

**UBC Botanical Garden
Redevelopment**

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University of British Columbia

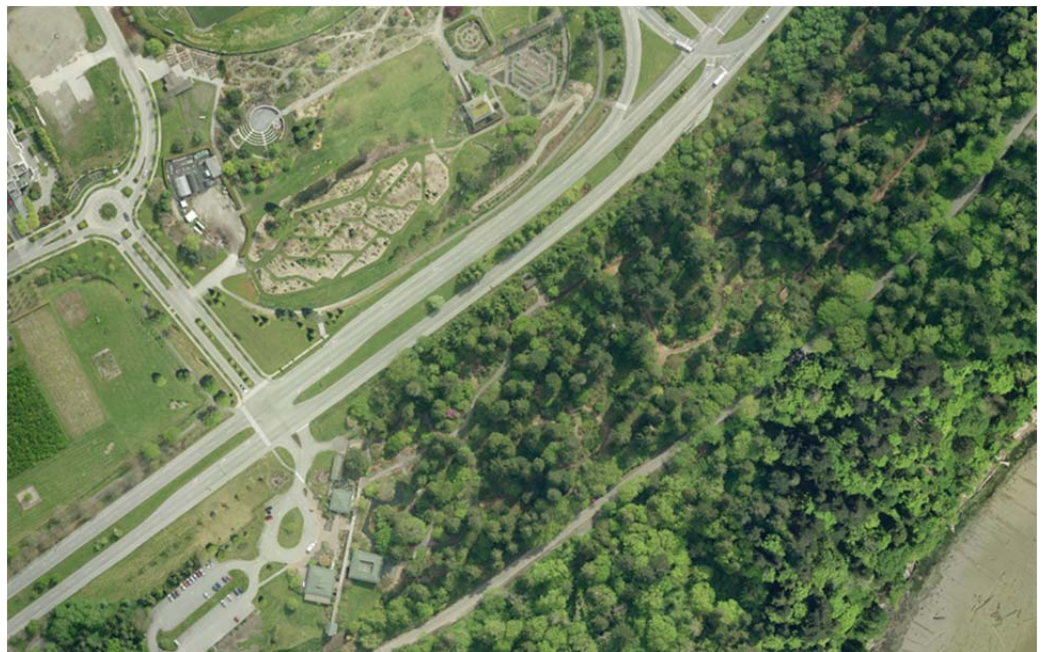
CIVL 445

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UBC Botanical Garden Redevelopment

Prepared for
UBC CIVIL 445 and UBC Botanical Garden



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Executive Summary

This document “Proposal for UBC Botanical Garden Redevelopment” is submitted by Group 1 in response to request by UBC Botanical Garden and also as a course deliverable for CIVIL 445. The proposal presents Group 1’s approach, team, conceptual designs, phase plan, schedule and estimated costs for the garden redevelopment.

In selecting an approach for this work, Group 1 reviewed site features, available data and information provided by UBC and UBC Botanical Garden. These considerations led to conclusions about the priority of each potential development area, and a proposed phase plan that would be effective and practical with the constraints of capital investment and UBC long term development plan.

Group 1 is assembled by a team of UBC 4th Year Students with experience in various fields, and sufficient support from the UBC CIVIL 445 instructor team to complete the work in an efficient manner. Group 1’s team includes enough resources to execute and carry out the detail design works for the later stage. However, Group 1 is open to cooperating with other teams or consultants that might be selected by UBC and UBC Botanical Garden.

A total of six designs are proposed for the re-development, namely Pedestrian Overpass, Picnic Cafe, Tunnel Renovation, Parking Lot Restructure and Storm Water Pond. Each conceptual design was developed based on the objective of increasing traffic and improving visitor experience with the considerations of potential impacts and costs to the garden. Each design targets to address existing issues and to create more anchor points within the garden. Proposed phase plan emphasizes on staging and incremental change to allow UBC Botanical Garden to utilize the potential income growth from initial stage development to support areas and items in the later stage development. This will minimize the amount of initial capital investment and allows UBC Botanical Garden to be self-sustainable throughout and after the redevelopment.

Group 1’s proposed schedule follows the proposed phase plan and was adjusted based on preliminary estimation and assessment on construction methods and material transport. Some details will need to be resolved once detail designs and construction plans are completed, but the schedule makes reasonable assumptions and develops a logical sequence of tasks for future planning.

The total estimated cost of the proposed designs is approximately \$1,400,000 CAD, and the details are presented for each of the proposed conceptual design. Similar to the proposed schedule, details will need to be refined based on the final detail design and construction plan. However, the estimated cost makes reasonable assumptions and provides a realistic estimate for UBC Botanical Garden’s considerations.

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1.0 Introduction

This proposal aims to provide conceptual designs with sufficient technical and costing details to the UBC Botanical Garden to carry out planning and detailed designs for their redevelopment. This proposal is structured to first provide the design background of the UBC Botanical Garden and followed with our design approach and design details. The overview of the team involved in this design project and the project background can be found in Section 2.0 and Section 3.0 respectively. Total of six conceptual designs are proposed, namely Pedestrian Overpass, Picnic Cafe, Tunnel Renovation, Parking Lot Restructure and Storm Water Pond. The location, size and important technical details are provided in Section 6.0 of the document. The potential benefits and impacts of each design are also presented in Section 6.0 along with a breakdown of costing details in Section 8.0 to assist UBC Botanical Garden in planning and decisions making. In Section 8.0, a proposed phase plan and a construction schedule are presented. The proposed phase plan was developed to allow UBC Botanical Garden to implement incremental changes and have less pressure on initial capital investment. The schedule is estimated based on average construction productivity and similar projects carried out in British Columbia.

A general summary of the six conceptual designs is listed below:

Picnic Café: A cafe located beside a picnic area to allow visitors to relax and enjoy the view of the garden. The Café is also designed to meet LEED Gold requirements, which is sustainable and non-invasive to the garden. The Café will offer gourmet beverages and snacks along with a unique picnic opportunity.

Pedestrian Overpass: A pedestrian overpass with public and private garden access, which also incorporates a living billboard, to provide a safe passage across Southwest Marine Drive and improve the overall flow of the garden. The living billboard offers advertising for the Botanical Garden and the unique wood design provides an attractive landmark for both UBC and the garden.

Storm Water Pond: A storm water storage pond based on proposals from SEED program and existing drainage network to reduce reliance and usage on potable water. The pond will also serve as a feature that complements the cafe.

Parking Lot Restructure: Restructure the parking lot by adding additional parking stalls to unused space to increase parking capacity, and constructing an All Season Bike Parking Shelter to meet the raising need of cyclists.

Tunnel Renovation: Renovate pedestrian tunnel that connects the Asian garden to the North garden by improving lighting and wood panel installation. The renovations will transform it into a unique feature of the garden.

2.0 Group Abilities and Experience

Group 1 was formed by grouping students registered in CIVIL 445 based on a survey conducted on student's interest and expertise. Resumes of the group members are attached as Appendix XX. The organization of the group is shown in Table 1. The group also includes sufficient depth and expertise to complete the detail designs for the proposed conceptual design.

Table 1: Team Organization

Name	Assigned Role	Assigned Component
Mike Lam	Group Leader	- Parking Restructure - Storm Water Pond
Kelsie Priest	Designer	- Green Café and Picnic Area
Leon Lam	Designer	- Green Overpass & Living Billboard
Manjot Toor	Designer and Minute Taker	- Green Overpass & Living Billboard
Marcel Olsthoorn	Designer	- Tunnel Renovation
Lahiru Chandra	Google Sketch-Up Specialist	- 3D Modeling and Videos Making

3.0 Project Background

The UBC Botanical Garden is located at the South West portion of the UBC Vancouver campus, with Southwest Marine Drive running through its center as shown in Figure 1 below. They were established in 1916 and are Canada’s oldest operating Botanical Garden based on a University Campus. Their main goal is to protect and maintain a vast array of unique plant species for research and conservation purposes. The Garden is currently home to a collection of 12 000 plants, representing 8000 taxa from around the world. The Garden also serves as a key part of UBC’s biodiversity collections for researchers, students and the public. They rely on funding from the University, private donors, and the small proceeds from admissions fees. Lately, the Botanical Garden has been struggling to obtain funding to maintain the garden, and relies on a network of garden volunteers to care for the plants. For this reason, the UBC Botanical Garden has requested Civil 445 Capstone Class to assist with conceptual designs for their redevelopment plan.

The management committee of UBC and UBC Botanical Garden is currently seeking fresh ideas for redevelopment to address various environmental, safety and business concerns. The key requests issued by the Botanical Garden can be summarized as follows:

- 1) Increase visitor traffic
- 2) Improve public access and visitor experience
- 3) Improve storm water management and implement a storm water reclamation system
- 4) Enhancement of capacity for research and future development
- 5) The redevelopment footprint of the UBC Botanical Garden is limited to its current size and cannot be reduced and expanded.

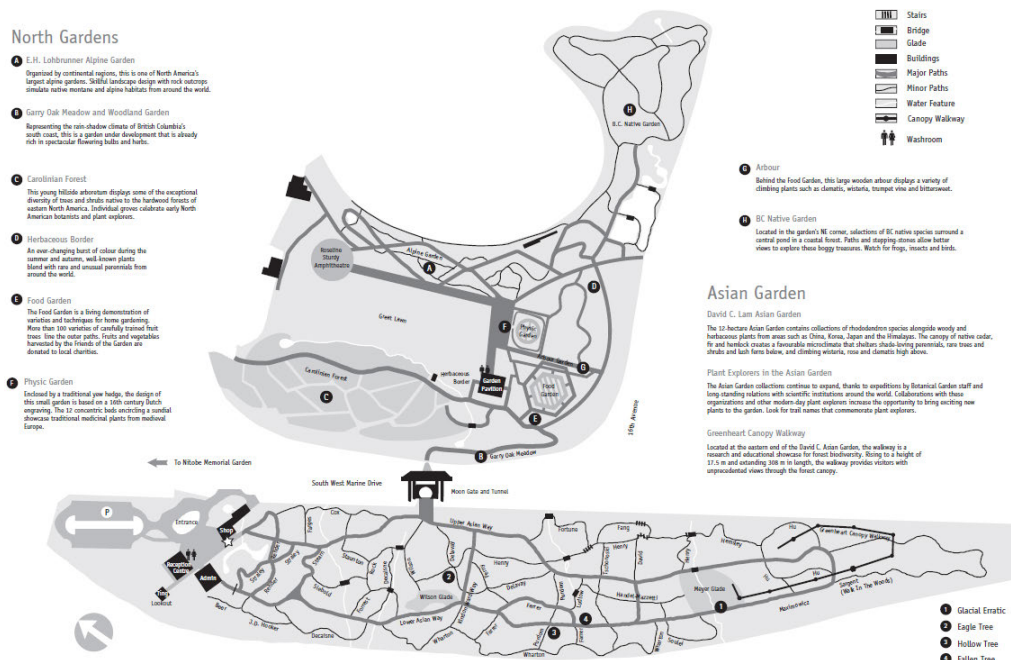


Figure 1: UBC Botanical Garden site Map

4.0 Design Development

The following sections describe the process, rationale and considerations taken to complete the proposed conceptual designs.

4.1 Sequence

The initial step in developing the project was gathering information. Plenary sessions presented by UBC Botanical Garden staff and other guest lecturers, tutorial sessions with UBC Professors, as well as team meetings aided in narrowing down the scope and identifying goals of the project. Information on the site was collected through individual and team site investigations. The data, which included dimensions, elevations, hydrologic conditions, and aerial photos, was then compared, and key focus areas were developed and chosen through team discussions. In order to justify our designs, criteria and considerations were set to focus our conceptual designs. In conjunction with design objectives, these criteria were used to develop the final designs. Finally, the designs were reviewed and a phase plan was created based on each design's potential benefits and estimated budget.

4.2 Considerations

During the initial planning process and team discussions, design solutions were developed and judged based on the following criteria:

- Cost-Effectiveness
- Impacts to the Botanical Garden
- Ability to Integrate Components
- Priority and Urgency
- Sustainability
- Feasibility and Practicality

Information from the plenary sessions indicated that cost efficiency and potential impacts were of highest importance to the Garden. Being one of the most diverse botanical gardens in the world, designs could not cause any significant adverse impacts to the Garden. Concurrently, budget limitations were noted, and therefore all designs had to compare costs to potential benefits. Ability to integrate individual components with the existing Garden is an important factor in our designs. It is necessary to maintain the cohesive and continuous environment of the garden to avoid creating a series of seeming afterthoughts. In addition, priority was added as a judging criterion to define the incremental Phasing Plan, which was necessitated by the cost limitations. Sustainability was a key item in assessing our design ideas, as it is the Universities initiative to commit their entire community to sustainability research. The last point, Feasibility and Practicality, is essentially a summation of all the other points, which is crucial in all parts of the design process.

4.3 Development

After the key considerations were set, development continued onto the next stage, which was identifying key items in the focus areas and marking them as the most important concerns and items which can bring the most potential growth and benefits to the Garden.

Most Important

- Insufficient and unsustainable drainage
- Limited and unsafe access to garden
- Poor signage and lack of public display
- Limited parking capacity

Highest Growth Potential

- Better signage and public display
- Café/Restaurant to generate income

Designs were conceptualized to address these issues and further developed to meet the criteria agreed upon previously. Designs were constantly improved upon and redeveloped to ensure finalized designs met and exceeded expectations.

5.0 Design Scope

The scope of the conceptual design report aims to provide guidelines to help designers to carry out further research and planning to complete the detail designs. Provided with each structure in this report are drawings, design considerations, background of similar structures, as well as purpose and functionality of the structure. These different types of information are crucial to ensure the original objectives of the conceptual design will be carried out. A google Sketch-Up model for each conceptual design is provided as a demo to allow visual inspection and evaluation. Included in each model are approximate dimensions, floor plans and orientation of the structure to allow designers to carry out further design and fine tuning of each structure. Furthermore, preliminary cost estimates and schedules are provided for designers and the Botanical Garden to gauge the amount of funding and time frames for construction. The cost estimates include labor hours and cost of materials as well as mark ups. The schedules contain approximate time frames for each stage of construction and the order in which each activity is to be carried out.

6.0 Conceptual Designs

The following sections contain technical details and design considerations of each conceptual design. Figure 2 below outlines the approximate location of each component, and a summary of the advantages of these chosen locations is also described below.



Figure 2: Designs locations

- 1) **Green Picnic Café** is located in the center of the upper half of the Botanical Garden. It is placed as an anchor point to attract tourists. Park visitors may warm up with a coffee or purchase a picnic kit to enjoy the wonderful environment at this central location. The existing service yard to the left of the café will allow easy access for supplies and special transportation during events.
- 2) **Living Overpass** crosses the SW Marine Drive, with the West end situating next to the entrance and East end touching the outskirts of the Carolinian Forest. This large visible display can notify visitors that they have entered UBC and are nearing the entrance of UBC Botanical Garden. This placement also allows easy access for pedestrians and park visitors that are coming from the South Side of the Campus. The East end is strategically placed near Carolinian Forest to take advantage of the existing high elevation to reduce the crossing footprint, which reduces construction cost and time.
- 3) **The Pedestrian Tunnel** is located in the middle of the park to connect the two sides of the garden. With the new Living Overpass, visitors can then travel around the park to visit all the anchors in one continuous circle without having to trace back and walk through the tunnel twice.
- 4) **The Parking Lot** is situated on the West side of the SW Marine Drive in front of the Garden's entrance. The current location is found to be convenient and have enough space for upgrade and development. Therefore, the parking upgrade will not alter the location and will make use of the current footprint to reduce cost and disturbance.

6.1 Living Overpass

The Living Overpass consists of a Pedestrian Overpass and a Living Billboard. The details of each component are described in the following sections.

6.1.1 Background and Traffic Conditions

The entrance of the UBC Botanical Garden is located on the south side of SW Marine Drive, which is a difficult location for visitors to walk to. The closest UBC bound bus stop is an approximately 10-15 minute walk away, and to reach the garden from campus requires pedestrians to cross six lanes of traffic. Currently there is an intersection near the entrance, with a crosswalk from the North side to the South side of Marine Drive, but it is uncontrolled and has no lights indicating pedestrian crossing. Therefore, a Pedestrian Overpass would be a much safer and more scenic way for crossing over, which may also increase foot traffic to the Garden.

6.1.1.1 Design Considerations

The conceptual design for a safer crossing went through several iterations before the final overpass took form. Our key consideration was to increase foot traffic while improving safety for both pedestrians and drivers. The initial designs included implementing a more visible crosswalk such as adding signal lights and high visibility road signs with additional traffic calming devices such as speed bumps. However, these measures are considered inefficient as it does not promote or showcase the attributes and ideals of the UBC Botanical Garden.

Once the two core values were identified, it was decided that a sustainable overpass design was desired. It can create a safe passage over and across Southwest Marine Drive and showcase the commitment and vision of UBC on sustainability.

The initial design was a simple, single span deck across Marine Dr. Since there was already road island bisecting the road, a reinforced concrete support pillar could easily be erected on the island with minimal disturbance to traffic. The deck will be supported by the main pillar, and supporting pillars on the north and south ends where the deck connects to the ramps.

To avoid the usage and reliance on unsustainable materials such as reinforced concrete, we decided that timber and engineered wood would be a more fitting material for this project. Although timber construction would cost more than concrete, the cost is outweighed by the fact that a timber overpass would be more suited for our core values and the Botanical Garden's goals of improving sustainability.

6.1.2 Pedestrian Overpass



Figure 3: Living Overpass Design

The design follows the guidelines set by the Ministry of Transportation (BC Ministry of Transportation, 2007). As shown in the Figure 3, the overpass uses an arch-bridge design typical of long span timber structures. In order to meet the sustainable design goal, the primary material used for the overpass will be engineered wood. The arches and deck will be made of glulam sections fastened together on site, whereas the supports for the arches and the handrails will be constructed using sawn timber.

The deck of the overpass is separated in the longitudinal direction by planters and lattice fencing, to allow both patrons of the Botanical Garden and general pedestrians to safely cross through the traffic. A single deck design separated by planters reduces the need to build separate crossings for patrons and regular pedestrians. The separator also acts as an aesthetic medium while crossing the overpass. Vines, flowers, and other plants will be planted along the length of the separator, creating a “green” look and feel of the overpass. In addition to aesthetics, plants will also help to improve air quality and promote sustainability by absorbing carbon.

In addition to the separated deck, four ramps are connected to the deck; two for Garden patrons, and two for regular pedestrians. Having a ramp located in the Carolinian Forest and the other ramp located near the main entrance to the Garden will, together with the tunnel, create a continuous circuit around the North and South Gardens. This will make strolls through the garden less repetitive and more enjoyable. However, it was also deemed important to have the overpass open to the general public as it is a much safer method of crossing Marine Dr., which is the reason there are two ramps straddling the east and west sides of the road. The ramps and deck on the public side are also wider to accommodate for cyclists who wish to walk their bikes across the overpass safely.

6.1.3 Living Billboard

The UBC Botanical Garden is a hidden treasure that several people are unaware of, which shall be highlighted to increase visitors. The living billboard, which will be hoisted against the south side of the pedestrian overpass, will act as visual advertisement of the garden. Its purpose is to increase awareness of the location of the UBC Botanical Garden for tourists and residents alike. The living aspect of the billboard highlights the purpose of the garden as a centre for plant research.

6.1.3.1 Design Considerations

Two key aspects were considered when designing the living billboard. First, it shall be effective in attracting more visitors and increase awareness of the Botanical Garden. Second, it was critical to promote sustainability as part of the billboard. This would go alongside UBC's strategic plan and commitment to a more sustainable campus. It would also act as a sneak preview of the various species of plants that could be found in the garden itself to captivate the interest of potential visitors.

6.1.3.2 Conceptual Design

Figure 4 displays a conceptual design for the living billboard. As seen in the figure, it is an extension of the pedestrian overpass to minimize the cost as opposed to an independent billboard structure. In addition, the billboard will be placed on the south side of the pedestrian overpass as that is more visible and also it is the side that is most likely to attract more attention.



Figure 4: Living Billboard

The living billboard consists of a cedar backboard to help support the plants covering the board. Cedar posts make up the frame of the billboard and the cedar is also used as the material for the box along the bottom of the board for planting other plants.

6.1.3.3 *The Living Aspect of the Billboard*

The living billboard will primarily be composed of Fukien tea plants, which will be placed along the baseboard. These plants will promote sustainability and display an eco-friendly billboard. The Fukien tea plant functions as an absorber of carbon dioxide and improves the air quality of the surrounding environment. To decrease its environmental footprint, the living billboard will use waste by-products and fertilizers as the potting soil and recycled material for plant pots.

For the box along the bottom of the billboard, various types of plants from the Botanical Garden will be used alongside some environmentally friendly plants. The display of several species of plants in this box will promote the diversity of the garden to potential visitors.

For the survival of the plants, a drip irrigation system will be set up behind the backboard of the billboard to provide water and other required nutrients to the plants. It is important for the billboard to be well maintained and kept in excellent condition so that it is attractive for those driving by.

6.2 **Green Picnic Café**

The UBC Botanical Gardens provides guests with several hours of viewing enjoyment with an expansive network of trails and gardens. In order to improve the visitor experience, and to encourage guests to sit down and soak in their unique surroundings, a gourmet Café is the key ingredient in the recipe for success at the Botanical Gardens. Visitors will be encouraged to take complimentary picnic blankets along with their locally sourced snacks inspired by the seasonal produce growing in the Food Garden, and find a quiet nook where they can soak up the fresh garden air. The cafe will attract food enthusiasts, families, couples, and more, expanding the demographic of visitors. Guests are given the unique opportunity to find serenity in an expansive garden while enjoying an extraordinary picnic that requires no preparation on their part.



Figure 5: A gourmet meal available for picnics

6.2.1 Design Considerations

The design for the new café has to be visually pleasing, sustainable, and accessible by service vehicles for deliveries. It must be bold enough to leave a lasting impression on visitors, but modest enough to fit the small budget of the UBC Botanical Garden. Initially, a restaurant was proposed, as this could potentially bring in more profit for the garden. A restaurant however, would not integrate as well with the garden, and may take away from the focus on the garden. The design must enhance the visitor experience rather than overpower the garden itself. Another problem with a restaurant would be its very high cost of building and operating, and to operate a successful restaurant, one must be sure that enough customers will come. For this reason, a small café was chosen, as it is much less expensive and will have a significantly lower operating cost. Visitors from all demographics will be able to afford to eat at the proposed café, whether splitting a slice of pie and coffee on a date, or taking the whole family out for a large lunch.

A simple café did feature the garden enough, so creating a café that focused on providing picnic meals to visitors became the final design. The picnic café encourages visitors to enjoy gourmet food while also appreciating the sights, sounds, and smells of the garden around them.

6.2.2 Conceptual Design

The building appears to grow out of the surrounding plants, with a glass wall making the front facade to provide unobstructed garden views. The side walls and back are covered in climbing vines that reach up to the green roof, home to native plant species. The University of British Columbia is interested in building new infrastructure if it fits into their “Living Laboratory” motto. To fit this desire, the cafe will allow for studies on unusual and unique plants for growing a green roof. Green roofs have a large place in Vancouver’s future, and UBC would benefit from extensive research on the topic. The building will also feature a living wall inside the café, to help bring the Botanical Garden inside the café to be enjoyed on rainy days.

The design for this building also considers the very small budget of the UBC Botanical Garden. The cafe is able to be kept small due its focus on providing a picnic in the garden with complimentary picnic blankets. This means that most guests will not be eating in the building, and its size is only 1000 square feet. The small size of the cafe can allow more open space for events such as the annual Apple Festival and weddings.

A cafe can be a very effective means to increase profits for the UBC Botanical Garden. The food and beverage sales, as well as increased amount of visitors entering the Garden will help to bring in more revenues. The full kitchen in the cafe will not only serve daily guests, but can also be used for catering weddings receptions and corporate functions. Due to the fact that the Garden already has weddings booked every weekend in the summer, catering is expected to be a successful and profitable service.



Figure 6: A conceptual view of the café from outdoors



Figure 7: A view of the interior of the café



Figure 8: A closer view of the interior of the cafe

6.2.3 Location

The location of the Cafe is crucial to its success and functionality. The Cafe is to be located on the North-East quadrant of the garden. It is tucked in behind the amphitheater on the arm of the Great Lawn, as shown in Figure 2 denoted '1'. The nearby proximity of the service entrance to the garden allows daily food deliveries to have minimal impact on the garden. Visitors can take their picnic lunch across the proposed footbridge to the Carolinian forest, or spread out their blankets on the roomy Great Lawn. The new proposed pedestrian overpass from the entrance to the garden provides a direct route for visitors who wish to head directly to the Cafe. The Cafe will also help support events in the Amphitheater by providing guests with food and beverages.

6.2.4 The Footbridge

The footbridge is a desirable feature that will help to promote the pond between the Great Lawn and the Carolinian Forest. The pond is used for research and education by UBC Biology courses, and a small footbridge across the pond will make it easier to take water samples. It will also prevent students from standing on the unstable edge of the pond, causing unwanted erosion. The bridge will provide access for the cafe's guests to take their picnic basket into the Carolinian Forest.



Figure 9: A conceptual design of the footbridge and storm water pond

6.2.5 Sustainability Initiatives

In compliance with the University of British Columbia's bold greenhouse gas reduction goals and mandatory LEED Gold certification for all new buildings, the new cafe will be energy efficient and made of environmentally friendly materials. The cafe will meet objectives in all seven categories from which LEED Points may be obtained. The green roof and climbing plants aid in reducing storm water runoff, moderating internal temperature, and absorbing carbon dioxide. Appliances will be energy efficient and low-flow to reduce water consumption. The timber frame construction utilizes a renewable building material, and recycled columns or beams will be considered depending material availability at the time of construction. The large glass facade and operable windows allows for natural light, improving the indoor environmental quality. The cafe itself will also utilize reusable drink containers, plates, and cutlery for those visitors who wish to eat their meal in the cafe or on picnic baskets in surrounding areas. For those visitors wishing to take their snacks or beverages to go, compostable or recyclable containers will be provided. The cafe will feature a recycling booth within it, similar to those in resident cafeterias on campus. All food scraps and biodegradable items will be composted for use in the garden.

6.3 Tunnel Renovation

The tunnel in the Botanical gardens is the only access connecting the Asian garden to the North garden by providing passage under South West Marine Drive. Currently, visitors to the garden must pass through this tunnel a minimum of two times to tour both sides of the garden. The tunnel is made of corrugated metal pipe approximately 9 feet in diameter with a length of 165 feet. Although it is well constructed and serves its purpose adequately, it offers little visual enhancement to the surrounding garden as shown in Figure 10: Tunnel West entrance. The space is poorly lit with old light fixtures spaced widely apart, giving the tunnel a dark and unwelcoming appearance. Due to the corrugated metal finish of the tunnel, any sounds in the tunnel are picked up and echoed throughout the space, taking away from the tranquility of the surrounding gardens.



Figure 10: Tunnel West entrance

6.3.1 Design Considerations

The current tunnel works satisfactorily as passage under South West Marine Drive but does not enhance visitor's experience. The goal in redesigning the tunnel is to transform it into a focal point of the garden. As it is already located in the main travel path, enhancing its appearance may improve visitors' experience at the garden. Two main aspects have been considered for improvement, the lighting of the tunnel and the appearance of the tunnel walls. By improving these two aspects, the tunnel can become an attraction that visitors would remember. An important design aspect is to maintain the width and clearance for equipment passage to not hinder its functionality.

6.3.2 Conceptual Design

Figure 11, 12, 13 show the conceptual designs for the tunnel with three different lighting options. This design will require minimal maintenance and will have a minimum lifespan of 20 years. The only items that may require replacement would be light bulbs. As shown the space will be considerably brighter and blends in with its surroundings. Different lighting options allow the Botanical Garden to create distinct feeling to suit the needs of any potential events. This renovation is reasonably simple, cost effective and provides a dramatic improvement to the space.



Figure 11: Rainbow light option



Figure 12: Flourescent light option from North side entrance



Figure 13: Wooden panel with fluorescent light option

6.3.3 Tunnel Wall Paneling

The first improvement proposed is to line the corrugated pipe walls with a wood paneling system. This would help to warm the space, remove echo and greatly improve the appearance. The paneling system would require minimal clearance. By utilizing the grooves in the corrugated pipe to install a fastening system for the wood panel, the panels can be attached tightly to the walls. Design and costing have been completed using 1"X8"X10' cedar panels, which only decreases the width of the tunnel by approximately 3 inches once installed. The tunnel at an estimated length of 165 feet would require approximately 580 pieces of lumber to cover its wall. The wood paneling on the tunnel walls would also make it simple for the UBC Botanical Garden to fasten signs and pictures along the tunnel, allowing the tunnel to also act as a gallery for exhibits. Figure 13 shows a sample of the recommended cedar panel used to line the sides of the tunnel.



Figure 14: Sample Tunnel Wall Panel

6.3.4 Tunnel Lighting

The lighting in the current tunnel is outdated and unable to keep the space lit even during day time. With the proposed design, lighting is improved by increasing the number for fixtures. The conceptual design has been completed using 48 inch long outdoor fluorescent light fixture, which would be spaced at 96 inches on center. Approximately 20 fixtures would be required with the specified size. Various lighting options are offered to the Garden, which can be easily interchanged for different occasions. Figures 11, 12 and 13 display the three lighting options, namely white fluorescent lights, green led lights, and rainbow lights.

6.4 Parking Lot Restructure

The existing UBC Botanical Garden Parking Lot has 84 parking spots, and with the additional parking spots along the Old Marine Drive can provide approximately 100 free parking spots that are conveniently available. The parking spots along Old Marine Drive are under the jurisdiction of Metro Vancouver, which is outside of UBC and UBC Botanical Garden's plan or influence. It is also observed that the free parking spots along Old Marine Drive are mainly occupied by students during school hours. Therefore, it is more practical to focus the restructure within the footprint of the Garden.

6.4.1 Conceptual Design

The current parking lot was analyzed for its maximum capacity within the current footprint with the consideration of removing the existing median. It is confirmed that the current design has already been optimized to maximum capacity, no additional parking units can be placed without decreasing the stall size or increasing the paved footprint. Families and gardeners are the main visitors that would require parking, and they will most likely be driving larger type vehicles such as trucks and vans. With the consideration of visitor's experience and safety, it is concluded that reducing stall size is not a viable option.

The sloped section beside the roundabout is analyzed, and it is found to be suitable for expanding the parking lot. By removing the bottleneck and paving approximately 600 m² of grass sections as shown in Figure 13 and *Appendix A*, 32 additional large parking stalls can be added, which increases the parking capacity by approximately 30%. The Bus parking stall is moved closer to the entrance for the proposed change, but the functionality shall not be affected. The existing roundabout will also not be affected by this change as no space was removed from the roundabout, so it may still provide convenient access and turning point for buses or commercial size vehicles.

To meet the rising biking population in Vancouver and UBC, an All Season Bike Parking is proposed. It will be located next to the current Bus Parking as shown in Figure 15, and will provide 80 sheltered bike parking spots. This will provide better experience for bikers and attract more visitors to travel to the Botanical Garden by bikes, which will also reduce the reliance on vehicles and parking.



Figure 15: Parking restructure design

6.5 Pond and Drainage System

The storm water collection system that passes through the Botanical Garden is a campus wide system that is responsible for receiving and discharging runoff from the South Portion of the Campus as seen in *Appendix B*. The potential upgrade or modification to the system may involve parties including Metro Vancouver and other UBC communities, which may be outside of the management scope and control of the UBC Botanical Garden. UBC and UBC SEED program are also currently working on upgrading and restructuring the potable and storm water systems around the campus. These two main factors have led to conclusion that it would be impractical to come up with any conceptual design that contains details or water routes based on the current conditions without any consultation or information from parties involved in the UBC water system upgrade. Furthermore, the upgrade of the storm water system would bring less direct and economic benefits to the Garden comparing to other developments. In the scope and objective of this proposal, it is considered more practical to suggest ideas and components to the committee in charge of the system upgrade to incorporate with Botanical Garden to solve the current water issue.

6.5.1 Conceptual Design

A design is proposed based on consideration of the current site conditions. To reduce the reliance on potable water for swales and ponds in the Botanical Garden, new piping systems may be installed to lead runoff from the existing storm water collecting pipe to the existing ponds or a new reservoir for storm water storage. The current ponds or new reservoir shall be lined with impermeable layer to reduce potential infiltration loss to maximize the benefits of storing storm water. A potential pond or reservoir location would be close to the existing service yard area where the proposed Cafe is located. A portion or the entire Bio-swale may be upgraded to a Storm Water Pond as it is located conveniently for drainage connection. The estimated storage volume of the Storage Pond using the footprint of the Bio-swale is approximately 600 m³. The existing storm water system as shown in *Appendix B*. has pipeline running close to the proposed location of the Cafe and Bio-swale, which reduces the amount of construction and alteration needed for the diversion. The pond can then be incorporated with the landscape to compliment the Cafe and provide irrigation water to all the living plants at the Cafe as illustrated in Figure 16. By constructing a pond near the service yard area would also make it easier to divert water to the current swale area for Biological research. However, the details and practicality of these designs are highly dependent on the changes of the current storm water system.



Figure 16: Storm Water Pond

7.0 Phase Plan and Schedule

The proposed construction and implementation plan consists of three phases. The first phase includes the construction of the café and the living overpass. The second phase implements the tunnel renovations, drainage system and the footbridge over the pond in front of the café. The last phase is suggested to be the upgrade of the parking lot.

7.1 Phase 1: Café and Living Overpass

The café and living overpass are expected to be completed within a time frame of eight months if the two projects are constructed simultaneously. The following subsections provide a detailed construction schedule.

7.1.1 Construction of the Café

Group 1 has estimated the café to take approximately 20 weeks to construct and build. This is a conservative estimate and as seen in Figure 17, 134 days have been allocated. This leaves six days to be used for unexpected delays in the construction process.

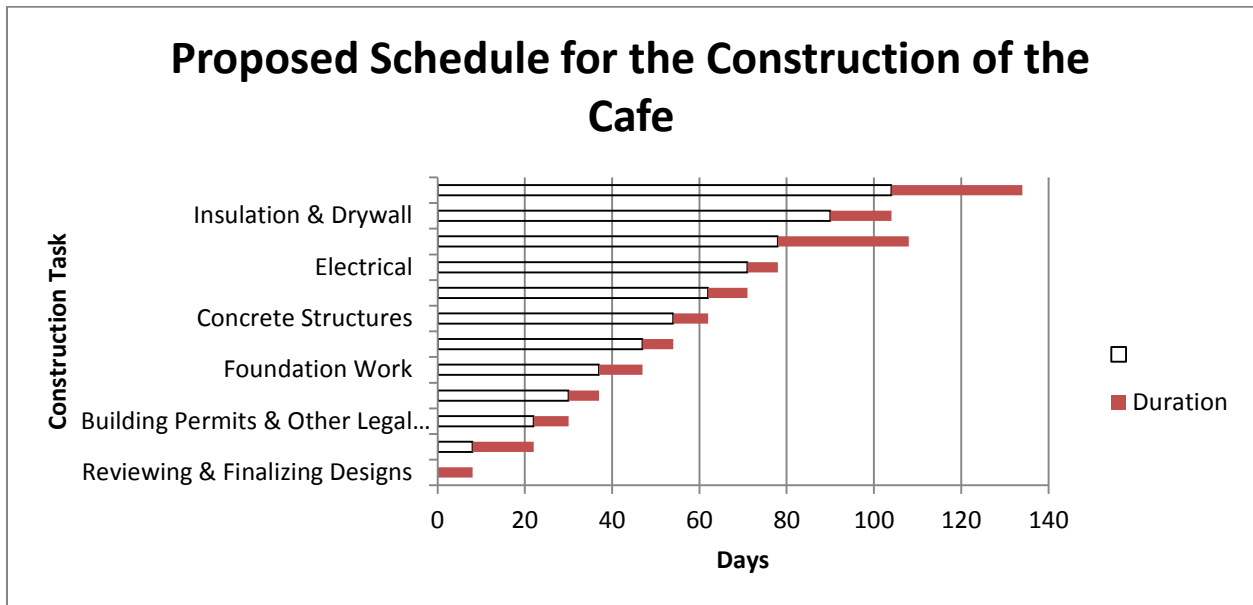


Figure 17: Proposed Schedule for the Construction of the Café

7.1.2 Construction of the Living Overpass

Group 1 has estimated the living overpass to take approximately 32 weeks to construct and build. This is a conservative estimate and as seen in Figure 18, 219 days have been allocated. There is room for delays with 5 additional days set aside for days of no work completed.

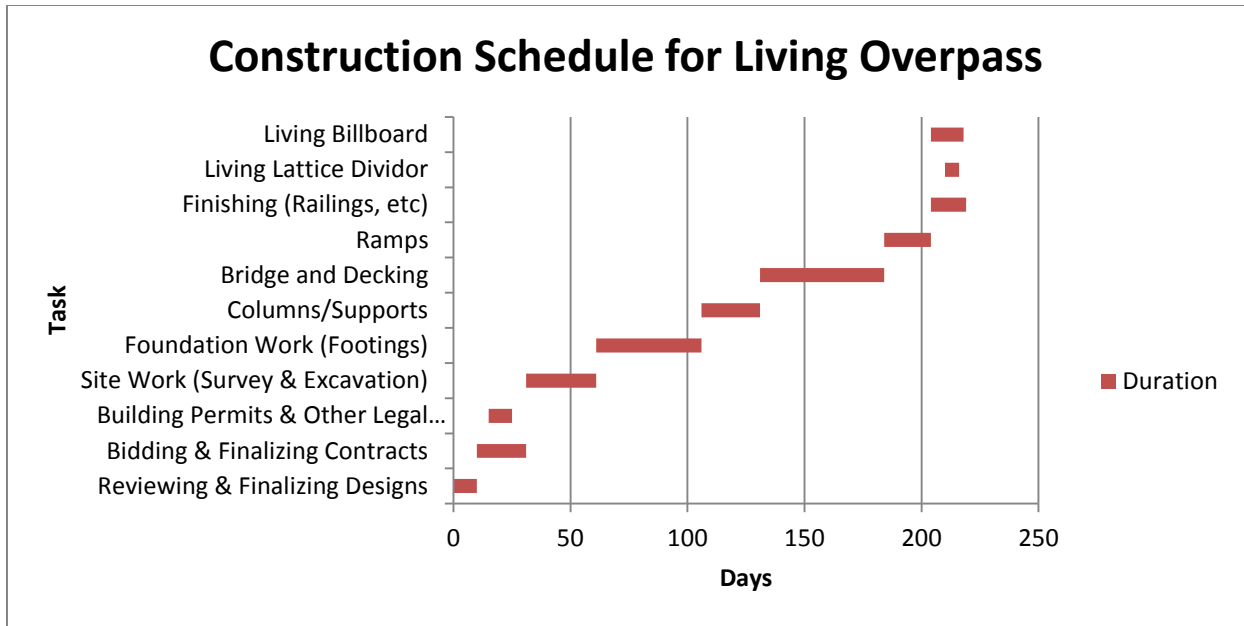


Figure 18: Construction Schedule for Living Overpass

7.2 Phase 2: Tunnel Renovations, Drainage System & Footbridge

The construction of a footbridge and the upgrading of the tunnel and drainage system are expected to be completed within six weeks. The following subsections provide a detailed construction schedule.

7.2.1 Tunnel Renovations

The upgrades to the tunnel are expected to be completed in approximately 10 days as shown in Figure 19. Four days have been scheduled for no work that may be used in the case of unforeseen circumstances.

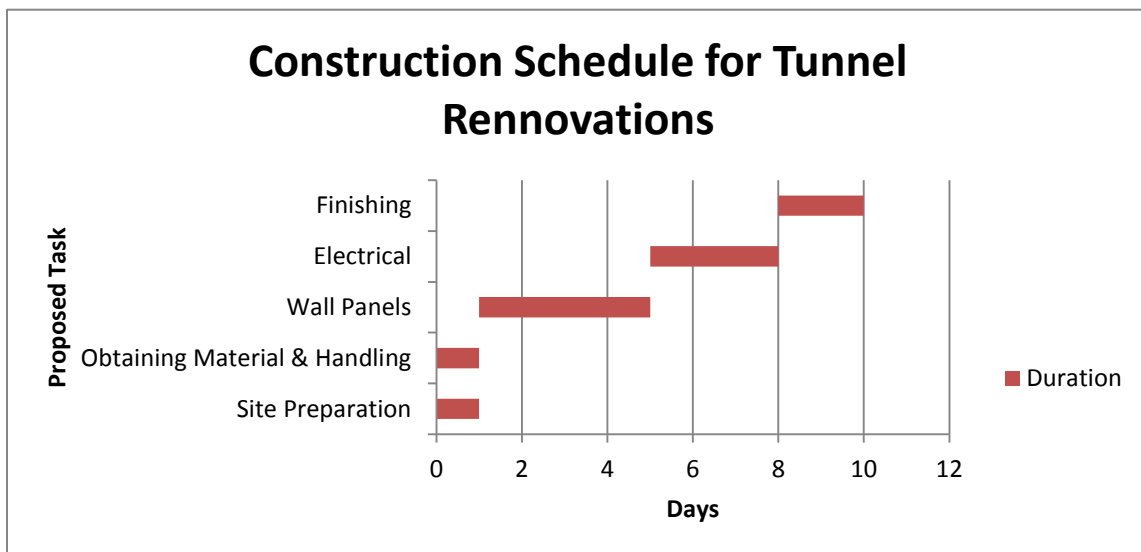


Figure 19: Construction Schedule for Tunnel Renovations

7.2.2 Drainage System and Footbridge

A total time of four weeks has been allocated for the upgrading of the drainage system at UBC Botanical Garden. This includes the implementation of a storm water pond, the required storage basins and the footbridge over the pond. The drainage system scheduling will be coordinated alongside the UBC SEEDS program.

7.3 Phase 3: Parking Lot Upgrade with Bike Storage

The improvement of the parking lot to increase the capacity and introduce all season storage area for bikes is estimated to take two weeks of work. This estimate allows for up to five days of no work to account for any unexpected delays such as severe weather conditions and delay in arrival of the material. The following figure shows the durations for each component.

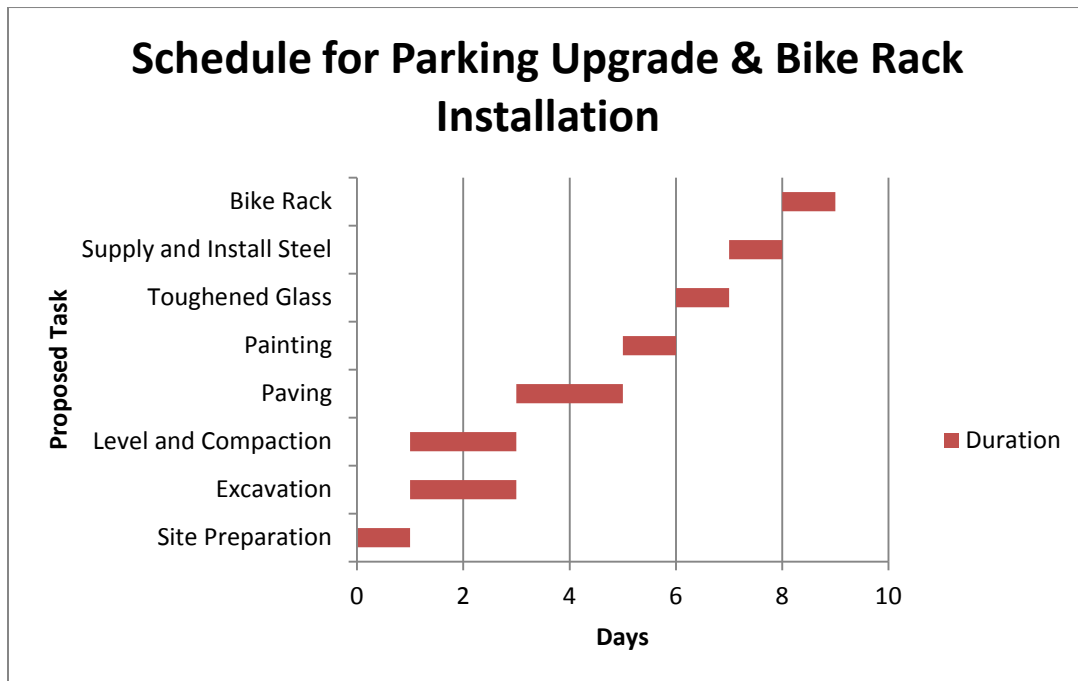


Figure 20: Schedule for Parking Upgrade and Bike Rack Installation

8.0 Cost Estimate

The following sections summarize Group 1's cost estimates for each design component based on recent Unit Price Average from Canada and other similar construction projects completed in British Columbia. Scaling using size and contingency factors are applied to provide a conservative estimate. Detailed cost estimate breakdowns are included in *Appendix C*. Taxes are not included.

8.1 Living Overpass Cost Estimate

The following subsections highlight the costs of the living overpass which are separated into costs of the overpass and the living billboard. The total estimated cost for the Living Overpass is approximately \$826 000 CAD.

8.1.1 Pedestrian Overpass Cost Estimate

The pedestrian overpass structure, excluding the living billboard, will be the most expensive upgrade of this project, but it can also potentially be the most rewarding by increasing pedestrian traffic and improving the overall appeal of the Botanical Garden. The high cost is mainly due to the material and installation. The decking and glulam arch structure will cost approximately \$360 000, and \$190 000 respectively, including labour and materials. Additionally, excavation work, footings installation and temporary supports are necessary. The entire overpass will cost approximately \$740 000, including labour and materials, and a 10% markup for location and fees. However, because the overpass is for public use as well, it may be possible to apply for funding from sources outside of UBC such as the Ministry of Transportation or the City of Vancouver. The detailed cost estimate can be found in *Appendix C*.

8.1.2 Living Billboard Cost Estimate

The living billboard will act as a method of advertising the Botanical Garden and increasing the number of visitors. The billboard will be posted against the pedestrian overpass along Marine Drive. The backboard of the billboard will be made of cedar and the posts for the frame of the billboard will also be constructed using cedar products. Approximately \$3 000 is expected to go towards the cedar material for the backboard, box for potted plants and the posts. In addition, 160 labour hours are estimated to be used for the construction of the living billboard and to hoist it against the overpass. The Fukien tea plants, which are the living aspect of the billboard, are estimated to cost \$64 500, including labour costs of potting them. The total cost for the living billboard is estimated to be \$86 000, after a 10% markup. The detailed cost estimate can be found in *Appendix C*.

8.2 Café Cost Estimate

The cafe is a smart investment for the long term success of the Botanical Garden, as it will increase the demographic and amount of visitors throughout the year. The café with less than 1000 square feet is designed to have lower operating costs with its LEED Gold Certification, which provides 50-60% in energy savings. The up-front building cost is expected to be approximately \$450 000. This price includes the substructure, main structure, interior finishes, a green roof and living wall, plumbing and electrical, and furniture and appliances. The cost estimate for the cafe was done using RS Means Software and data released in the third quarter of 2013. RS Means software was used to scale the cost of constructing

a restaurant in Vancouver based on the actual square footage, height, and perimeter of the cafe. The cost estimate also includes a contractor fee of 25% of total material cost, and an Architectural fee of 7%. Due to the University of British Columbia's requirement for all new buildings to be at least LEED Gold, another 10% was added to the total cost of the project. The extra investment in building a LEED Gold building should pay off within five to ten years. Additionally, due to the number of stakeholders at UBC, the total cost of the project was increased by an additional 10%, representing the difficulty in getting the campus community and planners to approve design decisions for campus infrastructure.

The detailed cost estimate can be found in *Appendix C*.

8.3 Tunnel Renovation Cost Estimate

The tunnel renovation will revitalize the space, giving it an upgraded visual appearance. Approximately 580 pieces of cedar paneling will be used to line the tunnel totaling a cost of \$13 000 CAD, including fastening material. The lighting will be upgraded to 20 new fluorescent lights fixtures totaling under \$2000 CAD. It is estimated just under 150 man hours will be needed to install the wood paneling and wire in the new light fixtures. This brings the total cost of the tunnel renovation to \$26 000 CAD, which includes all labour, material and an additional 10% markup. The detailed cost breakdown can be found in *Appendix C*.

8.4 Parking Restructure and All Season Bike Shelter Cost Estimate

The Parking Restructure utilizes the existing layout and pavement of the parking lot to minimize the amount of new pavement required. No changes are proposed for the existing parking lot, paving and painting are only required for the new extended area and the relocated bus stop. Approximately 600 m² of paving and 300 m³ of excavation will be needed for the construction of the parking extension and all season bike shelter installation. The bike shelter has a relatively simple design and mainly consists of steel and toughened glass, which will require minimal maintenance and installation cost. The total cost of the parking extension and bike shelter will be approximately \$63 000 CAD including labour and material costs. The detail cost breakdown can be found in *Appendix C*.

8.5 Storm Water Pond Cost Estimate

The Storm Water Pond is an upgrade of the current Bio-swale pond. The existing soil and plants will be excavated and temporarily stored elsewhere for the impermeable lining installation. The major cost of this upgrade will be from the temporary relocation and storage of the plants and soil due to the relatively complex and delicate nature of the operation. As explained in the previous section, UBC is in the progress of designing a new campus wide drainage system that will likely affect Botanical Garden's drainage system, it would be impractical to come up with a detail plan based on the existing piping system. Therefore, the cost estimate of the pond upgrade does not include any piping system or connection related costs. Approximately 200 m³ of excavation and 625 m² of lining are required for the upgrade. The total cost of the pond upgrade is estimated to be approximately \$11 000 CAD. The detail cost breakdown can be found in *Appendix C*.

9.0 Closure

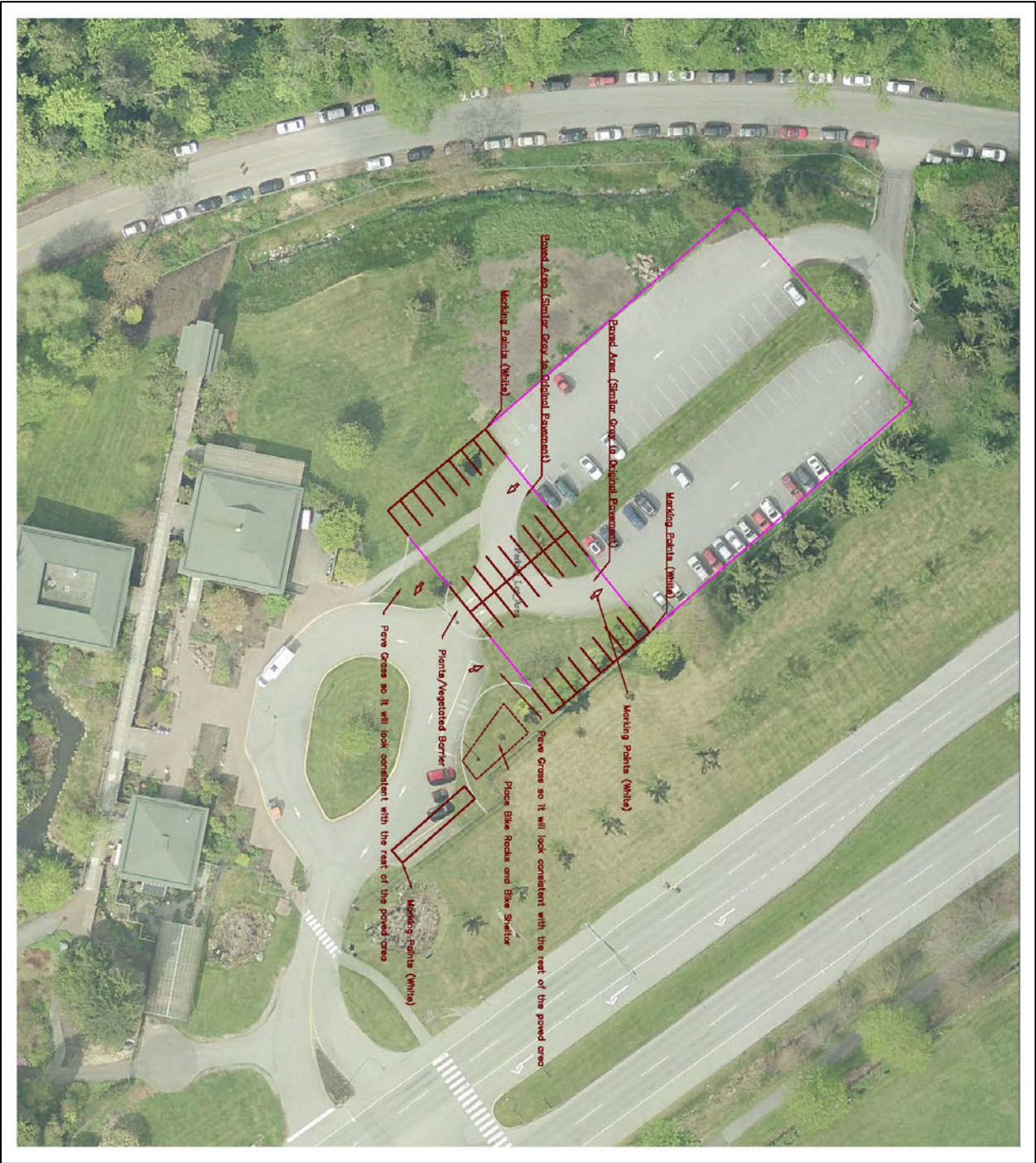
This Conceptual Design Proposal has been prepared by Group 1 in response to request from UBC CIVIL 445 and UBC Botanical Garden. With the given constraints and information, Group 1 believes the Conceptual Designs and Proposed Plans will be effective and practical in increasing traffic and improving visitor experience. Each component was designed to both address existing issues and create more attractions. Proposed phase plan also allows UBC Botanical Garden to utilize the potential income growth from early stage development to support development in the later stage. The provided Cost Estimates are believed to be conservative and sufficient for details planning and decision making.

Please contact Mike Lam at [REDACTED] if you have any questions or concerns.

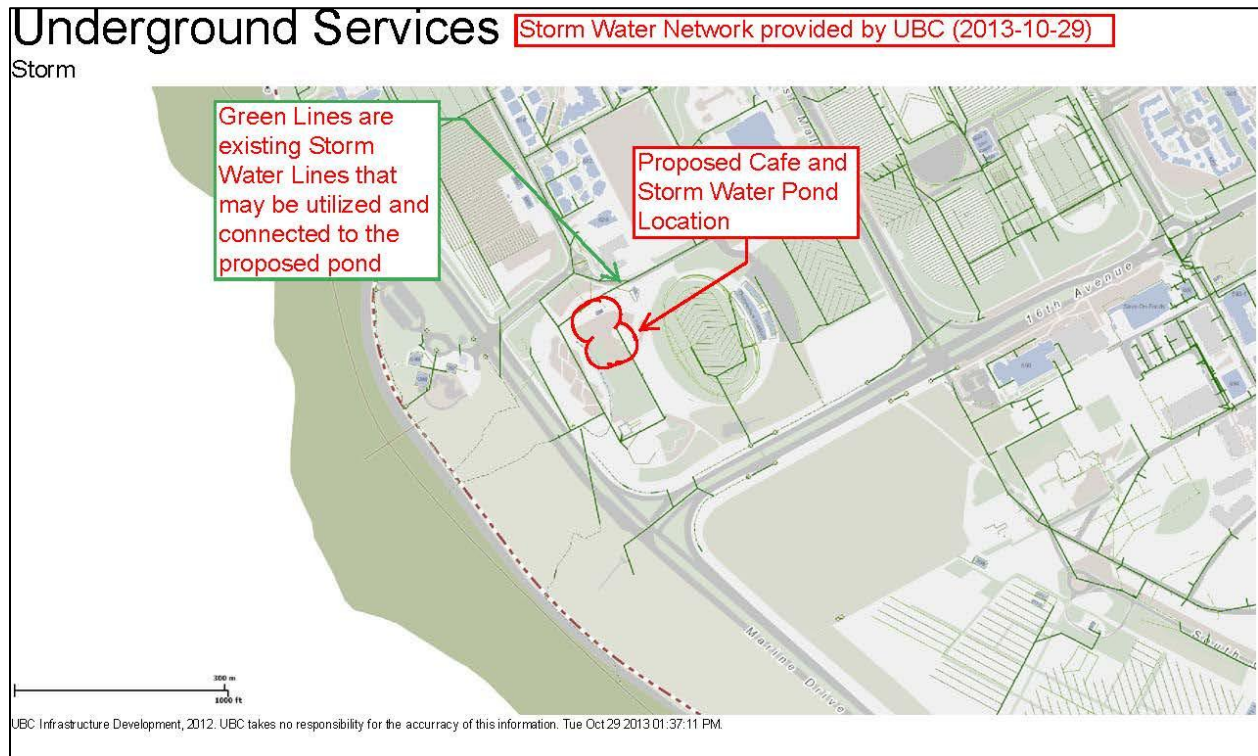
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Appendix A: Parking Restructure Design



Appendix B: Storm Water Network



Appendix C: Estimated Costs

Total Project Cost Estimate:

Phase	Item	Construction Duration (weeks)	Cost (CAD)
1	Coffee Shop	20	\$452,229
	Over Pass	32	\$738,474
	Living Billboard	As stated above	\$85,886
	Storm Water Pond	2	\$11,072
2	Tunnel	2	\$19,555
	Parking and Bike Parking	2	\$62,410
	Total:	58	\$1,369,626

Square Foot Cost Estimate Report

Estimate Name:	Coffee Shop UBC Botanical Garden University of British Columbia , Vancouver , British Columbia	
Building Type:	Restaurant with Wood Siding / Wood Frame	
Location:	VANCOUVER, BC	
Story Count:	1	
Story Height (L.F.):	10	
Floor Area (S.F.):	900	
Labor Type:	STD	
Basement Included:	No	
Data Release:	Year 2013 Quarter 3	
Cost Per Square Foot:	\$493.16	
Building Cost:	\$452,228.88	



Costs are derived from a building model with basic components.
Scope differences and market conditions can cause costs to vary sign ificantly.

		% of Total	Cost Per S.F.	Cost
A Substructure		9.51%	26.12	23500
A1010	Standard Foundations KSF, 12" deep x 24" wide - 0" square x 12" deep		6.67	6000
A1030	Slab on Grade Slab on grade, 4" thick, non industrial, reinforced		6.11	5500
A2010	Basement Excavation storage		0.56	500
A2020	Basement Walls thick		12.78	11500
B Shell		23.89%	75.55	68000
B1010	Floor Construction 160 PSF total allowable load		1.11	1000
B1020	Roof Construction Wood roof, truss, 4/12 slope, 24" O.C., 30' to 43' span		9.44	8500
B2010	Exterior Walls 4" battens		14.44	13000
B2020	Exterior Windows intermediate horizontals Glazing panel, plate glass, 1/4" thick, tempered		23.33	21000
B2030	Exterior Doors hardware, 6'-0" x 7'-0" opening hardware, 6'-0" x 10'-0" opening 0" opening		6.67	6000
B3010	Roof Coverings Green Roof Waterproof membrane Gutters, box, aluminum, .027" thick, 5", enameled finish thick		20	18000
B3020	Roof Openings glazing		0.56	500
C Interiors		9.92%	67.22	28500
C1010	Partitions OC framing,same opposite face, 0 insul 5/8" gypsum board, taped & finished, painted on metal furring		6.11	5500
C1020	Interior Doors Door, single leaf, wood frame, 3'-0" x 7'-0" x 1-3/8", birch, hollow core		2.22	2000
C1030	Fittings Toilet partitions, cubicles, ceiling hung, plastic laminate		0.56	500
C3010	Wall Finishes primer & 2 coats Ceramic tile, thin set, 4-1/4" x 4-1/4"		1.67	1500
C3020	Floor Finishes Carpet tile, nylon, fusion bonded, 18" x 18" or 24" x 24", 35 oz Tile, quarry tile, mud set, minimum Tile, quarry tile, mud set, maximum		9.44	8500
C3030	Ceiling Finishes channel grid, suspended support		7.22	6500
C0000	Living Wall Waterproof membrane Plants Irrigation System		40	4000
D Services		39.27%	107.78	97000
D2010	Plumbing Fxtures Water closet, vitreous china, bowl only with flush valve, wall hung		11.11	10000

	Lavatory w/trim, vanity top, PE on CI, 20" x 18"			
	Kitchen sink w/trim, countertop, stainless steel, 44" x 22" triple bowl			
	Service sink w/trim, PE on CI, wall hung w/rim guard, 24" x 20"			
	Water cooler, electric, wall hung, dual height, 14.3 GPH			
D2020	Domestic Water Distribution	8.89	8000	
	Gas fired water heater, commercial, 100< F rise, 500 MBH input, 480 GPH			
D2040	Rain Water Drainage	1.67	1500	
	Roof drain, CI, soil, single hub, 3" diam, 10' high			
	Roof drain, CI, soil, single hub, 3" diam, for each additional foot add			
	Roof drain, CI, soil, single hub, 4" diam, 10' high			
	Roof drain, CI, soil, single hub, 4" diam, for each additional foot add			
D3050	Terminal & Package Units	36.11	32500	
	Rooftop, multizone, air conditioner, restaurants, 3,000 SF, 15.00 ton			
	Commercial kitchen exhaust/make-up air system, rooftop, gas, 2000 CFM			
D4010	Sprinklers	8.33	7500	
	Wet pipe sprinkler systems, steel, light hazard, 1 floor, 2000 SF			
	Wet pipe sprinkler systems, steel, ordinary hazard, 1 floor, 1000 SF			
D4020	Standpipes	1.67	1500	
	Wet standpipe risers, class III, steel, black, sch 40, 4" diam pipe, 1 floor			
D5010	Electrical Service/Distribution	27.22	24500	
	phase, 4 wire, 120/208 V, 400 A			
	Feeder installation 600 V, including RGS conduit and XHHW wire, 400 A			
	V, 1 phase, 400 A			
D5020	Lighting and Branch Wiring	8.89	8000	
	Receptacles incl plate, box, conduit, wire, 10 per 1000 SF, 1.2 watts per SF			
	Miscellaneous power, 1.8 watts			
	Central air conditioning power, 6 watts			
	fixtures @32watt per 1000 SF			
D5030	Communications and Security	3.33	3000	
	detectors, includes outlets, boxes, conduit and wire			
	conduit			
D5090	Other Electrical Systems	0.56	500	
	gas/gasoline operated, 3 phase, 4 wire, 277/480 V, 15 kW			
E Equipment & Furnishings		17.41%	47.78	80519
E1090	Other Equipment from RS MEANS DATABASE	47.78	43000	
	1 standard oven, 36" wide			
	1.00-Ice cube maker, commercial kitchen equipment, 50 lbs per day			
	1.00-Freezers, commercial kitchen equipment, reach-in, 44 C.F.			
	1.00-Dishwasher, commercial kitchen equipment, 10 to 12 racks per hour			
	1.00-Cooler, commercial kitchen equipment, reach-in, beverage, 6' long			
	1.00-Coffee urn, commercial kitchen equipment, twin, 6 gallon			
	1.00-Broiler, commercial kitchen equipment, without oven, standard			
	light, 25 W, 6 V each			
	1.00-Cupolas, stock units, pine, painted, copper roof, 18" x 18" x 28" h			
	10.00-Restaurant furniture, bar, built-in, back bar			
	10.00-Restaurant furniture, bar, built-in, front bar			
0	Equipment not specified on RS MEANS			
	4 x Table for 2		400	
	3 x Table for 4		369	
	3 x Couch		2400	
	3 x Coffee Table		2100	
	2 x Armchair		800	
	4 x Bar Stool		400	
	Large Chalkboard menu		200	
	Bakery Display Case		3450	
	Picnic Baskets and Blankets		1000	
	Compost and Recycle Station		400	
	Espresso Machine		5000	
	Panini Grill		500	
	Blender		500	
	Dishes and Cultery		10000	
	Miscellaneous Storage and Appliances		10000	
F Special Construction		0%	0	0
G Building Sitework		0%	0	0
SubTotal	100%	\$324.45	\$297,519.00	
Incremental Construction Cost for Leed GOLD	10%	\$32.45	\$29,751.90	
Contractor Fees (General Conditions,Overhead,Profit)	25.00%	\$81.11	\$74,379.75	
Architectural Fees	7.00%	\$22.71	\$20,826.33	
Convert Building Location from Vancouver to UBC Campus	10.00%	\$32.45	\$29,751.90	
Total Building Cost		\$493.16	\$452,228.88	

Over Pass Cost and Schedule Estimate

Sitework

	Qty	UOM	Unit Cost	Total Cost
Footing Excavation				
- Arch		3 m3	\$15.37	\$46.11
- Column		0 m3	\$15.37	\$0.00

Foundation

	Qty	UOM	Unit Cost	Total Cost
Footing				
- Arch		1 EA		\$27,607.05
- Column		0 EA		\$0.00

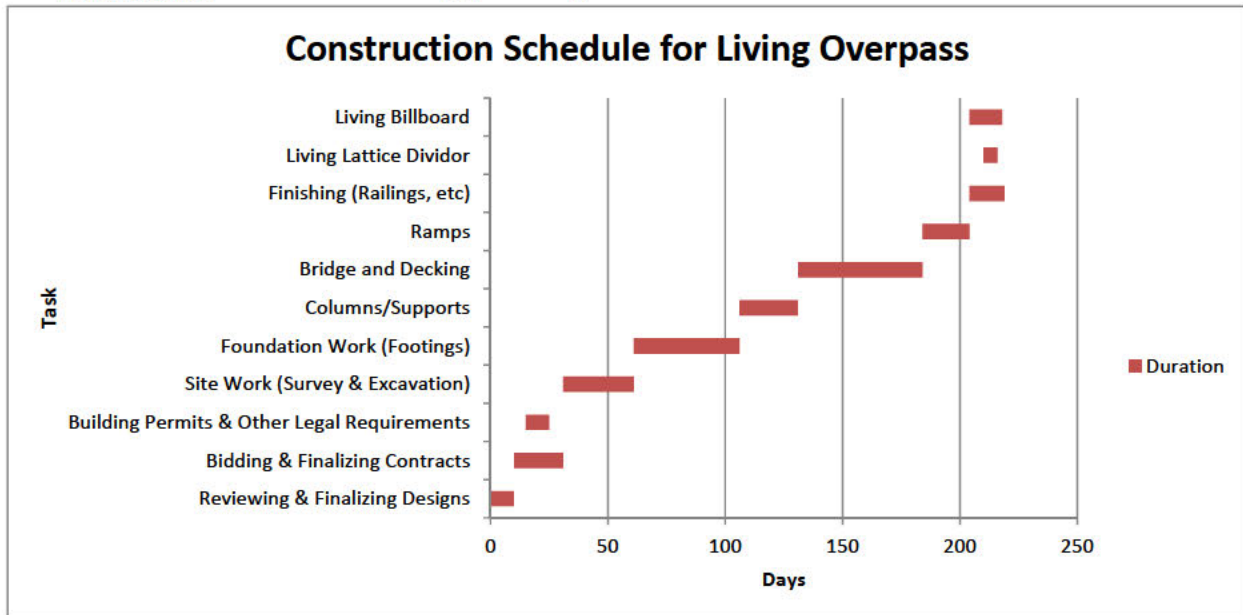
Structural

	Qty	UOM	Unit Cost	Total Cost
Overpass				
- Glulam Bridge and Decking		1 EA		\$531,693.00
- Timber Supports		1 EA		\$111,994.00

Total Cost

Subtotal	\$671,340.15
Contractor Fee	10% \$67,134.02
Total	\$738,474.17

Task	Start	Duration
Reviewing & Finalizing Designs	0	10
Bidding & Finalizing Contracts	10	21
Building Permits & Other Legal Requirements	15	10
Site Work (Survey & Excavation)	31	30
Foundation Work (Footings)	61	45
Columns/Supports	106	25
Bridge and Decking	131	53
Ramps	184	20
Finishing (Railings, etc)	204	15
Living Lattice Dividor	210	6
Living Billboard	204	14



Living Billboard Cost Estimate

Plants	Plants + Labour per ft ²	Total ft ²	Cost
Fukien Tea Plants	\$ 300.00	215	\$ 64,500.00
Potted Plants	\$ 25.00	46	\$ 1,150.00
Billboard	Unit Cost	Total	Cost
Cedar backboard	\$ 3.50 / ft ²	215 ft ²	\$ 752.50
Potted Plants Box	\$ 4.00 / ft ²	150 ft ²	\$ 600.00
Posts for frame	\$ 18.00 / ft ²	82 ft	\$ 1,476.00
Labour + Equipment - 4 men, 10 Hours/day	\$ 60.00 / hr	4 days	\$ 9,600.00
Total			\$ 78,078.50
10% Adjustment for Market			\$ 7,807.85
Total Estimated Cost			\$ 85,886.35

Cost Estimate for Parking Restructure and All Season Bike Shelter

Volumen and Quantity Estimate:

Pond Surface Area:	400 m ²
Excavation depth for lining:	0.5 m
Total amount of excavation requi	200 m ³
Amount of Geotextile/Linging:	625 m ²

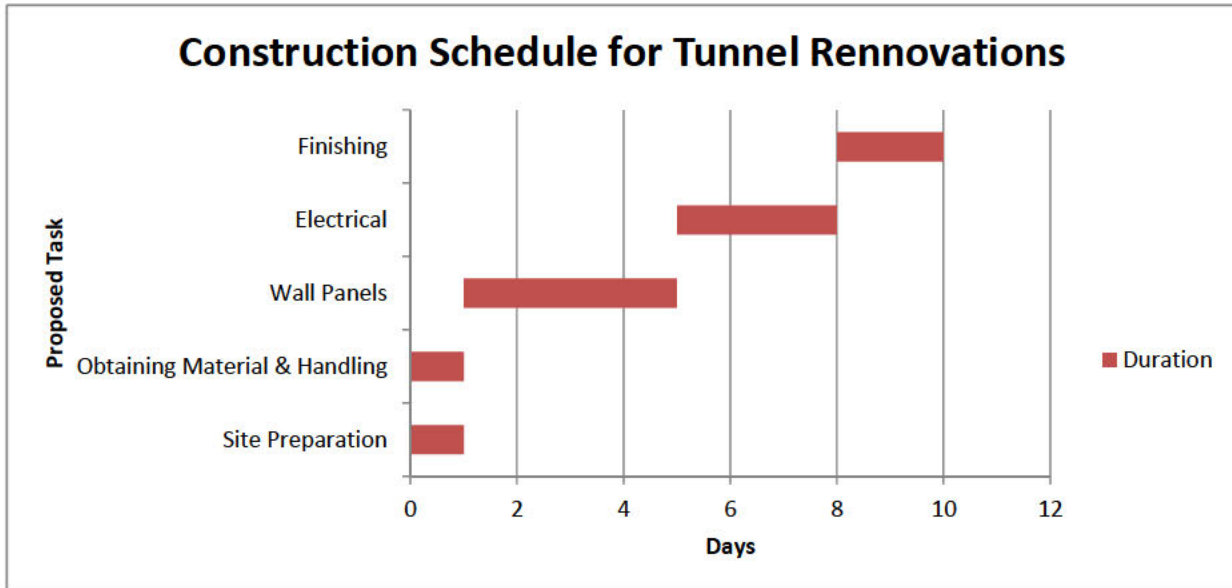
Task Unit Cost and Men Hours:

Item	Unit	Cost per U	Productivity (l Hours	Cost
Excavation	m ³	3	100	2 600
Level and Compaction	m ³	4	80	2.5 800
Revegetation and Plans Removal	m ²	300	20	20 6000
Impermeable Geotextile Lining	m ²	4 -		0.0 2500
Lining Placement	m ²	150	80	7.8 1171.875

Total Cost: 11072 CAD

Tunnel Upgrades Cost Estimate				
Wall Pannels	Unit Cost	Quantity Required		Cost
Material				
1"X8"X10' Cedar Planks	\$ 17.00	577	Pieces	\$ 9,814.55
Backing and fastening material	-	-		\$1,000
Labour				
2 People 4 days	\$50	64	Hours	\$3,200
Lighting				
Material				
48" Florecent	\$ 85.00	20	Pieces	\$ 1,700.00
Labour				
2 People 3 days	\$80	48	Hours	\$3,840
Total				\$ 19,554.55

Task	Start	Duration (Days)
Site Preparation	0	1
Obtaining Material & Handling	0	1
Wall Panels	1	4
Electrical	5	3
Finishing	8	2



Cost Estimate for Parking Restructure and All Season Bike Shelter

Volumen and Quantity Estimate:

Amount of Paving Required:	600 m ²
Excavation depth for paving:	0.5 m
Total amount of excavation required:	300 m ³
Amunt of Painting:	55 m ²
Amount of Glass:	70 m ²
Amount of Steel:	110 m ²
No. of Steel Bike Rack:	8

Task Unit Cost and Men Hours:

Item	Unit	Cost per Unit	Productivity (Unit/Hr)	Hours	Cost
Excavation	m ³		3	100	3 900
Level and Compaction	m ³		4	80	3.75 1200
Paving	m ²		60	150	4 36000
Painting	m ²		2	20	2.75 110
Toughened Glass	m ²		100	70	1 7000
Supply and Install Steel	m ²		120	100	1.1 13200
Bike Rack	Unit		500	8	1 4000

Total Cost: 62410 CAD

Task	Start	Duration
Site Preparation	0	1
Excavation	1	2
Level and Compaction	1	2
Paving	3	2
Painting	5	1
Toughened Glass	6	1
Supply and Install Steel	7	1
Bike Rack	8	1

