var. pulcherrima* Former scientific name: *Rudbeckia hirta*	☀◐	S L C	30-90	N/A


Long-fruited Anemone


Calico Aster


Sky-blue Aster


White Heath Aster

☀ Full sun: 6 or more hours of sunlight; ◐ Part shade: 4-6 hours of sunlight; ● Shade: 4 or less hours of sunlight

Soil: **S** Sand; **L** Loam; **C** Clay

Table 22: List of native wildflowers with sun and soil preferences cont. (Credit Valley Conservation 2022a).

	Common Name	Scientific Name	Sun	Soil	Height (cm)	Spread (m)
	Dry - Slightly Moist					
Wildflowers	**Blazing-star, Dense***	*Liatris spicata*	☀	S L C	60-150	N/A
	Blazing-star, Slender*	*Liatris cylindracea*	☀	S	20-45	N/A
	Blue-eyed-grass, Strict*	*Sisyrinchium montanum*	☀◐	S	15-30	N/A
	Bluets, Long-leaved*	*Houstonia longifolia* Former scientific name: *Hedyotis longifolia*	☀	S	10-30	N/A
	Bush-clover, Round-headed*	*Lespedeza capitata*	☀	S L	60-120	N/A
	Cinquefoil, Prairie* Other name: Tall Cinquefoil	*Drymocallis arguta* Former scientific name: *Potentilla arguta*	☀	S	20-70	N/A
	Compass Plant*	*Silphium laciniatum*	☀	S	90-250	N/A
	Coneflower, Eastern Purple*	*Echinacea purpurea*	☀◐	S L C	60-120	N/A


Dense Blazing-star

Slender Blazing-star

Strict Blue-eyed-grass

Long-leaved Bluets

☀ Full sun: 6 or more hours of sunlight; ◐ Part shade: 4-6 hours of sunlight; ● Shade: 4 or less hours of sunlight

Soil: **S** Sand; **L** Loam; **C** Clay

Table 23: List of native wildflowers with sun and soil preferences cont. (Credit Valley Conservation 2022a).

	Common Name	Scientific Name	Sun	Soil	Height (cm)	Spread (m)
	Dry - Slightly Moist					
Wildflowers	**Harebell, American*** Other name: Giesecke's Bellflower	*Campanula gieseckiana* Former scientific name: *Campanula rotundifolia*	☀◐	S	30-45	N/A
Wildflowers	**Lupine, Wild*** Other name: Sundial Lupine	*Lupinus perennis*	☀◐	S	30-60	N/A
Wildflowers	**Milk-vetch, Canada***	*Astragalus canadensis*	☀◐	S L	60-120	N/A
Wildflowers	**Milkweed, Butterfly***	*Asclepias tuberosa*	☀	S L C	60-90	N/A
Wildflowers	**Milkweed, Common**	*Asclepias syriaca*	☀	S L C	60-90	N/A
Wildflowers	**Nodding Wild Onion***	*Allium cernuum*	☀◐	S L C	20-60	N/A
Wildflowers	**Pearly Everlasting**	*Anaphalis margaritacea*	☀	S	30-90	N/A
Wildflowers	**Prairie Smoke*** Other name: Three-flowered Avens	*Geum triflorum*	☀	S	20-30	N/A


American Harebell

Wild Lupine

Canada Milk-vetch


Butterfly Milkweed

☀ Full sun: 6 or more hours of sunlight; ◐ Part shade: 4-6 hours of sunlight; ● Shade: 4 or less hours of sunlight

Soil: **S** Sand; **L** Loam; **C** Clay

Appendix D – Updated Version of Division 32 of the Queen's Building Design Standards

32 00 00 Exterior Improvements

32 01 00 Operations and Maintenance of Exterior Improvements

.1 Existing plant material to be retained, including plants that may be affected by construction activities both within and outside the actual project limits, shall meet the protection and maintenance requirements specified in this section. Such plant and root systems shall be protected from damage, compaction and contamination resulting from construction.

.2 All deciduous trees within the work zone shall be protected with wood plank tree protection. Maintain tree protection during construction period. Remove only when risk of damage has passed and upon approval by the University's representative.

.3 Tree protection shall be 28 x 89 mm wood planks, minimum 1500 mm long, secured with two bands of metal strapping. Place wood planks around base of trunk at 150 mm maximum on center to provide full protection from impact and abrasion. Do not puncture or damage bark with wood planks or fasteners. Arrange wood planks around branches and other irregularities to provide protection without damaging tree.

.4 Prevent damage to trees and shrubs in lawn areas or planting beds that are to remain by erecting a snow fence barrier to provide a continuous barricade between designated plant materials and the work area prior to construction. Place snow fence at dripline of trees unless inadequate to provide a 1.5 m buffer zone between the fence and limit of construction. Dripline is defined as ground surface directly beneath tips of outermost branches, at least 3 m radius from the tree trunk or larger as directed by the University's representative. With the permission of the University's representative, the fence may be placed within dripline of tree to provide a buffer zone of up to 1.5 m, but in no case less than 1 m from the outer circumference of the trunk.

.5 Do not operate, park, repair or refuel equipment, do not store construction materials, or stockpile any earth materials within barricades or within 2 m of the outer edge of the drip line of a tree. Do not cause flooding or deposition of sediment where trees are located. Maintain barricades during construction operations and remove on completion as directed by the University's representative.

.6 Snow fence barrier shall be standard plastic fencing or approved equivalent in good condition, 1.2 m high, supported vertically by steel T-bars, and horizontally at the top of the fencing by 39 x 89 mm wood railing, bolted to the steel T-bars. T-bars are to be straight, 1.8 m long. Drive T-bars vertically 60 cm into ground, spaced maximum 4.5 m apart. Wire snow fence at 3 places to each T-bar. Stretch snow fence to prevent sag.

32 05 00 Common Work Results for Exterior Improvements

.1 Landscaping may be included in the building contract. Landscape design shall be reviewed by the Campus Grounds Advisory Committee (CGAC) and approved by the Campus Planning and Development Committee (CPDC).

32 14 00 Unit Paving

.1 Unit paving should be unified by set dimensions and colours for field paving, borders, banding and accents. Variety can be achieved by varying the pattern at specific locations in response to the setting. The perimeter of unit paving areas should be defined by walls, curbs, and paver edging system and banding material, as appropriate for the location. Unit paver for field paving shall be 200 x 200 mm size in dark grey colour, and for borders and banding shall be 100 x 100 mm grid size, textured, natural (light grey) colour. Pavers shall be laid in stack bond pattern, flush with adjacent paving. The standard widths for unit paver border and banding shall be 600 mm and 400 mm respectively. The University shall approve paver size, colour and pattern for non-standard field, banding, and accents.

.2 Unit pavers approved for use at walkways shall be of colour and pattern consistent with the predominant precedent in the streetscape and vicinity. Finish and detailing should be durable, attractive, low maintenance, slip resistant, wheelchair accessible and convenient for snow removal.

32 16 00 Concrete Walkways, Roadways, and Curbs

32 16 13 Curbs

.1 Concrete curbs will be used to separate vehicle accessible area from those where vehicles are not meant to access such as at sidewalks and the edges of parking lots.

.2 Concrete curbs at sidewalks shall be flush with sidewalk. Concrete curbs defining shrub beds and turf areas shall be raised a minimum of 100 mm above finish grade of adjacent paving.

.3 Exposed edges of concrete curbs shall be rounded or chamfered to prevent chipping and damage from maintenance equipment. Sharp edges and corners shall be avoided.

.4 The dimension, finish and detailing of concrete curbs should be compatible with the predominant precedent in the vicinity, and should be durable, attractive, and low maintenance.

.5 Curbs adjacent to hard surfaces shall be fitted with skateboard deterrent devices that are tamper-proof, safe, attractive, designed to minimize liability and blend in with the character of the site.

32 16 23 Walkways and Roadways

.1 Walkway and roadway construction in a project should take into consideration the specific character of the site and the campus precinct, recognize the unique purpose of the project, ensure the continuity of design in the pedestrian circulation network, and effect economies in the long-term maintenance of that network. Walkway layout and dimension should follow desired line of pedestrian movement and adequately accommodate pedestrian traffic. Walkway detailing should signify pedestrian priority, indicate changes in use (e.g., city sidewalk, sidewalk widening,

transition space and linkages), and provide clear separation between pedestrians and vehicles at high use zones. Roadways should be designed using the minimum required widths to ensure that travel by foot and non-motorized vehicles is prioritized.

.2 Major sidewalk shall be poured-in-place concrete. Width shall be 4.5 m and may be modified if justified by use and site conditions. Where city sidewalks need to be widened to accommodate pedestrian needs, sidewalk widening of 1 m or wider than the standard city sidewalk shall have a unit paver border at the back of the city sidewalk. The standard unit paver border shall be 600 mm wide, unless approved by the University. Unit paver shall be 100 x 100 mm grid size, textured, natural (light grey) colour, laid in stack bond pattern, flush with adjacent paving.

.3 Standard sidewalk shall be poured-in-place concrete, natural (light grey) colour, 2.8 m wide. Standard unit paver border at the back of the curb shall be determined on a project-by-project basis, depending on local conditions.

.4 Shared streets shall be 4.0 m to 4.5 m wide. Major pathways shall be 3.0 m to 3.5 m wide. Intermediate pathways shall be 2.0 m to 2.5 m wide. Shared streets, and major and intermediate pathways shall be poured-in-place concrete, natural (light grey) colour, with unit paver border along both edges. The width of the border shall be approximately 750 mm (5 courses) wide for walkways 3 m or wider, and approximately 450 mm (3 courses) wide for walkways less than 3 m wide. The University shall approve variances in border width that are required to suit site and walkway proportion. Border shall be tumbled concrete unit paver 150 x 150 mm size, dark grey colour, laid in stack bond pattern. Walkway and border surfaces should finish flush.

.5 Minor pathways shall be 1.6 m to 1.8 m wide poured-in-place concrete, natural (light grey) colour. If a minor walkway is not the sole accessible route to a facility, alternate materials may be accepted subject to university approval. Alternate materials should be durable, attractive, low maintenance, slip resistant, wheelchair accessible and convenient for snow removal.

.6 Concrete walkway configuration, finish and detailing should be compatible with the established design on campus, be appropriate for the intended use and maintenance equipment, and should be durable, attractive, low maintenance, slip resistant, wheelchair accessible and convenient for snow removal. Concrete shall be broom finish, in straight lines perpendicular to the primary direction of travel. Paving patterns may be adapted in response to setting but should ensure continuity with the established walkway design on campus. Unnecessary grade changes and steps should be avoided, and if present, alternate and convenient accessible routes should be provided.

.7 Patios and courts along major pedestrian routes shall be poured-in-place concrete to provide ease of wheelchair access. Field paving materials other than poured-in- place concrete is subject to university approval. The use of unit pavers shall be limited to borders, banding and accents.

.8 Poured-in-place concrete shall meet the appearance and performance criteria specified in these standards. Unit paver for border and banding shall be 100 x100 grid size, textured, natural (light grey) colour, laid in stack bond pattern, flush with adjacent paving. The standard widths for unit paver border and banding shall be 600 mm and 400 mm respectively, unless approved by the University.

32 30 00 Wood Fences and Gates

.1 Wood fence should be sturdy, durable, attractive, and low maintenance.

.2 Design should discourage climbing. Footing and joint detailing should minimize damage from moisture and impact from vehicles and maintenance equipment.

.3 Lumber shall be pressure-treated. Colour and finish should be compatible with the site and architectural character. Apply weatherproof sealant per manufacturer's specifications.

.4 Hardware should be rustproof and tamper resistant.

32 31 00 Metal and Chain-link Fences and Gates

.1 Fence and fittings shall be aluminum, minimum 11 gauge.

.2 Minimum post size shall be 50 mm (1 7/8 in.) outside diameter. Fence post shall be direct buried in concrete footing for permanent installations.

.3 Chain-link fabric shall be secured on all sides to post and frame. Maximum panel module size shall be 50 ft. wide.

.4 Gate design should distribute forces evenly to avoid premature wear. Swing gate is preferred.

32 32 00 Retaining Walls

.1 Walls serve a variety of functions such as controlling the movement of people and vehicles, defining edges, and screening bicycles and cars. The design of walls should complement the setting and be appropriate for the intended use.

.2 Poured-in-place concrete is the most easily applied retaining wall material. Alternative retaining walls require additional research and consideration given the variance in strength and durability. However, they are a more aesthetically appealing option also more effectively integrate the structure with the surrounding environment. The use of alternative retaining walls is subject to university approval and should be pursued when feasible for a project.

32 32 13 Cast-In-Place Concrete Retaining Walls

.1 Exposed edges shall be rounded or chamfered to prevent chipping and damage from maintenance equipment. Sharp edges and corners shall be avoided.

.2 Finish and detailing should be compatible with the predominant precedent in the vicinity, and should be durable, attractive, and low maintenance. Seat wall should be minimum 400 mm wide in cross section. The standard concrete finish shall be natural (light grey) colour. Non-standard colours require University approval.

.3 Walls shall be fitted with skateboard deterrent devices that are tamper-proof, safe, attractive, designed to minimize liability and blend in with the site and architectural character.

32 32 23 Segmental Concrete Unit Masonry Retaining Walls

.1 Retaining wall system using modular concrete units installed without mortar should be limited to areas of lower visibility and usage.

.2 The colour and face texture should be grey or earth tone, depending on site and building character. Natural rock-like texture is preferred. The top of wall should be finished with cap unit. Skateboard deterrent device along top of wall and Installations should follow manufacturer's specifications.

32 33 00 Site Furnishings

32 33 13 Bicycle Racks

.1 Bicycle racks should be in well-lit and convenient locations to meet the needs of potential users. Locations that allow casual supervision from building occupants and passers-by may provide additional safeguard against theft.

.2 Bicycle rack should allow the frame and one wheel to be locked to the rack with a high security, U-shaped shackle lock if both wheels are left on the bicycle.

.3 Bicycle rack shall be bolted to pavement. Placement of racks should allow for parking perpendicular to the rack on both sides. A minimum clearance of 2 m between parked bicycles is required for snow removal.

.4 Racks should be a catalogue item rather than custom made. The preferred product is the Ring Rack by Bikeup Bicycle Parking Systems Inc.

32 33 23 Trash Receptacles

See Appendix A - 32 33 23 Trash Receptacle

.1 Trash receptacles should be located at major activity centres and along major routes. The location of individual units should not be visually intrusive.

.2 Receptacle unit should be durable, vandal resistant, attractive in design with easy to remove liner and protection of contents from rain and weather.

.3 Trash receptacle shall be production item, Victor Stanley model S-42 with S-2 spun steel dome, powder coat finish RAL 7024 graphite grey semi-gloss. Anchor to concrete using tamper-proof hardware.

32 33 43 Benches

See Appendix B/C/D - 32 33 43 Benches

.1 Benches should be conveniently located in areas of frequent use. A variety of seating arrangements for different social patterns and for choices in sun and shade should be provided. Seating arrangements can also help define a space.

.2 Bench should be a catalogue item rather than custom made. The design should be comfortable, durable, attractive, and low maintenance.

.3 Freestanding bench shall have back with no arm rests. The base plate shall be anchored to a concrete pad or footing with tamper-proof hardware.

.4 Where the bench is built-in such as a seat wall, refer to Cast-in- Place Concrete Planter and Seat Walls, for requirements.

.5 Free-standing bench shall be Victory Stanley model NRB-6, 6 ft. length, surface mount base, powder coat finish RAL 7024 graphite grey semi-gloss.

32 39 00 Manufactured Site Specialties

32 39 13 Bollards

.1 Rigid and collapsible bollards can be used to prevent access by unauthorized vehicles to walkways and fire lanes, but do not interfere with pedestrians. A special tool allows the collapsible bollard to be lowered to the ground, remaining attached to a hinge, and then replaced in the upright position. Bollards should only be utilized when alternative methods of preventing vehicle access are not feasible or the potential for car access to an area poses an extreme threat to people, the environment, or infrastructure.

.2 Bollards shall be Maxiforce 1 collapsible style bollard Model MF and rigid type bollard Model MF, supplied by G. Reale Enterprises, Inc., 3444 Marshall Road, Drexel Hill, PA 19026, Tel. 610-623-2611. Standard dimensions of extruded steel tubing are 6 in. x 3 in., above ground height is 32 in. Bollards shall have powder coat finish, RAL 7024 graphite grey semi-gloss. Apply reflective tape as specified. Installation shall be per manufacturer's specifications.

32 91 00 Planting Preparation

32 91 19 Landscape Grading

.1 Subgrade preparation is required under all areas designated to receive landscaping as shown on drawings.

.2 Subgrade should be free of rocks, weeds, roots, and other debris. Foreign material shall not be buried beneath areas to be landscaped.

.3 Completed subgrade should be even and have positive drainage. Subgrade should be scarified to a minimum 100 mm (4 in.) depth. Subgrade shall be approved by project manager before topsoil placement begins.

.4 Topsoil mixture shall be 3 parts Grade 1 topsoil, 1-part sterilized mushroom compost, 1-part peat moss. Mixture should avoid being excessively wet and should be free of weeds, roots, rocks, and other debris.

.5 Place topsoil in dry weather, on dry unfrozen grade to obtain minimum depth after settlement of 100 mm (4 in.) or depth specified in planting details. Allow settling to occur for 1 week or roll to facilitate settling. Top layer should be loosely raked to allow for rooting of seed or sod. Surface should be smooth, uniform and sufficiently firm to prevent sinkage pockets when irrigated. Surface should fall smoothly to catch basin rim and finish flush and ensure positive drainage away from building and sidewalks.

.6 Project manager should be present for inspection at all stages of grading.

32 92 00 Turf and Grasses

32 92 19 Seeding

.1 Seed mixture should be 60 percent Kentucky Blue Grass, 20 percent Red Fescue, 10 percent Annual Rye, 10 percent Perennial Rye

.2 Apply half of the seed at the recommended rate in a north-south direction, half in an east- west direction. Lightly rake to cover seed and roll. Water lightly and frequently until seed is established. Contractor should be responsible for two cuttings, the first at the highest level of the mower.

.3 Project manager should be present for inspection at all stages of seeding.

32 92 23 Sodding

.1 Sod should be laid within 24 hours of being cut. Sod should be laid in a brick-like pattern so that joints are staggered. Cuts should be made with a sharp instrument, preferably a knife or a spade. No overlaps or gaps should be present. Sod should be rolled immediately after installation to remove air from under the sod.

.2 Sod should be watered after installation to penetrate 300 cm (6 in.) into soil. Sod should be watered daily except in periods of intense heat or drought when frequency should be increased.

.3 Contractor is responsible for first two cuttings of sod. The first cutting should be approximately 10-14 days after installation when sod is firmly established. Cutting should be on the highest level of the mower.

.4 Project manager should be present for inspection at all stages of sodding.

32 93 00 Plants

.1 Tree planters for a single specimen in paved areas shall have a minimum inside dimension of 3.05 m (10 ft.). The minimum clearance from adjacent paving and structures (e.g., steps, curbs, walls, fences, and buildings) shall be 3.05 m (10 ft.) or 50% of the average mature spread for trees, and 900 mm (3 ft.) or 50% of the average mature spread for shrubs, whichever is the greater measurement. Departure from these minimum clearance requirements must have the approval of the University before installation begins.

.2 Planting mixture should be 3 parts topsoil, 1-part sterilized mushroom compost, 1-part peat moss, free of weeds, roots, stones, and similar material. It should be placed in layers of not more than 150 mm at a time.

.3 Installation requirements for subgrade, plant pit, planting soil mixture, root ball, mulch, finish grade around tree, staking, trunk wrap, and pruning shall be as shown in Appendix A, Figure 2.906.3-A.

.4 Installation requirements for subgrade, base of plant pit, planting soil mixture, root ball, mulch, and pruning shall be as shown in Appendix A, Figure 2.906.4-A.

.5 <u>The use of landscaping designs such as meadowscape and sedgescape designs are encouraged to increase site naturalization and biodiversity. The use of the designs also reduces the maintenance requirements of greenspaces by eliminating the need for mowing and the application of fertilizers, pesticides, and herbicides.</u>

.6 Planting should be inspected by the project manager at all stages of installation.

32 94 00 Planting Accessories

32 94 13 Landscape Edging

.1 Where the perimeter of unit pavers abuts planting areas or where no curb edge is present, paver-edging products are required.

.2 Aluminum edging system is preferred, and should have locking joining system with no obstructions, be durable, flexible, and non-rusting.

32 94 33 Precast Free-Standing Planters

.1 In general, cast-in-place planters are preferred to portable planters as the former provides better growing conditions. Corners should be rounded or chamfered; finish should be lightly textured natural (light grey).

.2 Portable planters shall be precast concrete, Cylindrical Grade Adjusting Planter Type JJR by Alpha Precast, sandblasted finish. Planter size shall be 36 in. (91.4 cm) diameter and 24 in. (61.0 cm) height. Planters shall allow drainage at base.

32 94 43 Precast Tree Grates

.1 Tree grate finish, slot openings and detailing should enable barrier-free accessibility.

.2 Top of tree grate shall be level with adjacent pavement. A minimum clearance of 100 mm (4 in.) is required between the bottom of the tree grate and the finish grade of soil in the tree pit.

.3 Tree grate shall be precast concrete, Type TG1 (circular) and Type TG3 (square), by Alpha Precast, sandblasted finish. Tree grate size shall be 121.9 cm (4 ft.) minimum diameter or square, center hole shall be 45.7 cm (18 in.) diameter.

<u>32 95 00 Stormwater Management</u>

<u>32 95 01 Low Impact Development Technologies</u>

.1 The use of Low Impact Development (LID) technologies is encouraged to increase the infiltration of stormwater runoff and improve the quality of water entering the ground through natural filtration mechanisms.

.2 LID technologies should be utilized when sites require significant pathing for pathways and parking. Large and rarely used pathways such as those meant for emergency and facilities vehicles should consider utilizing permeable pathing and including infiltration trenches in the buffer zones adjacent to the pathway.

.3 Sites that include large green spaces and flower beds should consider utilizing vegetative swales and bio-retention cells to increase the infiltration at these areas. The use of rain barrels is encouraged to reduce water supply needs at sites that would require green space management. Rain barrels should be unplugged as temperatures approach freezing to prevent the expansion of frozen water in the barrel which could result in significant damage.

Appendix E – Acknowledgement Email from Client

Tuesday, October 11, 2022 at 18:17:35 Eastern Daylight Time

Subject: RE: Confirmation of Acceptance of Work Plan - Sustainable Landscaping
Date: Friday, October 7, 2022 at 9:39:09 AM Eastern Daylight Saving Time
From: Nathan Splinter
To: Brooke Sampson
CC: Neil Trainor, Nathan Fitzpatrick, Brenden Underwood, Llynwen Osborne

Good Morning Brooke,

I support the work plan as submitted.

Regards,
Nathan

From: Brooke Sampson <brooke.sampson@queensu.ca>
Sent: October 6, 2022 10:22 PM
To: Nathan Splinter <splinter@queensu.ca>
Cc: Neil Trainor <18njt4@queensu.ca>; Nathan Fitzpatrick <18nwf1@queensu.ca>; Brenden Underwood <18btu@queensu.ca>
Subject: Confirmation of Acceptance of Work Plan - Sustainable Landscaping

Hello Nathan,

I forgot to mention this in yesterday's meeting but could you please reply with confirmation that you agree with the Work Plan that we reviewed with you yesterday?

Thank you,

Brooke Sampson
Bachelor of Applied Science and Engineering – Civil Engineering Candidate 2023
Queen's University

Appendix F – Work Breakdown Structure

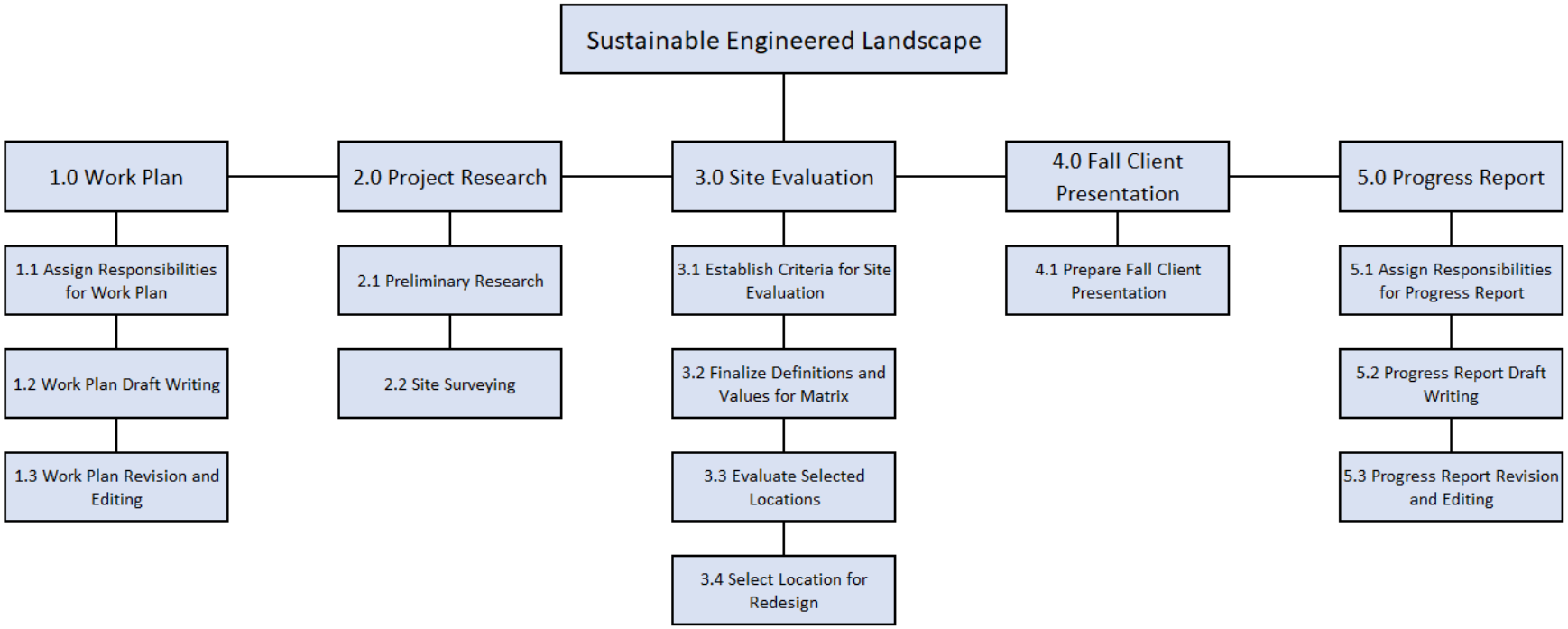


Figure 57: Work Breakdown Structure for the Fall Term.

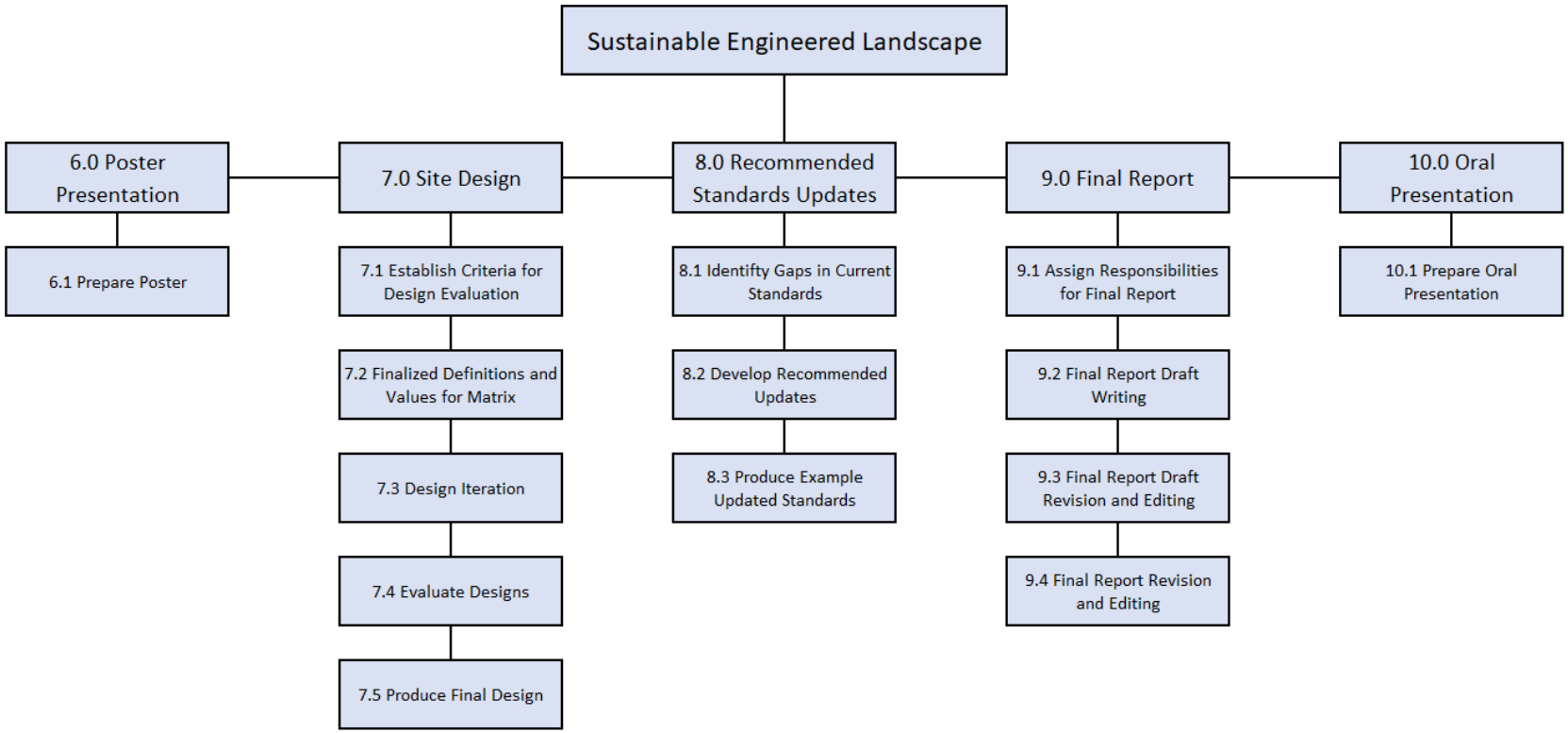


Figure 58: Work Breakdown Structure for the Winter Term.

Appendix G – Responsibility Assignment Matrix

Tasks	Team Lead Neil Trainor	Technical Advisor Brenden Underwood	Communication Lead Brooke Sampson	Societal Coordinator Nathan Fitzpatrick
1.0 Work Plan				
1.1 Assign Responsibilites for Work Plan	P	S	S	S
1.2 Work Plan Draft Writing	P	P	P	P
1.3 Work Plan Revision and Editing	P	S	P	S
2.0 Project Research				
2.1 Preliminary Research	P	P	P	P
2.2 Site Surveying	P	P	P	P
3.0 Site Evaluation				
3.1 Establish Criteria for Site Evaluation	P	S	S	S
3.2 Finalize Defintions and Values for Matrix	P	S	S	P
3.3 Evaluate Selected Locations	P	P	P	P
3.4 Select Location for Redesign	P	P	P	P
4.0 Fall Client Presentation				
4.1 Prepare Fall Client Presentation	P	P	P	P
5.0 Progress Report				
5.1 Assign Responsibilities for Progress Report	P	S	P	S
5.2 Progress Report Draft Writing	P	P	P	P
5.3 Progress Report Revision and Editing	P	S	P	S
6.0 Poster Presentation				
6.1 Prepare Poster	P	P	P	P
7.0 Site Design				
7.1 Establish Criteria for Design Evaluation	S	P	S	S
7.2 Finalize Definitions and Values for Matrix	P	P	P	P
7.3 Design Iteration	P	P	P	P
7.4 Evaluation Designs	P	P	P	P
7.5 Produce Final Design	P	P	P	P
8.0 Recommended Standards Updates				
8.1 Identifty Gaps in Current Standards	P	C	C	C
8.2 Develop Recommended Updates	P	S	C	C
8.3 Produce Example Updated Standards	P	C	C	C
9.0 Final Report				
9.1 Assign Responsibilites for Final Report	P	S	P	S
9.2 Final Report Draft Writing	P	P	P	P
9.3 Final Report Draft Revision and Editing	P	S	P	S
9.4 Final Report Revision and Editing	P	S	P	S
10.0 Oral Presentation				
10.1 Prepare Oral Presentation	P	P	P	P

Figure 59: Responsibility Assignment Matrix for the 2022/2023 academic year.

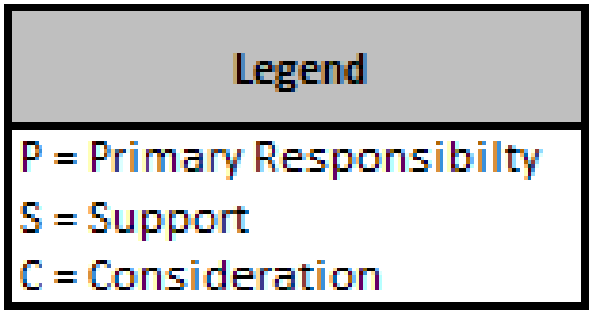


Figure 60: Legend for the Responsibility Assignment Matrix.

Appendix H – Gantt Chart

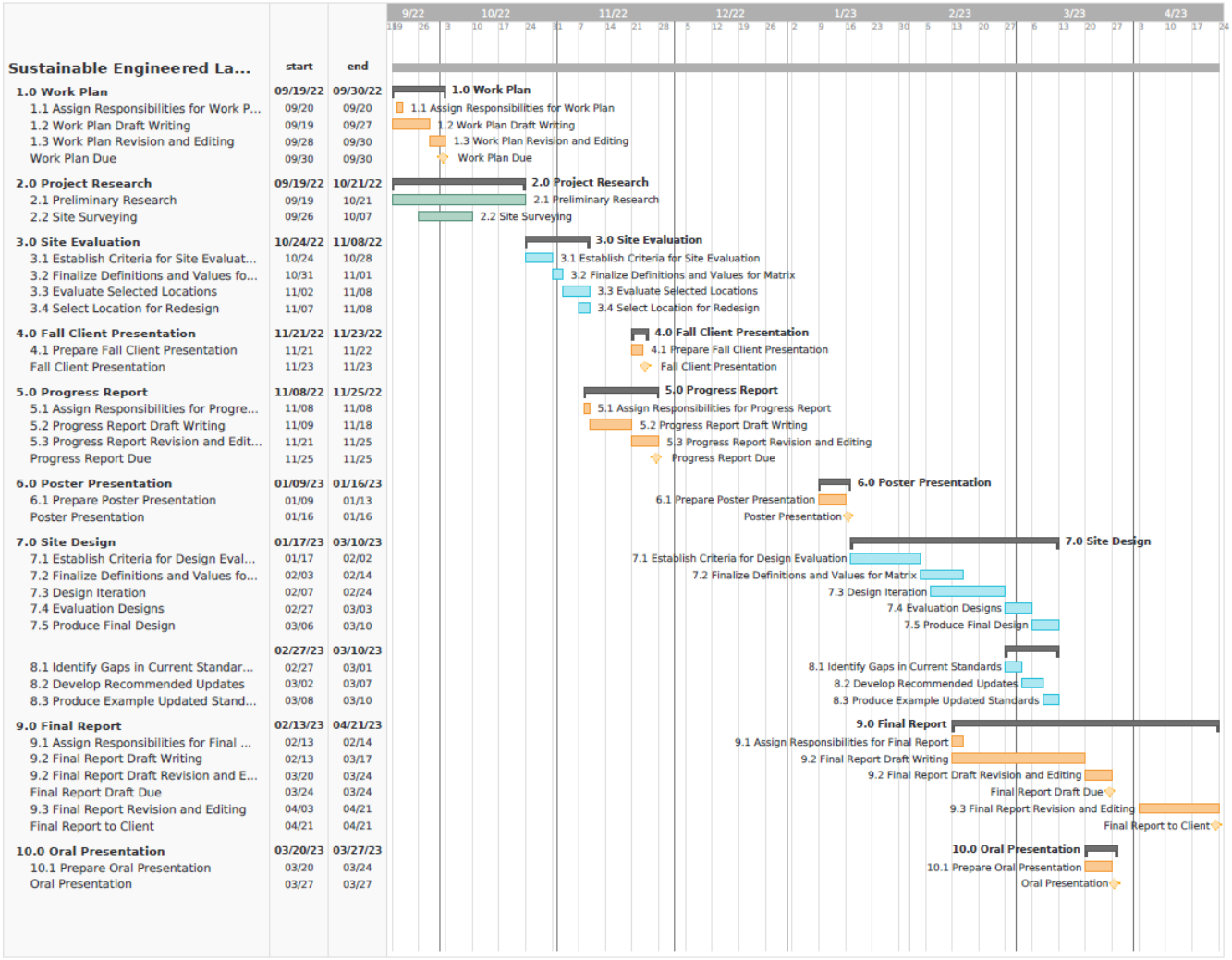
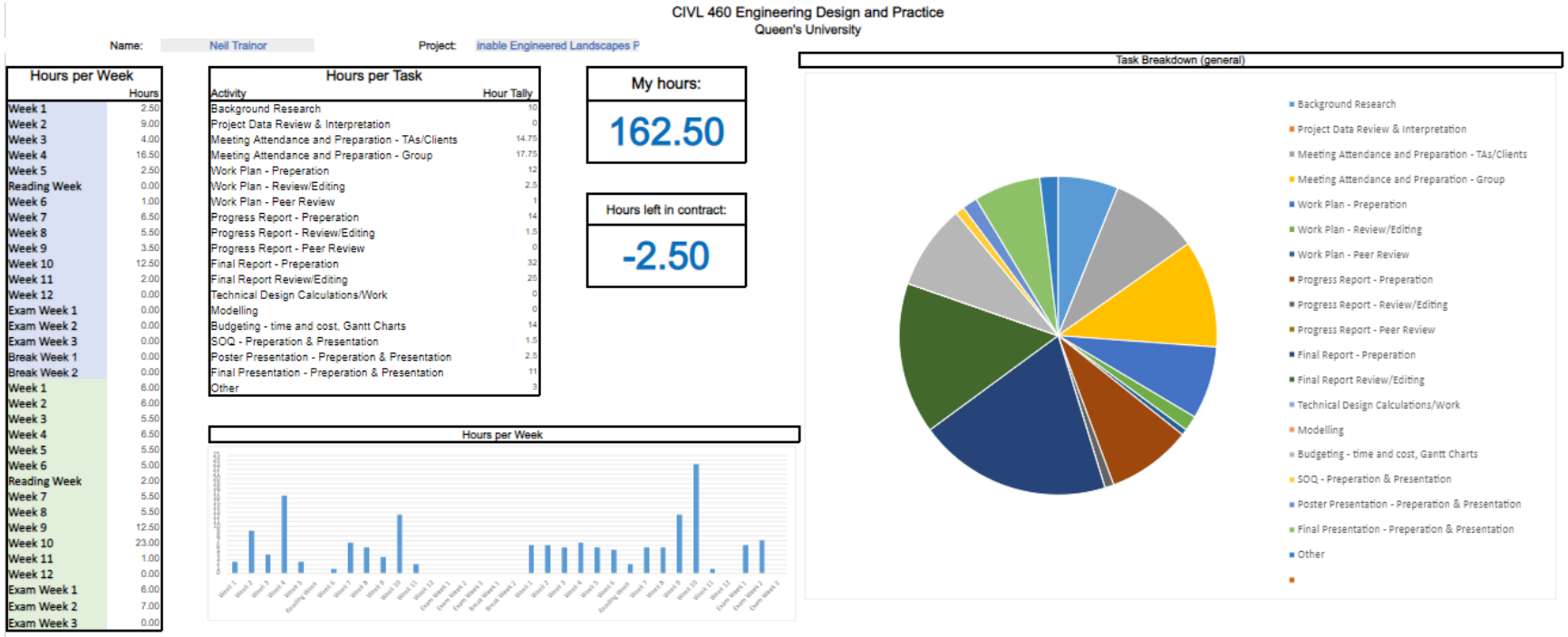


Figure 61: Gantt chart for the 2022/2023 academic year.

Appendix I – Hour Logs for Each Team Member



CIVL 460 Engineering Design and Practice
Queen's University

Name: Neil Trainor Project: inable Engineered Landscapes P

Hours per Week

	Hours
Week 1	2.50
Week 2	9.00
Week 3	4.00
Week 4	16.50
Week 5	2.50
Reading Week	0.00
Week 6	1.00
Week 7	6.50
Week 8	5.50
Week 9	3.50
Week 10	12.50
Week 11	2.00
Week 12	0.00
Exam Week 1	0.00
Exam Week 2	0.00
Exam Week 3	0.00
Break Week 1	0.00
Break Week 2	0.00
Week 1	6.00
Week 2	6.00
Week 3	5.50
Week 4	6.50
Week 5	5.50
Week 6	5.00
Reading Week	2.00
Week 7	5.50
Week 8	5.50
Week 9	12.50
Week 10	23.00
Week 11	1.00
Week 12	0.00
Exam Week 1	6.00
Exam Week 2	7.00
Exam Week 3	0.00

Hours per Task

Activity	Hour Tally
Background Research	10
Project Data Review & Interpretation	0
Meeting Attendance and Preparation - TAs/Clients	14.75
Meeting Attendance and Preparation - Group	17.75
Work Plan - Preperation	12
Work Plan - Review/Editing	2.5
Work Plan - Peer Review	1
Progress Report - Preperation	14
Progress Report - Review/Editing	1.5
Progress Report - Peer Review	0
Final Report - Preperation	32
Final Report Review/Editing	25
Technical Design Calculations/Work	0
Modelling	0
Budgeting - time and cost, Gantt Charts	14
SOQ - Preperation & Presentation	1.5
Poster Presentation - Preperation & Presentation	2.5
Final Presentation - Preperation & Presentation	11
Other	3

My hours: 162.50

Hours left in contract: -2.50

Hours per Week

Task Breakdown (general)

Background Research
Project Data Review & Interpretation
Meeting Attendance and Preparation - TAs/Clients
Meeting Attendance and Preparation - Group
Work Plan - Preperation
Work Plan - Review/Editing
Work Plan - Peer Review
Progress Report - Preperation
Progress Report - Review/Editing
Progress Report - Peer Review
Final Report - Preperation
Final Report Review/Editing
Technical Design Calculations/Work
Modelling
Budgeting - time and cost, Gantt Charts
SOQ - Preperation & Presentation
Poster Presentation - Preperation & Presentation
Final Presentation - Preperation & Presentation
Other

Figure 62: Hour logs for Neil Trainor during the 2022/2023 academic year.

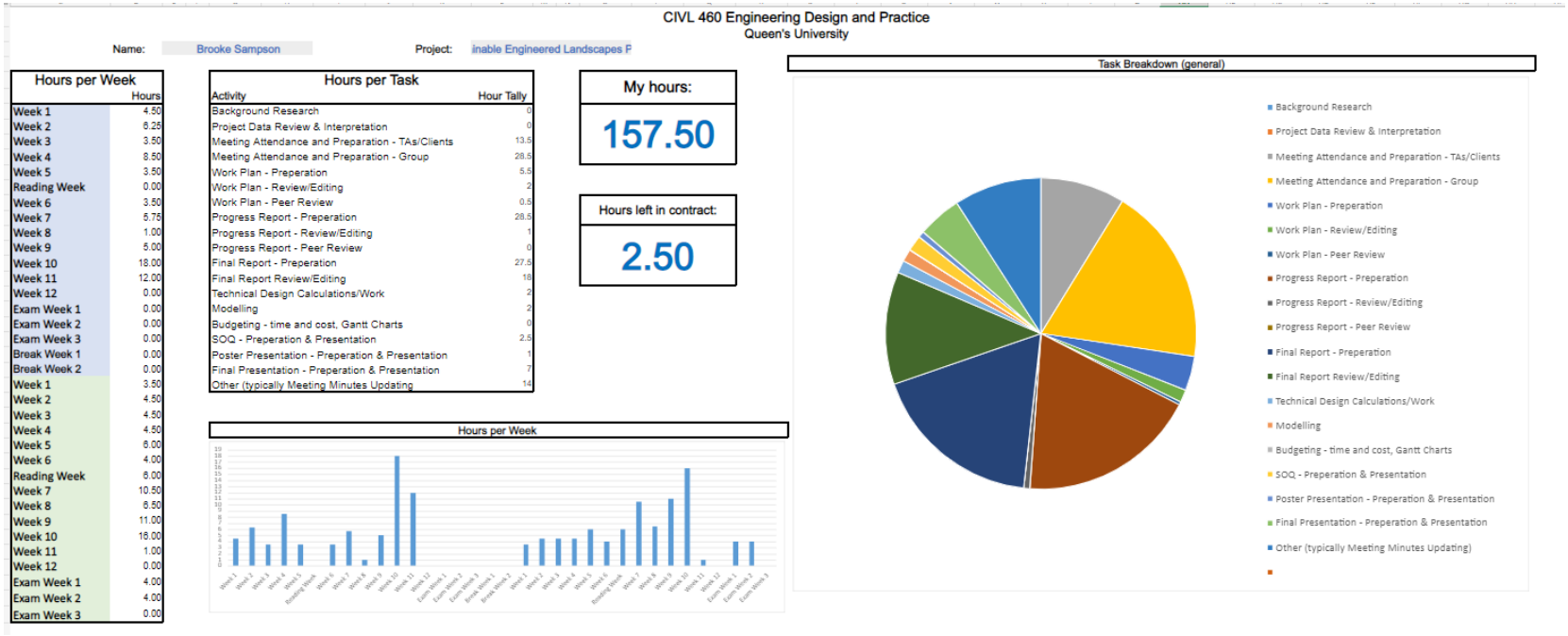


Figure 63: Hour logs for Brooke Sampson during the 2022/2023 academic year.

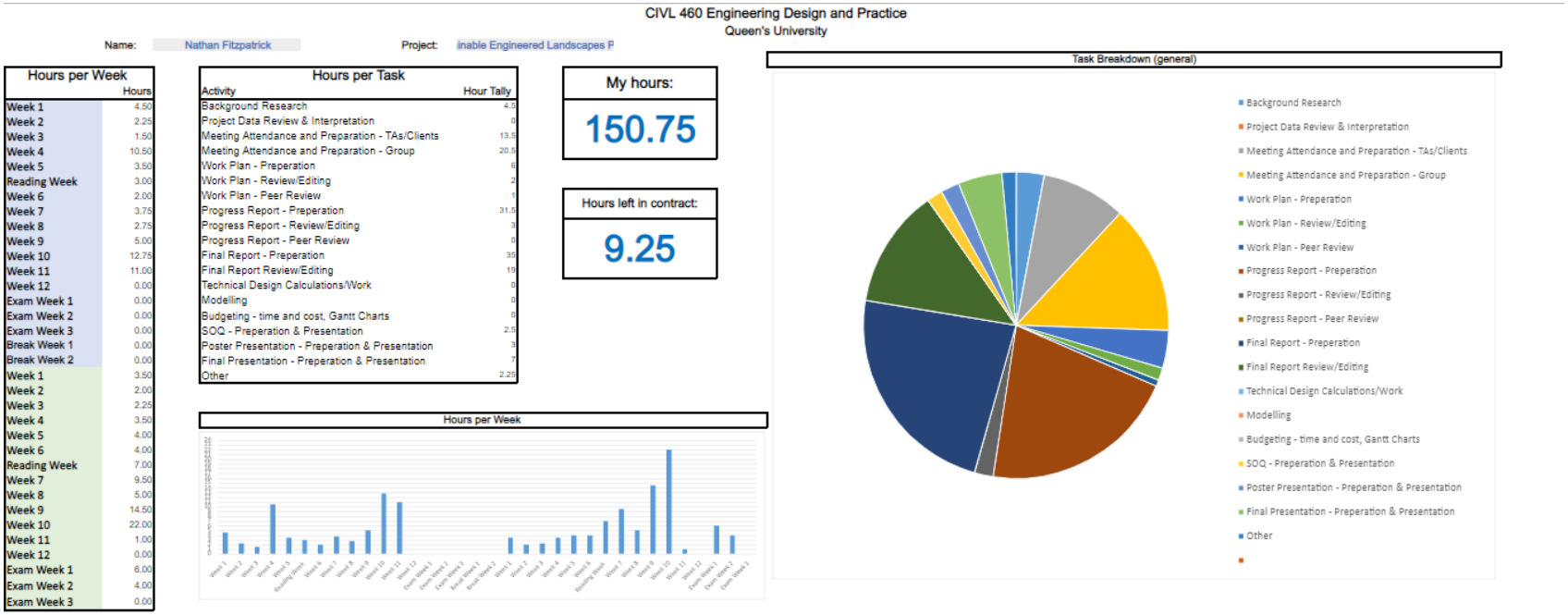


Figure 64: Hour logs for Nathan Fitzpatrick during the 2022/2023 academic year.

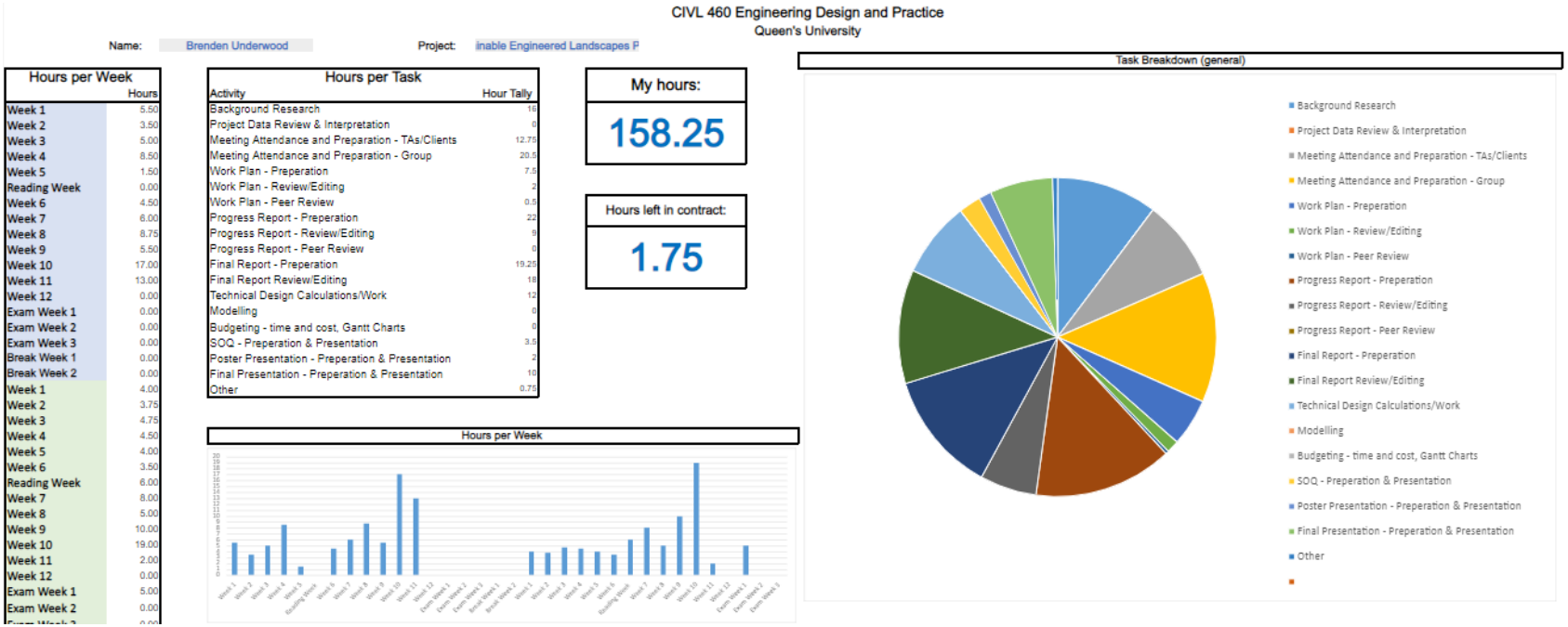


Figure 65: Hour logs for Brenden Underwood during the 2022/2023 academic year.